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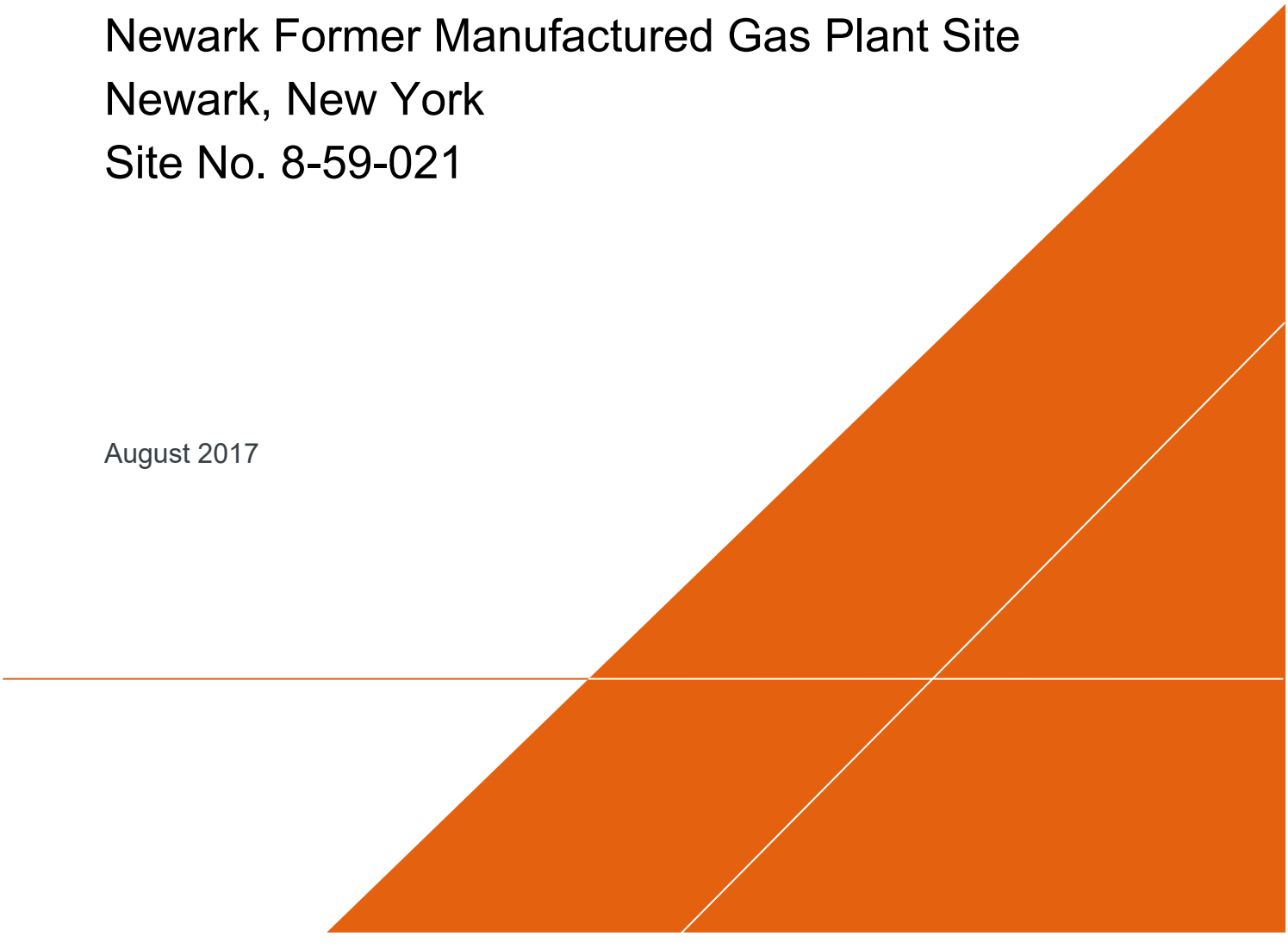
NYSEG

REMEDIAL DESIGN WORK PLAN

Newark Former Manufactured Gas Plant Site
Newark, New York
Site No. 8-59-021

August 2017



Certification

I, Jason D. Brien, certify that I am currently a New York State registered Professional Engineer and that this design was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the DER *Technical Guidance for Site Investigation and Remediation* (DER-10).

August 7, 2017

Jason D. Brien, P.E. Date

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Newark, New York
Site No. 8-59-021

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NYSEG

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ACRONYMS AND ABBREVIATIONS

ASTM	American Society for Testing and Materials
BASE	Building Assessment and Survey Evaluation
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, and xylene
BTU	British thermal unit
CAMP	Community Air Monitoring Plan
CERP	Community and Environmental Response Plan
CFR	Code of Federal Regulations
CLSM	controlled low-strength material
COC	constituent of concern
CP	Contingency Plan
CPP	Citizen Participation Plan
CQAP	construction quality assurance plan
CY	cubic yards
DER	Division of Environmental Remediation
DNAPL	dense non-aqueous phase liquid
DRO	diesel range organics
ELAP	Environmental Laboratory Accreditation Program
FSP	Field Sampling Plan
ft/day	feet per day
GPR	ground-penetrating radar
GRO	gasoline range organics
HASP	Health and Safety Plan
HSA	hollow-stem auger
LTTD	low-temperature thermal desorption
mg/kg	milligrams per kilogram
µg/L	micrograms per liter
µg/m^3	micrograms per cubic meter
MGP	manufactured gas plant

NAPL	non-aqueous phase liquid
NYCRR	New York Code of Rules and Regulations
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
NYSEG	New York State Electric and Gas Corporation
OLM	oil-like material
O&M	operation and maintenance
OSHA	Occupational Safety and Health Administration
PAHs	polycyclic aromatic hydrocarbons
PCBs	polychlorinated biphenyls
PCE	tetrachloroethene
PDI	pre-design investigation
PID	photoionization detector
ppm	parts per million
PVC	polyvinyl chloride
QAPP	Quality Assurance Project Plan
QA/QC	quality assurance/quality control
RCRA	Resource Conservation and Recovery Act
RD	remedial design
RDWP	Remedial Design Work Plan
RF	radio frequency
RI	remedial investigation
ROD	Record of Decision
SCGs	standards, criteria, and guidance
SCO	soil cleanup objective
SMP	Site Management Plan
SSI	Site Screening Investigation
SVOC	semi-volatile organic compounds
TCE	trichloroethene
TCLP	toxicity characteristic leaching procedure
TLM	tar-like material

TOGS	Technical and Operational Guidance Series
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound

1 INTRODUCTION

This *Remedial Design Work Plan* (RDWP) presents the proposed activities associated with the preparation of the remedial design (RD) for the New York State Department of Environmental Conservation (NYSDEC) selected remedy for the Newark Former Manufactured Gas Plant (MGP) Site (the site) located in Newark, New York (Site No. 8-59-021). The selected remedy to address environmental impacts identified at the site is presented in the March 2013 Record of Decision (ROD; NYSDEC 2013).

This RDWP has been prepared by Arcadis of New York, Inc. on behalf of New York State Electric and Gas Corporation (NYSEG) in accordance with the Order on Consent (Index #DO-0002-9309) between NYSEG and the NYSDEC. This RDWP has also been prepared in accordance with the NYSDEC's Division of Environmental Remediation (DER) *Technical Guidance for Site Investigation and Remediation* (DER-10) (NYSDEC 2010b). and includes a work plan for conducting the pre-design investigation (PDI) needed to support the remedial design, as well as the anticipated components of the remedial design.

1.1 RDWP Organization

This RDWP has been organized as described in the table below.

Table 1.1 RDWP Organization

Section	Description
Section 1 – Introduction	Presents site background information; potentially applicable standards, criteria, and guidance (SCGs); a summary of the remedial investigation (RI); remedial objectives; and a summary of the NYSDEC-selected remedy.
Section 2 – Pre-Design Investigation	Presents the scope and rationale for the PDI activities to be completed in support of the remedial design.
Section 3 – Remedial Design Activities	Describes the remedial design activities to be completed in support of implementing the remedial construction activities.
Section 4 – Permits and Approvals	Identifies the permits and approvals necessary to conduct the PDI and implement the remedial action.
Section 5 – Remedial Design Documents and Schedule	Identifies the remedial design documents to be prepared in support of the remedial action and presents the anticipated schedule for implementing the PDI and preparing the remedial design.
Section 6 – Post-Construction Activities	Describes the activities to be conducted following completion of the remedial construction activities.
Section 7 – References	Lists documents used to support the preparation of this RDWP.

1.2 Background

This section summarizes background information, including a description of the site location and physical setting and a brief site history.

1.2.1 Location and Physical Setting

The former MGP site is located on West Shore Boulevard in an urban area of the Village of Newark, New York (Figure 1). The project area is defined as the former MGP property and surrounding properties that were investigated during the RI. The limits of the former MGP property are shown on Figure 2. The majority of the former MGP property is located at 125 North Main Street (Tax Parcel ID 68111-18-318101) that currently operates as a hotel. The former MGP property also extends to the approximate northern boundary of what is now West Shore Boulevard. Additional properties that are considered part of the project area consist of a grass-covered area located at 101 West Shore Boulevard (Tax Parcel ID 68111-18-292130) and a vacant grass-covered lot located immediately west of the hotel property (Tax Parcel ID 68111-18-297095). According to the January 2016 Village of Newark Official Zoning Map, the property west of the hotel is zoned for “Planned Unit Development – Industrial” and the remaining properties that comprise the project area zoned for “General Business”.

The New York State Barge Canal borders the hotel property to the south (approximately 250 feet south of the former MGP property). A small creek (Military Brook) was formerly located immediately south of the MGP property, but has since been backfilled. The creek was no longer present by 1924 based on a review of historical mapping.

1.2.2 Site History and Operation

The MGP reportedly operated from circa 1900 into the 1920’s (Atlantic Environmental Services [AES] 1991). Based on a review of available records, the MGP property ownership is presented below.

- 1899 to 1910 – Newark New York Gas & Light Fuel Company
- 1910 to 1911 – Wayne County Gas & Electric Company
- 1911 to 1916 – Central New York Gas & Electric Company
- 1916 to 1936 – Empire Gas & Electric Company
- 1936 to 1974 – New York State Electric & Gas Corporation
- 1974 – Sold to Newark Urban Renewal Agency, then to Edward Braverman and Edward Storto

The current property owner, Newark Hotels, Inc., acquired the property sometime after 1974.

During its peak operation, the MGP consisted of two gas holders (referred to as the eastern and western holders), a retort house, a purifier house, a coal shed, two tar wells and two “pressure tanks”. The Newark MGP produced gas using the coal carbonization process and later the carbureted water gas process. The tars produced by the coal carbonization process were generally viscous and contained higher concentrations of phenols and base nitrogen organics when compared to the tars generated from the later carbureted water gas process. Coal carbonization also produced cyanide in the gas, which was removed during gas purification and often appears in wastes such as lime and wood chips.

Former MGP structures were removed by 1974, based on a review of Sanborn Fire Insurance Maps for the period of 1885 through 1963 and historical aerial photographs. The hotel was constructed sometime between 1974 and 1985, and construction of West Shore Boulevard began in approximately 1985.

1.3 Standards, Criteria, and Guidance

Chemical-, action-, and location-specific SCGs that are potentially applicable to the design and implementation of the NYSDEC-selected remedy are presented in the *Final Feasibility Study Report* (FS) (Arcadis, 2013a). Primary SCGs that were considered during the development of this RDWP include the following:

- NYSDEC's DER-10 Technical Guidance for Site Investigation and Remediation
- Soil cleanup objectives (SCOs) based on Title 6 of the New York Code of Rules and Regulations (NYCRR) Part 375-6 (6 NYCRR Part 375-6)
- Groundwater, drinking water, and surface water SCGs based on NYSDEC's Division of Water, Technical and Operational Guidance Series (TOGS) 1.1.1 Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations (NYSDEC 2004) and Part 5 of the New York State Sanitary Code
- Resource Conservation and Recovery Act (RCRA) and New York State regulations regarding the identification and listing of hazardous wastes outlined in 40 Code of Federal Regulations (CFR) 261 and 6 NYCRR Part 371, respectively
- NYSDEC's Management of Coal Tar Waste and Coal Tar Contaminated Soils and Sediment from Former Manufactured Gas Plants (DER-4) (NYSDEC 2002)

1.4 Site Characterization Summary

This section presents an overall site characterization and a summary of the nature and extent of impacted media based on the results obtained for the site investigation activities completed to date, which include the following:

- Early 1990's – Unknown Investigation. Four wells (i.e., monitoring wells MW-1A through MW-4A) were observed on the hotel property by Arcadis of New York, Inc. (Arcadis), during a site visit in October 2009. The property owner suggested that these wells were installed in the early 1990's, but documentation or records pertaining to the wells do not exist. NYSEG suspects that these wells were installed as part of a commercial property transfer or re-finance (i.e. a Phase I Environmental Site Assessment) and not driven by a regulatory requirement.
- 1991 – Site Screening Investigation (SSI). AES conducted an SSI that included a historical review; collection and analysis of surface soil, surface water, and streambed samples; and a sensitive habitat survey. The primary objectives of the SSI were to:
    - Determine if an imminent threat to human health and/or the environment existed.
    - Establish a rank for the site relative to NYSEG's other MGP sites.

- 2008 – Soil Vapor Intrusion Evaluation conducted by Arcadis. The soil vapor evaluation included sub-slab soil gas, indoor air and ambient air sampling. The primary objective of the soil vapor evaluation was to evaluate the potential presence or migration of MGP-related vapor phase compounds beneath or inside the hotel building.
- 2011 – RI conducted by Arcadis. The RI consisted of soil and groundwater investigations (surface soil, near surface soil, subsurface soil and groundwater sampling) and a risk evaluation. The overall objectives of the RI were to:
  - Characterize the site by establishing the nature and extent of MGP-related impacts.
  - Evaluate the risk posed to human health and environment by the MGP-related impacts.
  - Provide the information needed for evaluating remedial actions to address MGP-related impacts.
- 2012 – Additional surface soil sampling conducted at the request of the New York State Department of Health (NYSDOH). Surface soil samples collected in 2011 during the RI were collected from the 0- to 1-foot and 0- to 2-foot depth intervals. In late 2012, the NYSDOH indicated that the 2011 surface soil sampling intervals were not appropriate for evaluating human exposure via soil ingestion, inhalation, or dermal contact, and NYSDOH requested that additional surface samples be collected from the 0- to 2-inch depth interval.

The results of these investigations were collectively used to develop the current site characterization which consists of, as presented in the sections below, a summary of site geology and hydrogeology and the nature and extent of impacts. A detailed site characterization is presented in the January 2013 *Remedial Investigation Report* (RI Report) (Arcadis 2013b).

1.4.1 Geology

The overburden strata, in descending order from the ground surface, consists of fill and a till unit. The character of these strata is briefly described below:

- Fill – The fill unit comprises the uppermost geologic unit. The fill unit is present at the ground surface and is generally 10 to 25 feet thick at the west and east, respectively. This unit is comprised of reworked alluvial deposits (sands, gravels, silts) and anthropogenic materials (e.g., slag, coal, wood, metal, ash, concrete, brick and foundations from former MGP structures).
- Till Unit – This unit lies directly beneath the fill at approximately 11 to 25 feet below ground surface (bgs). This unit is at least 15 feet thick and is comprised of a dense mixture of sand and silt with varying amounts of clay and gravel. The dense nature of the till suggests that it is a lodgment till formed at the base of a glacier.
- Bedrock – Although bedrock was not encountered during the previous investigations, the bedrock in the Newark regions has been mapped as the Upper Silurian age (formed 410 million years ago) Camillus Shale (Rickard and Fisher 1970).

1.4.2 Hydrogeology

As described in the RI Report, shallow groundwater flow is relatively complex and does not appear to flow in a uniform direction. Groundwater appears to converge near the center of the hotel property and head to

the northeast. There also appears to be a component of groundwater flow toward the south, in the immediate vicinity of the Barge Canal. The hydrogeology of the fill and till units is as follows:

- Fill – The majority of water moving through this unit is likely derived from upgradient sources to the south (Barge Canal) and west. Infiltrating precipitation also contributes a small fraction of groundwater in this unit. The hydraulic conductivity of the unit ranges between 0.3 and at least 168 feet per day (ft/day), with a geometric mean of 4.1 ft/day.
- Till Unit – The permeability of the till is low and thus, groundwater moves slowly in this unit compared to the overlying fill. The dense nature and fine-grained composition of the till suggests that the hydraulic conductivity of this unit is very low.

1.4.3 Nature and Extent of Impacts

Surface soil, subsurface soil, groundwater, and soil vapor were investigated during the RI. Based on the information presented in the RI Report, surface soil, subsurface soil, and groundwater were impacted by the MGP.

Manufactured gas-production byproducts, typically dense non-aqueous phase liquid (DNAPL) (i.e., coal tar) and purifier waste, often account for the majority of the impacts at former MGP sites. Principal components of coal tar that are routinely analyzed for at MGP sites are benzene, toluene, ethylbenzene, and xylene (BTEX) compounds, which are volatile organic compounds (VOCs), and polycyclic aromatic hydrocarbons (PAHs), which are semi-volatile organic compounds (SVOCs). The principal chemical of concern associated with purifier waste is cyanide, and as such, total and free cyanide analyses are typically performed during investigations of MGP sites.

Sporadic amounts of coal tar were observed and elevated concentrations of BTEX and PAHs were detected in the soil and/or groundwater within the project area; however, deposits of purifier waste and elevated levels of total cyanide were not observed within the project area. The RI identified BTEX and PAH compounds as constituents of concern (COCs) because these compounds were detected in soil and/or groundwater at concentrations exceeding applicable SCGs. Total cyanide was not identified as a COC because it was not detected in any soil or groundwater samples at concentrations greater than applicable SCGs.

It should be noted that some metals were detected at concentrations exceeding applicable SCGs. However, the RI determined that the metals were either naturally occurring or related to the presence of abundant urban fill within the project area. As such, these metals were not considered COCs associated with the former MGP.

MGP-related impacts were identified in the following primary areas:

- North of West Shore Boulevard
- Tar Well and Eastern Gas Holder
- Western Gas Holder

Summaries of the MGP-related impacts identified in these areas are presented in the subsections below.

1.4.3.1 NAPL Distribution and Characterization

Non-aqueous phase liquid (NAPL) in the project area generally consisted of oil-like material (OLM; which is considered DNAPL), tar-like material (TLM; which is also considered DNAPL), and sheens. NAPL-related impacts are generally distributed as follows:

- North of West Shore Boulevard – Visual impacts observed in this area consisted of solidified TLM at soil borings SB-23, SB-29, and SB-30 (at depths ranging from 0.5 to 5.4 feet bgs).
- Tar Well and Eastern Gas Holder – Visual impacts observed within the northern tar well consisted of solidified TLM at soil borings SB-6 and SB-7 at depths ranging from 5 to 7.5 feet bgs, and south of the tar well at soil boring SB-9 at a depth of approximately 15 feet bgs. Trace amounts of OLM were also observed at soil borings SB-3 and SB-6 at depths of 18 and 15 feet bgs, respectively.
- Western Gas Holder – Visual impacts observed in this area consisted of a 0.2-foot interval of solidified TLM at soil boring SB-2 at a depth of 7.5 feet bgs. This material is assumed to have been placed as part of backfilling activities in the western gas holder area and is not believed to be associated with the former western gas holder.

1.4.3.2 Soil Quality

The extent of soil containing concentrations of MGP-related COCs exceeding applicable SCOs has a strong correlation to the observed TLM and OLM distribution within the project area. Surface and subsurface soil analytical results were compared to 6NYCRR Part 375-6 SCOs for commercial land use (commercial SCOs). Soil impacts are distributed primarily in the three areas identified above, as follows:

- North of West Shore Boulevard – Analytical results for surface and subsurface soil samples collected from this area indicated the presence of PAHs at elevated concentrations.
    - Surface soil samples collected in 2012 (i.e., collected from the 0- to 2-inch depth interval below vegetation) contained total PAHs at concentrations ranging from 9.3 to 350 milligrams per kilogram (mg/kg), with the greatest concentration observed at surface soil sampling location SS-13.
    - Near surface (i.e., between 2-inches and 2-feet bgs) soil samples SB-23 (0.6-0.9') and SB-29 (0-2') contained total PAHs at concentrations of 68,000 and 44,000 mg/kg, respectively. These elevated total PAH concentrations are attributed to the TLM observed at shallow depths at these locations (as described in Section 1.4.3.1).
    - Subsurface soil (i.e., greater than 2 feet bgs) sample SB-23 (7-9') contained total PAHs at a concentration of 520 mg/kg.
- Tar Well and Eastern Gas Holder – Analytical results for subsurface soil samples SB-6 (7-7.3') and SB-9 (9-11') located within and immediately south of the northern tar well (respectively) indicated the presence of BTEX and PAH compounds at elevated concentrations.
    - Soil sample SB-6 (7-7.3') contained total BTEX and total PAHs at concentrations of 120 and 8,200 mg/kg, respectively.
    - Soil sample SB-9 (9-11') contained total PAHs at a concentration of 2,800 mg/kg.

- Western Gas Holder – None of the soil samples collected in the vicinity of the western gas holder contained BTEX or PAH compounds at concentrations exceeding 10 or 500 mg/kg, respectively.

Additionally, PAHs were detected at concentrations ranging from 2.3 to 120 mg/kg in near surface soil samples collected west (samples SS-03 through SS-05) and northwest (SS-07 through SS-10) of the hotel property. These concentrations exceed the commercial SCOs. However, based on the visual characterization of the soil in this area, the RI concluded that these PAHs are likely associated with the presence of urban fill observed throughout the project area.

1.4.3.3 Groundwater Quality

The distribution of groundwater samples with concentrations exceeding TOGS 1.1.1 is as follows:

- North of West Shore Boulevard – None of the groundwater samples collected in this area contained BTEX or PAH compounds at concentrations exceeding the NYSDEC Class GA standard for benzene.
- Tar Well and Eastern Gas Holder – Benzene was detected in a groundwater sample collected from monitoring well MW-10-02 at a concentration of 2.1 micrograms per liter (µg/L), which slightly exceeds the NYSDEC Class GA standard for benzene (i.e., 1 µg/L).
- Western Gas Holder – Benzene was detected in a groundwater sample collected from monitoring well MW-10-01 at a concentration of 1.1 µg/L, which only slightly exceeds the NYSDEC Class GA standard of 1 µg/L.

Additionally, trace levels of total cyanide were detected in groundwater samples from three monitoring wells with the highest concentration detected in the sample collected from MW-3A at 0.034 µg/L. This concentration is much lower than the Class GA standard of 200 µg/L for total cyanide. Therefore, cyanide is not considered to be a constituent of concern in groundwater. Polychlorinated biphenyls (PCBs) were not detected in groundwater samples from any of the wells.

1.4.3.4 Soil Vapor Quality

A soil vapor evaluation was conducted in the hotel building in April 2008 to evaluate the potential presence or migration of MGP-related vapor phase compounds beneath or inside the hotel building. Sampling results were submitted to the NYSDEC on July 8, 2008. The soil vapor investigation involved the collection of six subslab soil gas samples, seven indoor air samples, and one outside (ambient) air sample. The work was conducted in general conformance with procedures outlined in the NYSDOH October 2006 document *Guidance for Evaluating Soil Vapor Intrusion in the State of New York*, (NYSDOH 2006). Samples were analyzed by a New York State Environmental Laboratory Accreditation Program- (ELAP-) certified laboratory for VOCs by United States Environmental Protection Agency (USEPA) Method TO-15 plus N-Alkanes and selected tentatively identified compounds. Subslab and coupled indoor air samples were collected from various locations within the building with two sample sets placed in close proximity to the reported locations of the former gas holders.

Results indicated that numerous VOCs were present in ambient air, indoor air and subslab soil vapor samples. In general, ambient air concentrations of VOCs were similar to indoor air concentrations, thus suggesting a background source. In most, but not all cases, when VOCs were detected in both indoor air

and subslab soil vapor samples, the indoor air concentrations tended to be similar to or lower than the subslab concentration for the same VOC.

BTEX compounds were detected in indoor air, subslab and ambient air samples. There is currently no regulatory database to which subslab concentrations of petroleum compounds can be compared.

Indoor and ambient concentrations of petroleum compounds were compared to the USEPA 2001 Building Assessment & Survey Evaluation (BASE) database Table C2. Concentrations of petroleum compounds in ambient (outdoor) air did not exceed the BASE data 90th percentile. Toluene was the only petroleum compound to exceed its associated 90th percentile value at indoor air samples IA-1 through IA-4.

1.5 Remedial Action Objectives

As presented in the ROD, the selected remedy shall eliminate or mitigate to the extent practicable all significant threats to public health and/or the environment. To achieve this goal, the following remediation objectives have been established for the site.

Soil

- Prevent ingestion/direct contact with contaminated soil.
- Prevent inhalation of or exposure from contaminants volatilizing from contaminants in soil.
- Prevent migration of contaminants that would result in groundwater or surface water contamination.
- Prevent impacts to biota from ingestion/direct contact with soil causing toxicity or impacts from bioaccumulation through the terrestrial food chain.

Groundwater

- Prevent ingestion of groundwater with contaminant levels exceeding drinking water standards.
- Prevent contact with, or inhalation of volatiles, from contaminated groundwater.
- Restore ground water aquifer to pre-disposal/pre-release conditions, to the extent practicable.
- Remove the source of ground or surface water contamination.

1.6 Description of Selected Remedy

The NYSDEC-selected remedy for the site consists of the following:

- A remedial design program will be implemented to provide the details necessary for the construction, operation, maintenance, and monitoring of the remedial program.
- Excavation and off-site disposal of contaminant source areas on-site and immediately off-site to the north, including grossly contaminated soil, as defined in 6 NYCRR Part 375-1.2(u) and soil containing SVOCs exceeding 500 mg/kg. Excavated on-site soil that does not exceed commercial use SCOs may be stockpiled and reused as subsurface backfill. Remaining excavation areas will be backfilled with clean imported fill. The site will be re-graded to accommodate installation of a cover system.

- A site cover currently exists and must be retained to allow for commercial use of the site. The cover will consist either of the structures such as buildings, pavement, sidewalks comprising the site development or a soil cover in areas where the upper one foot of exposed surface soil will exceed the applicable SCOs. Where the soil cover is required it will be a minimum of one foot of soil, meeting the SCOs for cover material as set forth in 6 NYCRR Part 375-6.7(d) for commercial use. The soil cover will be placed over a demarcation layer, with the upper six inches of the soil of sufficient quality to maintain a vegetation layer. Any fill material brought to the site will meet the requirements for the identified site use as set forth in 6 NYCRR Part 375-6.7(d).
- Imposition of an institutional control in the form of an environmental easement for the controlled property that:
    - Requires the remedial party or site owner to complete and submit to the NYSDEC a periodic certification of institutional and engineering controls in accordance with Part 375-1.8 (h)(3).
    - Allows the use and development of the controlled property for commercial and industrial uses as defined by Part 375-1.8(g), although land use is subject to local zoning laws.
    - Restricts the use of groundwater as a source of potable or process water, without necessary water quality treatment as determined by the NYSDOH or County Department of Health.
    - Requires compliance with the NYSDEC-approved Site Management Plan (SMP).
- An SMP is required, which includes the following:
    - An Institutional and Engineering Control Plan that identifies all use restrictions and engineering controls for the site and details the steps and media-specific requirements necessary to ensure the following institutional and/or engineering controls remain in place and effective:
        - Institutional Controls (as described above)
        - Engineering Controls (the soil cover described above)

        This plan includes, but may not be limited to:
        - An Excavation Plan which details the provisions for management of future excavations in areas of remaining contamination.
        - A provision for further investigation to refine the nature and extent of contamination in the following areas where access was previously hindered: the eastern holder and the western holder under part of the hotel building if and when the building is demolished.
        - Provisions in the environmental easement limiting any land use to commercial usage and groundwater use restrictions.
        - Provisions for the management and inspection of the identified engineering controls.
        - Maintaining site access controls and NYSDEC notification.
        - The steps necessary for the periodic reviews and certification of the institutional and/or engineering controls.

- A Monitoring Plan to assess the performance and effectiveness of the remedy. The plan includes, but may not be limited to:
  - Monitoring of groundwater to assess the performance and effectiveness of the remedy.
  - A schedule of monitoring and frequency of submittals to the NYSDEC.
  - Maintaining site access controls and NYSDEC notification.
  - Providing the NYSDEC access to the site and operation and maintenance (O&M) records.

2 PRE-DESIGN INVESTIGATION ACTIVITIES

A PDI will be completed during the remedial design phase of the project to support design of the NYSDEC-selected remedy. The following PDI data needs have been identified:

- Soil sampling to further delineate soil removal areas.
- Geotechnical soil sampling for excavation support design.
- In-situ waste characterization sampling to evaluate waste handling, treatment, and/or disposal requirements.
- Test pitting to evaluate subsurface structures/conditions.
- Hydraulic data collection to support excavation dewatering evaluation/design.
- Structural survey to evaluate building conditions.
- Site survey to document PDI locations and develop a topographic site plan.

Detailed descriptions of the work activities and descriptions of the specific activities necessary to facilitate the development of the remedial design are presented in this section. PDI activities will include:

- PDI Task 1 – Utility Identification
- PDI Task 2 – Soil Investigation
- PDI Task 3 – Structural Inspections
- PDI Task 4 – Groundwater Investigation
- PDI Task 5 – Site Survey

Methodologies and protocols to be followed during completion of PDI activities are presented in the *Field Sampling Plan* (FSP; Appendix A). Analytical procedures and requirements for laboratory analysis of samples collected during the PDI are presented in the *Quality Assurance Project Plan* (QAPP; Appendix B). Health and safety protocols to be followed by field personnel during investigation activities are presented in the *Health and Safety Plan* (HASP; Appendix C). Worker health and safety air monitoring requirements and action levels can be found in the HASP.

Community air monitoring activities will be performed consistent with the general requirements provided in Appendix 1A of DER-10 (NYSDOH Generic Community Air Monitoring Plan [CAMP]), included as Appendix D. Given the limited soil disturbance activities anticipated for the PDI, real-time air monitoring for VOCs and particulate will be completed during all intrusive activities at two air monitoring stations located at the upwind and downwind perimeter of the exclusion zone (i.e., designated work area).

2.1 PDI Task 1 – Utility Identification

The presence and location of utilities that may impact implementation of the selected remedy will be identified in coordination with NYSEG, the City of Newark, and other parties (as appropriate). Utilities known to be in the vicinity of the site include overhead electrical transmission and distribution lines and subsurface communication, natural gas, water, storm sewer, sanitary sewer lines, and associated

manholes/vaults. Prior to implementing intrusive PDI activities, some or all of the following activities will be conducted to identify overhead and subsurface utilities/structures at and in the immediate vicinity of the proposed remedial limits:

- Reviewing available drawings showing locations of utilities prior to selecting soil boring and test pit locations in the field.
- Performing a detailed visual site inspection to identify existing utilities present in the area.
- Flagging/Marking all proposed soil boring and test pit locations with white paint.
- Contacting Dig Safely of New York at least two working days, and not more than 10 working days, before subsurface work is initiated to identify and mark locations of all underground utilities at, and in the immediate vicinity of, the proposed investigation/remediation areas.
- Marking out of utilities by utility owners.
- Performing geophysical survey using ground-penetrating radar (GPR) and radio frequency (RF) methods (i.e., non-intrusive methods) in vicinity of the proposed investigation/remediation areas.

Soil boring and test pit locations will be adjusted to maintain safe setback distances from identified utilities. Arcadis will review precautions regarding safe distance from overhead electrical lines and flag and mark equipment offset distances in accordance with NYSEG guidance, as appropriate, during the site kick-off meeting prior to initiating intrusive field work. Utility mark-outs will be surveyed and included on detailed drawings.

Arcadis will complete and retain in the project file a Utility Structures Checklist (included as Attachment D to the HASP [Appendix C]) prior to initiating soil disturbance work.

2.2 PDI Task 2 – Soil Investigation

As presented in the ROD, and summarized in the FS Report, soil impacts at the site were sufficiently delineated by the previous investigations for the purpose of selecting the soil remedy. For the purpose of developing the remedial design, additional soil investigation is required to:

- Further delineate the extent of soil removal.
- Evaluate the location of subsurface structures (e.g., former gas holders/tar well, shallow foundations).
- Evaluate geotechnical properties of soil within the excavation areas.
- Evaluate handling requirements for soil to be removed as part of the remedy.

Proposed PDI activities to be completed under this task are presented in the following subsections. The final soil boring and test pit locations may be relocated in the field based on accessibility, obstructions, and subsurface conditions encountered. Soil investigation locations are shown on Figure 3 and anticipated analytical and geotechnical sample locations are listed in Table 1. Prior to drilling soil borings, locations will be cleared using intrusive methods (e.g., via hand digging, air knife/vacuum truck, etc.) to verify the absence of utilities in the top 4 to 5 feet of the soil boring.

2.2.1 Impacted Soil Delineation

This PDI subtask consists of conducting delineation of the horizontal extent of impacted material and evaluate potentially impacted material in the eastern and western holder areas. The soil delineation activities will include completing soil borings in the following areas.

- Tar Well – Two soil borings (SB-101 and SB-102) will be completed in the vicinity of the tar well to further delineate the horizontal extent of impacted material.
- Eastern Former MGP Gas Holder – Up to four soil borings (SB-105 through SB-108) and one test pit (TP-100) will be completed within or immediately adjacent to the eastern former MGP gas holder to evaluate the presence of impacted material previously identified at soil boring SB-3 and the potential need to excavate material at this location. The soil borings will be completed sequentially, as needed, and subsequent soil borings may not be completed if visibly impacted material is not observed.
- Western Former MGP Gas Holder – Up to two test pits (TP-101 and TP-102) will be completed within or immediately adjacent to the western former MGP gas holder to evaluate the presence of impacted material previously identified at soil boring SB-2 and the potential need to excavate material at this location. The test pits will be excavated sequentially, as needed; test pit TP-102 will not be excavated if visibly impacted material is not observed at test pit TP-101.

Proposed locations of soil borings and test pits are shown on Figure 3. Final locations of soil borings and test pits will be determined in the field based on confirmation of utility locations and conditions encountered. Anticipated depths of the borings and test pits are presented in Table 1; however, field data/observations will be used to determine the actual depth of each boring/test pit.

Soil borings will be advanced using hollow-stem auger (HSA) methods as described in the FSP included as Appendix A. Test pits will be excavated using a small excavator or rubber-tired backhoe. Excavated material will be visually examined and logged by a geologist and temporarily staged on polyethylene sheeting adjacent to the test pit. Excavated material will be placed back into the test pit in the reverse order that it was excavated (i.e., visually impacted material will be placed at its original depth, as to not affect groundwater quality). Material meeting site-specific soil cleanup objectives (see Section 1.6) will be removed and transported off-site for treatment/disposal during the remedial action.

Soil samples will be retrieved continuously to the top of the till unit (approximately 10 to 25 feet bgs) or the deepest observed impacts in nearby borings using a split spoon sampler, screened with a photoionization detector (PID), described, and logged by the field geologist. Soil descriptions will include color, soil components and gradation, moisture condition, particle shape (e.g., angular), plasticity, structure (e.g., layered), and presence/absence of NAPL. The length of representative sample recovered from each interval will be measured and recorded. Soil cuttings will be placed into an appropriate container (e.g., drum, roll-off) for waste characterization sampling and disposal. Soil cuttings that contain visual impacts will be containerized separately.

A soil sample from each delineation soil boring and select test pits (described below) will be submitted for laboratory analysis of total SVOCs by USEPA SW-846 Method 8270C. Soil samples for laboratory analysis will be selected from the 2-foot interval where, based on PID readings and visual and olfactory observations, the strongest evidence of impacts is identified. Quality assurance/quality control (QA/QC) samples will be submitted to facilitate validation of the analytical testing results.

Analytical test methods, detection and reporting limits, and required QA/QC samples are described in the QAPP (Appendix B). A summary of the soil sampling analytical and QA/QC requirements are included in the Table 1.

2.2.2 Structure Evaluation

Test pits will be excavated to confirm the location of the former gas holders/tar well, shallow foundations/obstructions, and/or other subsurface features that may potentially impact the design and implementation of the remedial construction activities (e.g., soil removal, installation of excavation support systems). Test pits will be completed adjacent (i.e., perpendicular) to the hotel structure, exposing the hotel foundation to evaluate foundation conditions. Test pits will be completed in a manner so as not to jeopardize structural integrity of the hotel or other nearby structures and utilities. Test pits excavated within the zone of influence of building foundations (including immediately adjacent to the structure) will be excavated in a manner to minimize the area against the foundation that is open at any time and will not extend below the foundation system. Final test pit locations will be determined based on results of the geophysical survey and utility markout.

Prior to excavating test pits, asphalt pavement will be saw-cut to minimize damage to the surrounding pavement. Test pits will be excavated to depths of approximately 10 feet bgs, or as allowable by soil conditions and will extend approximately 15-20 feet in length. Excavated material will be visually examined and logged by a geologist and temporarily staged on polyethylene sheeting adjacent to the test pit. Excavations will be sketched and photographed, as appropriate, to record pertinent subsurface features. Additionally, the location and depth of subsurface foundations and/or obstructions (if any) will be documented.

Each test pit will be backfilled by replacing excavated material in the reverse order it was removed (i.e., excavated materials will be placed back into the test pits at approximately the same depths and locations from which they were removed). Visually clean soil will be used to cover visually impacted material (if encountered). Observations of subsurface structures/conditions and visual impacts (if present) will be considered during preparation of the remedial design. Following the completion of the test pits, removed pavement will be replaced with a hot or cold mix asphalt, as available.

2.2.3 Soil Waste Characterization Sampling

Materials excavated during remedial construction activities are anticipated to be transported off-site for treatment and/or disposal as follows:

- Soil containing visible MGP-related impacts and/or is characteristically hazardous for SVOCs is anticipated to be transported off-site for treatment via low-temperature thermal desorption (LTTD).
- Excavated materials that do not contain visible impacts are anticipated to be transported off-site for disposal as non-hazardous solid waste.

Additionally, soil that does contain visual impacts and contains total SVOCs at concentrations less than 500 mg/kg may potentially be reused as subsurface backfill.

In-situ waste characterization sampling will be performed to support profiling for off-site treatment/disposal and facilitate direct-loading of the excavated materials during remedial construction of the selected remedy. Waste characterization samples will be collected from soil borings and test pits. In general, composite soil samples will be composited separately for the upper (anticipated to contain non-visually impacted material) and lower (anticipated to contain visually impacted material) portions of the soil boring/test pit. Sample depth intervals may be modified in the field, based on the presence/absence of visual impacts and subsurface obstructions, to meet treatment/disposal facility analytical and sampling frequency requirements. The need for additional waste characterization samples will be evaluated based on field observations.

Up to an anticipated 14 waste characterization samples containing visually impacted material will be submitted for chemical analysis in accordance with the ESMI's Fort Edward, New York facility analytical requirements. Up to an anticipated 12 waste characterization samples containing non-visually impacted material will be submitted for chemical analysis in accordance with Seneca Meadows Landfill analytical requirements. Soil waste characterization analytical requirements are presented in Table 2.

2.2.4 Geotechnical Soil Sampling

Geotechnical soil samples will be collected from soil borings and test pits to support the design of excavation activities. Geotechnical soil borings and test pits will be completed using the methods described above. If soil boring interval recovery is poor, a 3-inch diameter split spoon sampler may be used. Standard Penetration Testing will be conducted at soil borings to assess the relative density of in-place soils in accordance with American Society for Testing and Materials (ASTM) D1586. Soil samples collected from geotechnical soil boring and test pit locations will be submitted for the following geotechnical analyses listed in Table 2. The number of samples to be submitted for geotechnical testing and specific geotechnical analyses to be performed will be determined based on field conditions.

2.3 PDI Task 3 – Structural Inspections

Qualitative structural reviews of the one-story building north of West Shore Boulevard and the two-story hotel will be conducted to evaluate existing foundation structure details. The reviews will be based on test pit observations, visual inspection of structural conditions, and/or as-built drawing review. Structural reviews will also include written and photographic documentation of building conditions, etc. near potential excavations areas and recommendations for performing soil excavation activities in proximity to the buildings, including structural monitoring requirements (if necessary) to be incorporated into the remedial design. Structural inspections will be documented in the PDI Summary Report and recommendations will be approved and stamped by a Professional Engineer licensed in the State of New York.

2.4 PDI Task 4 – Groundwater Investigation

A temporary water treatment system may be required to support soil excavation during implementation of the remedy (to be determined as part of the remedial design). Three groundwater samples will be collected and submitted for laboratory analysis to support treatment/disposal requirements and/or the

design of a temporary water treatment system. Groundwater samples will be collected as a grab sample using a bailer. A summary of the treatability analytical requirements is included in Table 1.

Additionally, a gauging event will be conducted to measure static water levels, confirm groundwater flow direction beneath the site, and evaluate the presence/absence of NAPL. Water levels will be measured in ten existing on- an off-site monitoring wells and two staff gauges located on the New York State Barge Canal.

2.5 PDI Task 5 – Site Survey

A land survey will be conducted in the project area to document PDI soil boring and test pit locations, locate overhead and subsurface utilities, and generate one-foot contours to facilitate preparation of the remedial design. The survey will be completed by a New York State Licensed Surveyor and will be collected in New York State Plane Coordinate System North American Datum of 1983 and relative to the north American Vertical Datum of 1988. Information obtained from the additional survey efforts will be used to update the site base map and other drawings for use during the remedial design.

2.6 IDW Management

Investigation-derived waste (IDW) generated during the PDI will be containerized on-site. Soil cuttings, personal protective equipment, spent disposable sampling materials, and water generated during sampling and decontamination activities will be segregated by waste type and placed in DOT-approved 55-gallon steel drums. Additionally, NAPL (if any) generated during the PDI will be containerized in DOT-approved 5-gallon steel containers. Each drum/container will be appropriately labeled (i.e., with the contents, generator, location, and date). As indicated above, soil containing visual impacts will be containerized separately from soil free of visual impacts.

Drums/containers are anticipated to be staged on the hotel property at a location that does not interfere with hotel operations. The analytical results for waste characterization samples collected during the PDI will be used prepare waste profiles for IDW. At the end of the PDI activities, NYSEG's waste disposal vendor (Clean Harbors) will transport the IDW for off-site treatment/disposal in accordance with state and federal regulations.

2.7 PDI Documentation

Results of the PDI will be documented in a summary letter report included as an attachment to the Preliminary Remedial Design. Those results, along with existing site information, will support the development of a basis of design. The PDI Summary Letter Report will include the following:

- A summary of PDI activities including community air monitoring, field observations, sampling results, changes made in response to field conditions (including any deviations from this RDWP and associated correspondence with NYSDEC), problems encountered and resolutions, and other pertinent information to document that the site activities were performed pursuant to this RDWP.
- Soil boring and test pit logs.
- Summary tables presenting analytical testing results.

- An updated site plan(s) showing locations of soil borings and test pits, overhead and subsurface utilities, and pertinent identified subsurface features.
- Laboratory analytical data reports and data validation reports will be attached electronically.

3 REMEDIAL DESIGN ACTIVITIES

This section presents a description of the remedial design activities to be completed in support of the design of the selected site remedy. Work activities associated with preparing the remedial design will be conducted under the following tasks:

- RD Task 1 – Utility Relocation/Protection
- RD Task 2 – Soil Excavation and Handling
- RD Task 3 – Liquid Waste Management
- RD Task 4 – Solid Waste Management
- RD Task 5 – Backfilling and Site Restoration

The design tasks listed above represent major tasks associated with preparation of the remedial design. Other related tasks (including, but not limited to, site preparation, site security/control/access, erosion and sedimentation control, noise/vapor/dust suppression, air monitoring, characterization/verification sampling, equipment decontamination, site restoration, etc.) will be detailed in the remedial design.

A description of the activities to be performed under each of the above-listed principal design tasks is presented below.

3.1 RD Task 1 – Utility Relocation/Protection

Various subsurface utilities are anticipated to be encountered within the proposed excavation areas. Specifically, utilities observed in the vicinity of the proposed excavation area include overhead and underground electric, communications, natural gas, potable water, sanitary sewer, and storm sewer lines. Certain utilities may need to be left in-place and protected or re-located to facilitate excavation.

The design will provide a means to either temporarily or permanently relocate, bypass, or protect these utilities. The proposed handling of utilities will be further evaluated during the remedial design based on the findings of the PDI.

3.2 RD Task 2 – Soil Excavation and Handling

As indicated in Section 2, soil investigation activities will be completed to refine the horizontal extent of soil requiring excavation. The remedial design will include the extent and approximate quantity of soil to be excavated, based on the results of the PDI, to meet the appropriate site cleanup levels, as presented in the ROD. Excavation activities are anticipated to include removal of soil from 3 to 15 feet bgs.

The soil excavation activities are anticipated to be conducted via open cut excavations with sloped and /or benched excavation sidewalls (as appropriate for shallow excavations) and vertical cuts using excavation support systems (e.g. trench boxes, slide rail shoring systems for deeper excavations) to allow excavation to proceed to the target depths, prevent cave-ins, and comply with Occupational Safety and Health Administration (OSHA) requirements outlined in Title 29 of the CFR Part 1926 Subpart P. The excavation support systems will be evaluated as part of the remedial design and will be designed to:

- Protect adjacent commercial structures and West Shore Boulevard roadway that may be affected by excavation activities.
- Protect utilities and slopes located in proximity to the excavation area.

Before soil removal is performed, existing asphalt pavement, sub-base materials, and concrete curbing will be removed. These materials will be staged on-site for potential re-use as fill material and/or transported off-site for re-use, recycling, or disposal (e.g., at a construction and demolition debris facility). In addition, existing landscaping (trees and other plantings) will be cleared. Subsurface concrete slabs, foundations, and obstructions encountered within the excavation limits, if any, will be removed (if practical), crushed as needed, and transported for proper off-site disposal.

Soil that exhibits no visible NAPL or obvious odors may be stockpiled for potential re-use as subsurface fill. With NYSDEC approval, soil deemed acceptable for re-use will be placed below a demarcation layer that will be covered with a minimum of one foot of imported clean backfill (see Section 3.5 for surface restoration requirements). Soil that does not meet re-use criteria or otherwise exhibits unacceptable characteristics will be transported for off-site treatment/ disposal.

3.3 RD Task 3 – Liquid Waste Management

Groundwater is generally encountered at depths from 11 to 15 feet bgs and water management is anticipated during excavation activities. The local hydrology will be evaluated during the remedial design to determine if an on-site water treatment system is required or if liquid waste will be containerized and transported off-site for treatment and disposal (depending on the anticipated volume of water to be generated). As indicated in Section 2, PDI groundwater samples will be collected and submitted for laboratory analysis to support the design of a temporary water treatment system and/or evaluation of off-site treatment/disposal requirements.

The final treatment/disposal method will be selected during the remedial design based on the feasibility of implementing each applicable option and a comparison of the relative costs for implementing the options.

3.4 RD Task 4 – Solid Waste Management

The remedial design will present solid waste management requirements for the waste streams anticipated to be generated during implementation of the remedial action. The waste management plan will include the following components:

- Applicable codes, standards, and specifications
- Description of anticipated waste streams
- Materials handling activities required for each waste stream

Excavated materials that are not suitable for reuse as subsurface fill will be transported off-site for disposal as a non-hazardous solid waste (e.g., at Seneca Meadows Landfill) or transported to ESMI's Fort Edward, New York facility as a conditionally-exempt waste for LTTD treatment.

The remedial design will present requirements associated with soil amendment (to pass faint filter testing and other disposal/treatment facility moisture content requirements), additional waste characterization

sampling (if necessary), and loading/hauling of excavated materials. The remedial design will also present anticipated waste stream quantities, including treatment/disposal requirements for soil removed from various depth intervals at each excavation area, based on the results of the PDI waste characterization sampling.

3.5 RD Task 5 – Backfilling and Site Restoration

Following soil removal activities, the disturbed portions of West Shore Boulevard, the hotel parking lot, landscaping, and lawn areas will be restored to match pre-construction conditions. Anticipated backfill materials included, but are not limited to: excavated soil suitable for reuse; imported clean soil fill; and controlled low-strength material (CLSM). The remedial design will include specifications (i.e. gradations, material types, and analytical criteria) for reuse and imported fill materials. Review of geotechnical data collected during the PDI activities will be used to identify the fill material(s) to be used during the remedial construction. Backfilling and grading protocols (e.g., lift thickness, compaction requirements, etc.) will also be specified in the remedial design. In accordance with the ROD, subsurface backfill will meet 6 NYCRR Part 375-6 SCOs for commercial use and groundwater protection SCOs (on-site), or residential use SCOs and groundwater protection SCOs (off-site).

As indicated in the NYSDEC ROD, a cover system currently exists and will be replaced, in kind following remedial activities to allow for continued commercial site use. The existing asphalt pavement and structures (such as buildings, sidewalks, etc.) within the project area serve as a cover. Hard surfaces (i.e., asphalt and concrete) removed/damaged during remedial construction will be restored in kind. Vegetated surfaces disturbed during remedial construction will be restored with a minimum of one foot of material that meets 6 NYCRR Part 375-6 SCOs for commercial use. Soil cover material will be placed over a demarcation layer and the upper six inches will be vegetated. The remedial design will include specifications for the various surface cover materials (i.e., asphalt, concrete, vegetated topsoil). Additional details regarding the final surface restorations will be developed as part of the remedial design.

4 PERMITS AND APPROVALS

The remedial design will be developed to meet applicable SCGs, permits, and approvals. In addition to NYSDEC approval of the remedial design, permits and approvals will be necessary to conduct the PDI field activities and to implement the NYSDEC-selected remedy.

4.1 PDI Permits and Approvals

Permits and approvals required for PDI activities are primarily associated with performing subsurface investigations within West Shore Boulevard and the associated right-of-way, and other properties not owned by NYSEG. NYSEG will renew access agreements with the property owners to gain access to the project area during the PDI. Street work permits are not required by the Village of Newark. However, NYSEG will notify and coordinate PDI activities with the Village of Newark, as necessary.

4.2 Remedial Construction Permits and Approvals

Permits and approvals necessary to complete the remedial construction activities include (but are not limited to) access agreements to facilitate access to and/or conduct remediation construction activities on properties not owned by NYSEG. NYSEG will obtain new access agreements with affected property owners prior to conducting the remedial construction activities. Additionally, NYSEG will coordinate with the Village of Newark for temporary lane/road closures within West Shore Boulevard during remedial construction activities.

Any additional regulatory and permitting requirements associated with implementing the remedial activities will be identified during the remedial design.

5 REMEDIAL DESIGN DOCUMENTS AND SCHEDULE

In accordance with the requirements set forth in DER-10, the following remedial design documents will be prepared:

- Preliminary Remedial Design Report
- Draft Final Remedial Design Report
- Final Remedial Design Report

A description of the remedial design documents is presented below, followed by a preliminary schedule for implementing the PDI and preparing the remedial design.

5.1 Preliminary Remedial Design Report

The purpose of the *Preliminary Remedial Design Report* is to present the general remedial approach and preliminary design for implementing the NYSDEC-selected remedy. The *Preliminary Remedial Design Report* is anticipated to include the following:

- An introductory section that will provide a brief overview of the remedial design, site background information, design report objectives, and report organization.
- A summary of the PDI activities, including the results obtained for the PDI activities.
- A summary of the remedy with a basis of design that describes the proposed remedial design and presents information used to develop the design (e.g., structural evaluation, geotechnical evaluation, etc.) and construction components of the project. Design calculations and other supporting data, where appropriate, will be included to support the basis of design.
- A description of site controls for protecting the public health, safety, welfare and environment and to maintain the effectiveness of the remedial action.
- The regulatory and permitting requirements associated with implementing the remedial construction activities.
- A summary of the organizational structure with responsibilities of NYSEG, the Design Engineer, the Remediation Engineer, and the Remediation Contractor.
- A description of the pre-remediation activities to be completed, including but not limited to: citizen participation, access agreements, permitting, and pre-mobilization submittals.
- A general description of the various components associated with completing the remediation tasks, including but not limited to:
    - Mobilization
    - Site Preparation
    - Site Controls and Monitoring
    - Utility Relocation/Protection

  - Excavation Support
  - Excavation and Backfilling
  - Solid Waste Management
  - Dewatering and Liquid Waste Management
  - Surface Restoration/Cover Installation
  - Demobilization
- A summary of the anticipated post-remediation reporting requirements and monitoring activities, including a description of operation, maintenance, and monitoring activities to be undertaken after the NYSDEC has approved the construction of the remedial design.
- A description of the certification report to be prepared after the remedy has been implemented.
- An anticipated schedule for completing the *Draft Final Remedial Design Report* and *Final Remedial Design Report*, contractor procurement, and implementation of the remedial construction activities.
- A set of engineering design drawings that represent an accurate identification of existing site conditions and an illustration of the proposed work. Each engineering design drawing will include a north arrow (where applicable), scale, legend, definitions of all symbols and abbreviations and sheet number. It is anticipated that the engineering design drawings will include, at a minimum, the following:
  - Title Sheet – to include at least the title of the project, key map, date prepared, sheet index and NYSDEC project identification.
  - Existing Site Plan – to include pertinent property data including owners of record for all properties adjacent to the site (as necessary); site survey including the distance and bearing of all property lines that identify and define the project site; all easements, right-of-ways and reservations (as necessary); existing buildings and structures, wells, facilities and equipment; a topographic survey of existing contours and spot elevations within the project limits of disturbance, based on United States Geological Survey datum; all known existing underground and aboveground utilities; and location and identification of significant natural features, including, among other things, wooded areas, water courses, wetlands and flood hazard areas.
  - General Site Layout Plan – to include general locations indicating lane closures, site facilities (parking areas, decontamination area, equipment/material lay down area), limits of the excavation; and relocation of utilities (if any).
  - Restoration Plan – to include final topographic survey (proposed contours and spot elevations) of the site, limits of the final surface covers, location of new structures and/or wells, final surface restoration for disturbed adjacent properties, and other final restoration features.
- A list of technical specifications.

5.2 Draft Final Remedial Design Report

The purpose of the *Draft Final Remedial Design Report* is to present a detailed design for implementing the NYSDEC-selected remedy. In addition to the items identified for the *Preliminary Remedial Design Report,* the Draft *Final Remedial Design Report* is anticipated include the following:

- Incorporated NYSDEC comments on the *Preliminary Remedial Design Report*, as appropriate.
- An updated project schedule presenting the anticipated timing for implementing the remedial activities.
- Draft Final Engineering Design Drawings, including but not limited to the following, in addition to the design drawings prepared for the *Preliminary Remedial Design Report*:
    - Site Preparation Plan – to include minimum requirements for temporary erosion and sedimentation controls; relocation/protection of utilities: identification of other site features to be protected during remedial construction activities; and site facilities (parking areas, decontamination area, equipment/laydown areas).
    - Excavation Plan and Cross Sections – to include limits of soil excavation to be completed.
    - Excavation Support Profile and Details – to include a profile of excavation support system, structural details related to the type of support to be used, and other miscellaneous details related to the excavation support system.
    - General Water Treatment System Details (if necessary) – to include general temporary water treatment system specifications and a piping and instrumentation diagram.
    - Miscellaneous Details – to include details related to the surface cover profiles, temporary erosion and sedimentation controls, decontamination area, and final surface water runoff and sedimentation controls.
- Technical Specifications for site preparation, erosion and sedimentation control, noise control, odor suppression, excavation, impacted soil and debris transportation, sidewall support, water management, backfill, and support facilities.
- Supporting plans that consist of the following:
    - Community and Environmental Response Plan (CERP) – describes the site monitoring and work practices that will be completed to address potential short-term impacts to the surrounding community and/or environmental resources.
    - Construction Quality Assurance Plan (CQAP) – describes the materials, procedures, and testing necessary for proper construction, evaluation, and documentation during remedial activities.
    - Community Air Monitoring Plan (CAMP) – describes the monitoring activities that will be conducted to detect potential airborne releases of constituents of concern during the implementation of remedial activities.
    - Contingency Plan (CP) – describes the procedures to be implemented at the site in the event of an emergency.

- Citizen Participation Plan (CPP) – incorporates appropriate activities outlined in the NYSDEC's January 2010, DER-23 Draft Citizen Participation Handbook for Remedial Programs (NYSDEC 2010a).
- Waste Management Plan (WMP) – describes the characterization, handling, treatment, and disposal requirements for various waste materials that are anticipated to be generated during the remedial construction activities.

5.3 Final Remedial Design Report

The purpose of the *Final Remedial Design Report* is to provide a remedial design that will be of biddable quality. Following NYSDEC review and approval of the *Draft Final Remedial Design Report*, the *Final Remedial Design Report* will be prepared. The *Final Remedial Design Report* will be stamped and signed by Professional Engineer licensed in the State of New York and will be used as the basis for procurement of a Remediation Contractor.

5.4 Remedial Design Schedule

The anticipated schedule for completing the PDI activities identified in this RDWP and a preliminary schedule for completion of the remedial design and construction of the selected remedy for the site is presented below.

Table 5.1 Anticipated Remedial Design Schedule

Schedule Component	Date
NYSDEC Approval of RDWP	August 2017
Conduct PDI Activities	September – October 2017
Submit Preliminary Remedial Design Report	March 2018
Receive NYSDEC Comments	July 2018
Submit Draft Final Remedial Design Report	December 2018
Receive NYSDEC Comments	March 2019
Submit Final Remedial Design Report	April 2019
Remedial Contractor Procurement	2019 – 2020
Remedial Construction	Q2/Q3 2021

The project schedule is subject to change based on NYSDEC timing for review/approval of this RDWP and the design documents. The schedule for implementing the PDI activities could be impacted by weather conditions and/or unexpected field conditions requiring additional soil borings/test pits. In addition, the results of the initial PDI activities may dictate the need for supplemental PDI activities, which would lengthen the overall project schedule. NYSEG will notify the NYSDEC regarding delays that impact the schedule for completing the PDI and design-related activities.

6 POST-CONSTRUCTION ACTIVITIES

This section describes the anticipated activities to be completed following completion of the soil remedial action. Following remedial construction activities, post-construction activities are anticipated to include preparation of a SMP and establishment of institutional controls for the site. The anticipated components of the SMP and institutional controls are presented below.

6.1 Site Management Plan

As indicated in the ROD, the primary components of the SMP will consist of an Institutional and Engineering Control Plan and Monitoring Plan. These plans will consist of the following:

- Institutional and Engineering Control Plan – describes the use restrictions and engineering controls that will be established. The primary institutional control will consist of an environmental easement (as described in Section 6.2) and the primary engineering control will consist of the existing/new site cover.
- Monitoring Plan – used to assess the performance and effectiveness of the remedial activities. Potential monitoring plan components are described in Section 1.6.

The SMP will include requirements for post-remedial action groundwater and NAPL monitoring, as well as site inspection schedules, and NYSDEC submittal requirements. The SMP will also include soil vapor intrusion monitoring requirements for any new buildings constructed at the site.

6.2 Institutional Controls

As indicated above, institutional controls in the form of an environmental easement will be established to:

- Require NYSEG to provide a periodic certification of institutional and engineering controls to the NYSDEC in accordance with 6NYCRR Part 375-1.8(h)(3).
- Limit the land use and development of the site to commercial and industrial use, subject to local zoning laws.
- Restrict the use of site groundwater for potable purposes or as process water, without necessary water quality treatment, as determined by NYSDOH or Wayne County Department of Health.
- Require compliance with an NYSDEC-approved SMP.

Institutional controls will be established by NYSEG following the completion of the remedial construction activities.

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TABLES

Table 1
Proposed PDI Sampling Summary

NYSEG
Newark Former MGP Site
Newark, New York

Location ID	Investigation Area	Boring/Test Pit Depth (ft bgs)	Laboratory Analysis[4]				Geotechnical Analysis[4]		
			Delineation	ESMI Waste Characterization Parameters	Seneca Meadows Landfill Waste Characterization Base Parameters	Seneca Meadows Landfill Waste Characterization Additional Parameters	Sieve	Moisture Content	Atterberg Limits
Soil Borings									
SB-100	North of West Shore Boulevard	10		xx	x	x		x	
SB-101		10	x	x	x		x	x	x
SB-102	Tar Well	25 or Top of Till	x	x	x				
SB-103		25 or Top of Till		x	x				
SB-104		25 or Top of Till		x	x				
SB-105	Eastern MGP Holder	25 or Top of Till	x	x	x		x	x	x
SB-106*		25 or Top of Till	x	x	x				
SB-107*		25 or Top of Till	x				x	x	x
SB-108*		25 or Top of Till	x	x	x		x	x	x
Test Pits									
TP-100	Eastern MGP Holder	10	x	xx	x	x	x	x	x
TP-101*	Western MGP Holder	10	x	x	x	x	x	x	x
TP-102*		10	x	x	x			x	

Notes:
1. ft bgs - feet below ground surface
2. x - indicates respective sample will be collected and number of samples
3. * - indicates waste characterization and/or geotechnical samples will only be analyzed if delineation sampling indicates excavation will be required in this area.
4. See Table 2 for analytical requirements.

Table 2
Laboratory Analysis Summary

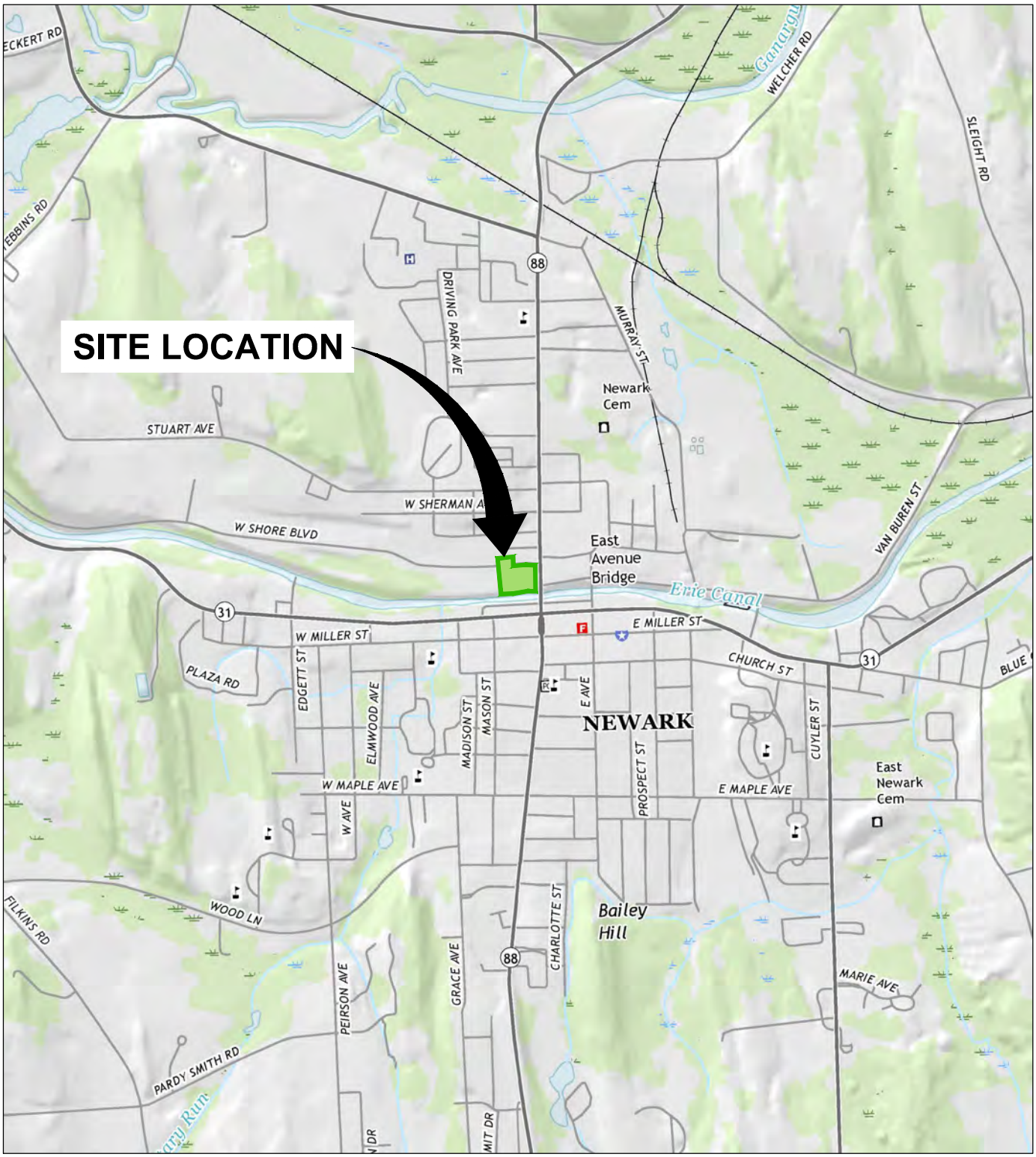
NYSEG
Newark Former MGP Site
Newark, New York

Laboratory Analysis	Quantity[1]	Field Duplicate	MS / MSD
Delineation Samples (Soil)			
Total SVOCs (TCL) using USEPA Method 8270C	10	1	1
Geotechnical Samples (Soil)			
Moisture content using ASTM D2216	12	0	0
Grainsize using ASTM 6913	6	0	0
Atterberg limits using ASTM D4318	6	0	0
ESMI Waste Characterization (Soil)			
TPH (GRO and DRO) using USEPA Method 8015	14	0	0
Total VOCs (TCL) using USEPA Method 8260B	14	0	0
Total SVOCs (TCL) using USEPA Method 8270C	14	0	0
Total PCBs using USEPA Method 8080	14	0	0
RCRA 8 Metals (plus antimony, beryllium, nickel, thallium, vanadium, and zinc) using USEPA Method 6010B	14	0	0
Total Cyanide using USEPA Method 9010	14	0	0
Percent Sulfur using USEPA Method D129-64	14	0	0
BTU using ASTM D240-87	14	0	0
Seneca Meadows Waste Characterization (Soil)			
TCLP VOCs (TCL) using USEPA Method 8260	3	0	0
TCLP SVOCs (TCL) using USEPA Method 8270	3	0	0
TCLP Metals (RCRA 8) using USEPA Method 6010B	3	0	0
Pesticides using SW-846 Method 1311/8081B	12	0	0
Herbicides using SW-846 Method 1311/8150A	12	0	0
Total PCBs using USEPA Method 8080	12	0	0
Reactivity (Cyanide) using USEPA Method 9012	3	0	0
Reactivity (Sulfide) using USEPA Method 9030A	3	0	0
Flashpoint using SW-846 Method 1010A	3	0	0
Total VOCs (TCL) using USEPA Method 8260B	12	0	0
Total SVOCs (TCL) using USEPA Method 8270C	12	0	0
TAL Metals using USEPA Method 6010B	12	0	0
Water Treatment System Samples (Water)			
Total Toxic Organics (TTO) using USEPA Methods 624 and 625	3	0	0
Target Analyte List (TAL) inorganics and cyanide (filtered) using USEPA Method 6010B and 9012	3	0	0
Target Analyte List (TAL) inorganics and cyanide (unfiltered) using USEPA Method 6010B and 9012	3	0	0
Oil and grease using USEPA Method 1664	3	0	0
Total suspended solids (TSS) using USEPA Method 160.2 or SM2540D	3	0	0
Total dissolved solids (TDS) using USEPA Method 160.2 or SM2540C	3	0	0
5-Day biological oxygen demand (BOD5) using USEPA Method 405.1 or SM5210B	3	0	0
Chemical oxygen demand (COD) using USEPA Method 410.4 or SM5220C	3	0	0
Hardness using USEPA Method 130.1 or SM2340B	3	0	0
pH	3	0	0

Notes:

1. Includes contingency for potential "step-out" locations.

FIGURES



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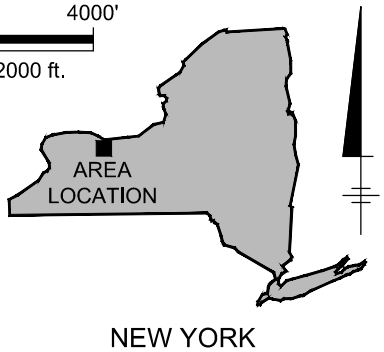
Approximate Scale: 1 in. = 2000 ft.



NYSEG
NEWARK FORMER MANUFACTURED GAS PLANT SITE
SITE NO. 8-59-021
REMEDIAL DESIGN WORK PLAN

SITE LOCATION MAP

ARCADIS Design & Consultancy for natural and built assets

FIGURE 1

CITY: SYRACUSE NY DIV/GROUP: ENVCAD DB: E. KRAHMER PIC: J. BRIEN PM: J. GOLUBSKI TM: M. HYSELL TR: J. SINAY LYR:(Opt)ON=*;OFF=*REF*
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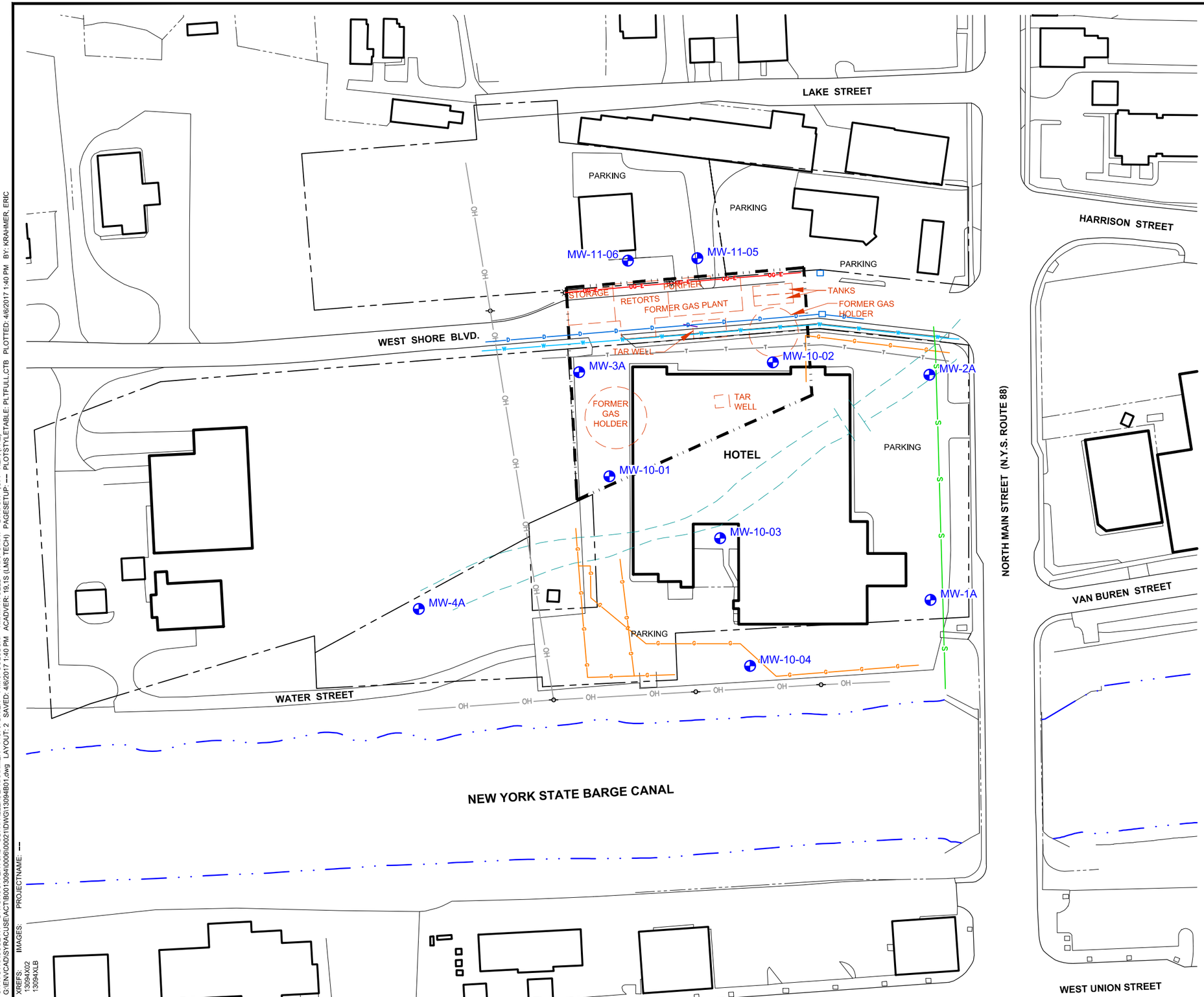

LEGEND:

- PROPERTY LINE
- APPROXIMATE FORMER LOCATION OF MILITARY BROOK (PRE 1924)
- UNDERGROUND ELECTRIC
- OVERHEAD ELECTRIC
- STORM SEWER
- SANITARY SEWER
- WATER
- GAS
- TELECOMMUNICATION
- CATCH BASIN
- LIGHT POLE
- UTILITY POLE
- FORMER MGP BOUNDARY (APPROXIMATE)
- FORMER MGP STRUCTURES
- MONITORING WELL LOCATION

NOTES:

1. BASE MAP PREPARED FROM DWG FILE PROVIDED BY NYSEG TITLED "LOCATION MAP NEWARK MGP SITE VILLAGE OF NEWARK WAYNE COUNTY, NEW YORK", REVISED 6/03/99, AT A SCALE OF 1"=200'.
2. FORMER MGP SITE FEATURES FROM DWG FILE PROVIDED BY NYSEG TITLED "NEWARK FORMER MGP SITE VILLAGE OF NEWARK TOWN OF ARCADIA WAYNE COUNTY, NEW YORK", REVISED 12/18/02, AT A SCALE OF 1"=40'. FORMER MGP SITE FEATURE LOCATIONS ARE APPROXIMATE.
3. SAMPLING LOCATIONS AND HOTEL BUILDING BASED ON A SURVEY DRAWING BY FISHER ASSOCIATES TITLED "MONITORING WELL LOCATION MAP", DATED 09/21/10, REVISED 11/3/11, @ A SCALE OF 1" = 40'. COORDINATES ARE NEW YORK STATE PLANE CENTRAL ZONE.
4. UTILITY LOCATIONS ARE APPROXIMATE.

0 100' 200'

GRAPHIC SCALE

NYSEG
NEWARK FORMER MANUFACTURED GAS PLANT SITE
SITE NO. 8-59-021
REMEDIAL DESIGN WORK PLAN

SITE LAYOUT AND FORMER MGP STRUCTURES

ARCADIS Design & Consultancy for natural and built assets

FIGURE 2

CITY: SYRACUSE NY DIV/GROUP: ENVCAD DB: R. ALLEN, E. KRAHMER PIC: J. BRIEN PM: J. GOLUBSKI TM: M. HYSELL TR: J. SINAY LYR: ON=*;OFF=REF, (FRZ)
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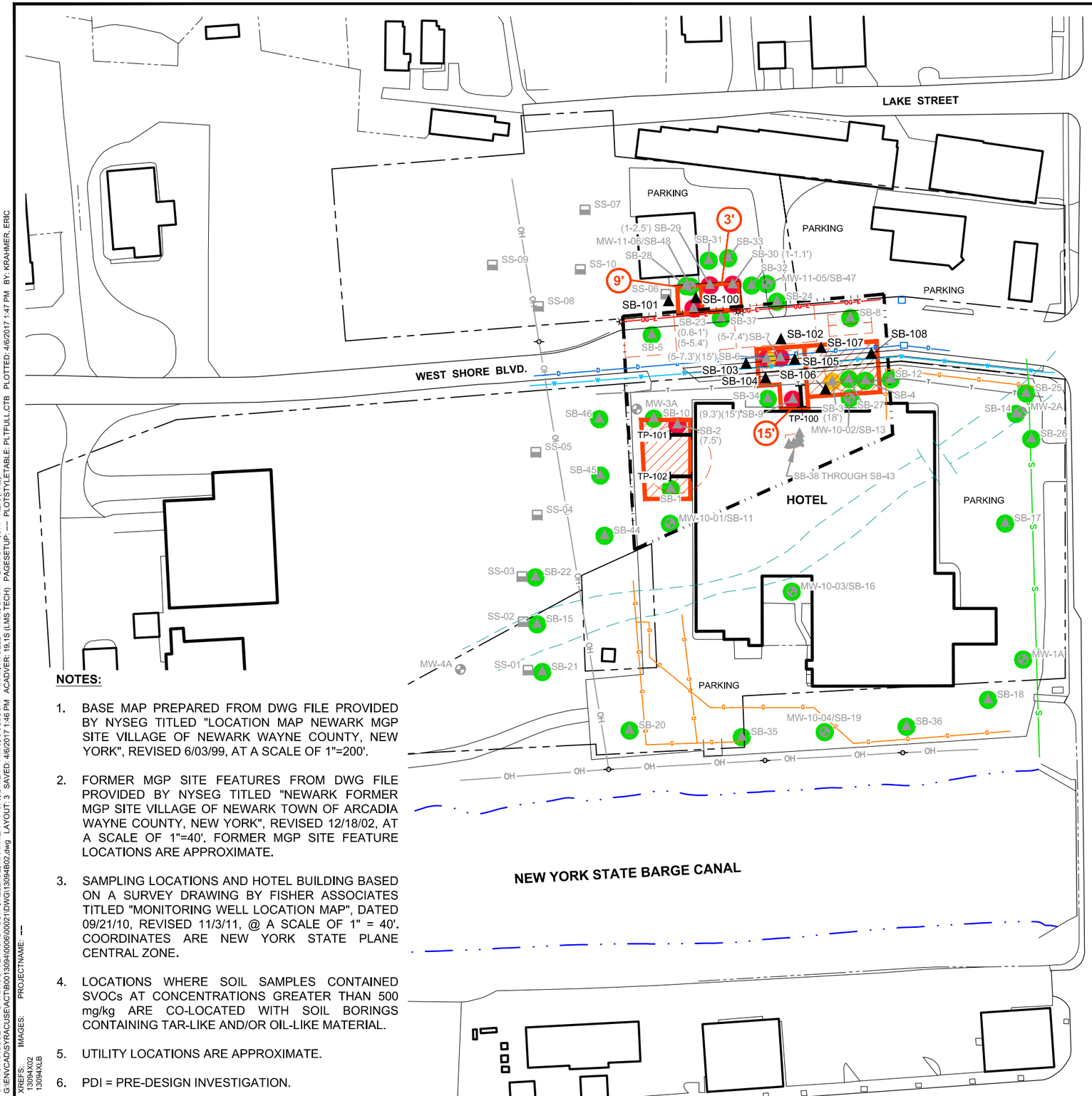

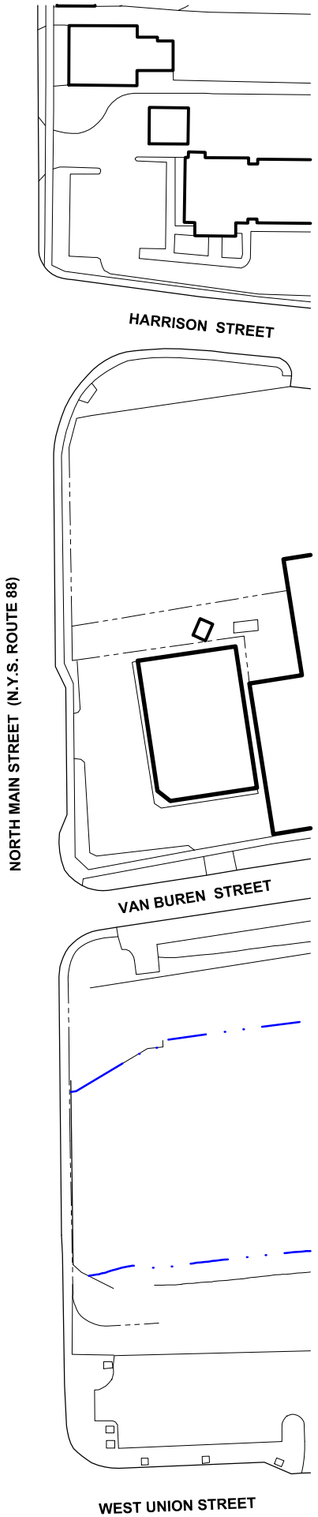

NOTES:

1. BASE MAP PREPARED FROM DWG FILE PROVIDED BY NYSEG TITLED "LOCATION MAP NEWARK MGP SITE VILLAGE OF NEWARK WAYNE COUNTY, NEW YORK", REVISED 6/03/99, AT A SCALE OF 1"=200'.
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3. SAMPLING LOCATIONS AND HOTEL BUILDING BASED ON A SURVEY DRAWING BY FISHER ASSOCIATES TITLED "MONITORING WELL LOCATION MAP", DATED 09/21/10, REVISED 11/3/11, @ A SCALE OF 1" = 40'. COORDINATES ARE NEW YORK STATE PLANE CENTRAL ZONE.
4. LOCATIONS WHERE SOIL SAMPLES CONTAINED SVOCs AT CONCENTRATIONS GREATER THAN 500 mg/kg ARE CO-LOCATED WITH SOIL BORINGS CONTAINING TAR-LIKE AND/OR OIL-LIKE MATERIAL.
5. UTILITY LOCATIONS ARE APPROXIMATE.
6. PDI = PRE-DESIGN INVESTIGATION.

LEGEND:

- PROPERTY LINE
- APPROXIMATE FORMER LOCATION OF MILITARY BROOK (PRE 1924)
- UNDERGROUND ELECTRIC
- OVERHEAD ELECTRIC
- STORM SEWER
- SANITARY SEWER
- WATER
- GAS
- TELECOMMUNICATION
- CATCH BASIN
- LIGHT POLE
- UTILITY POLE
- FORMER MGP BOUNDARY (APPROXIMATE)
- FORMER MGP STRUCTURES
- MONITORING WELL LOCATION
- SOIL BORING LOCATION
- SURFACE SOIL SAMPLE LOCATION
- SOIL BORING WITH TAR-LIKE MATERIAL
- SOIL BORING WITH TRACE OIL-LIKE MATERIAL
- SOIL BORING WITH NO OBSERVED IMPACTS
- (1-2.5') DEPTH OF OBSERVED IMPACT
- PROPOSED HORIZONTAL LIMITS OF REMOVAL
- 9' PROPOSED DEPTH OF REMOVAL
- AREA REQUIRING FURTHER INVESTIGATION
- PROPOSED PDI SOIL BORING LOCATION
- PROPOSED PDI TEST PIT LOCATION

0 100' 200'

GRAPHIC SCALE

NYSEG
NEWARK FORMER MANUFACTURED GAS PLANT SITE
SITE NO. 8-59-021
REMEDIAL DESIGN WORK PLAN

PROPOSED PDI LOCATIONS

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FIGURE 3

CITY: SYRACUSE NY DIV/GROUP: ENVCAD DB: R. ALLEN, E. KRAHMER PIC: J. BRIEN PM: J. GOLUBSKI TM: M. HYSELL TR: J. SINAY LYR: ON=*;OFF=REF; (FRZ)
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APPENDIX A

Field Sampling Plan

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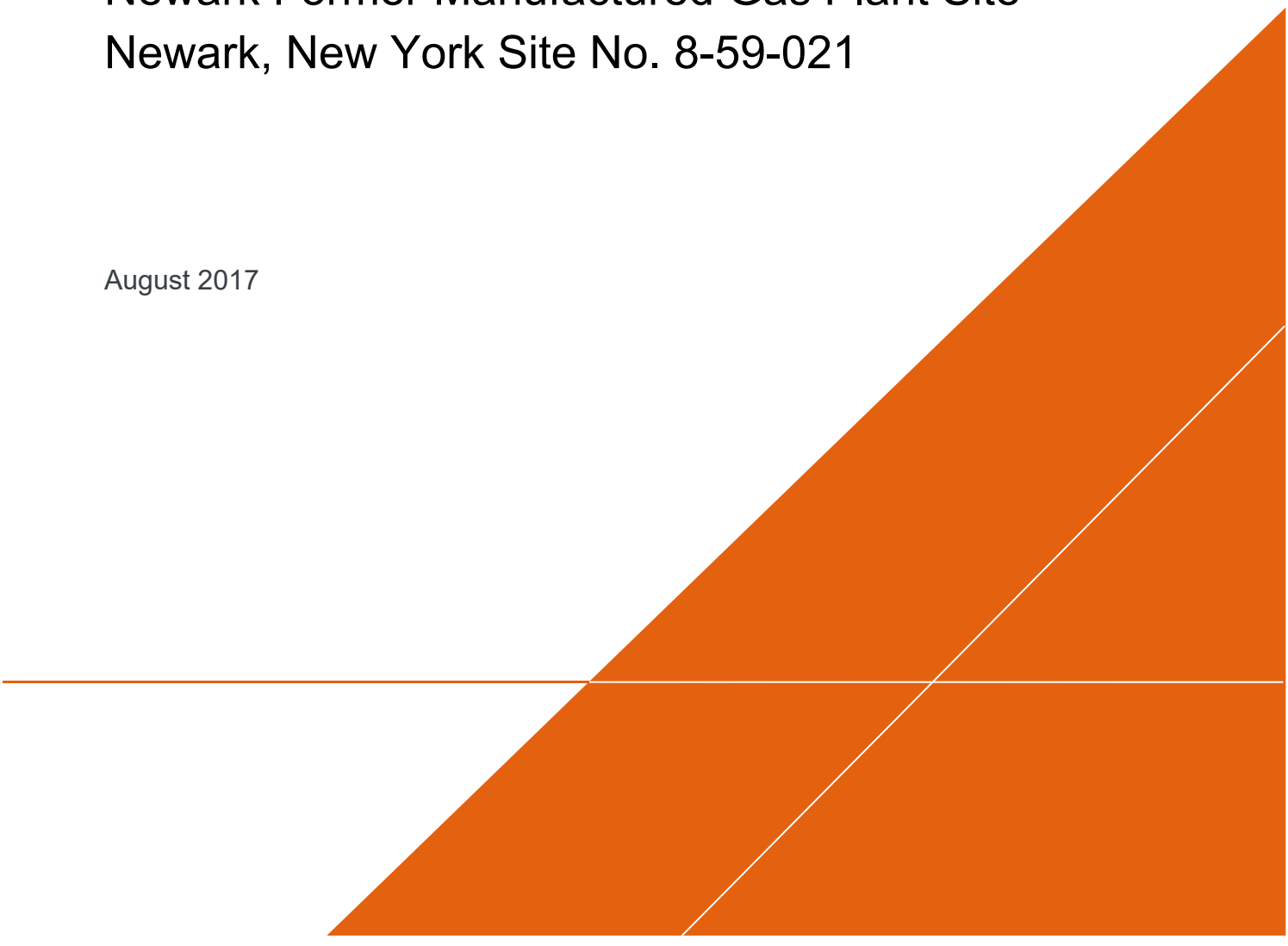
NYSEG

FIELD SAMPLING PLAN

Newark Former Manufactured Gas Plant Site
Newark, New York Site No. 8-59-021

August 2017



FIELD SAMPLING PLAN

Newark Former Manufactured Gas Plant Site Newark, New York Site No. 8-59-021

Prepared for:

NYSEG

Prepared by:

Arcadis of New York, Inc.

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Our Ref.:

B0013094.0006

Date:

August 2017

CONTENTS

ATTACHMENTS

1 INTRODUCTION

1.1 General

This *Field Sampling Plan* (FSP) supports the *Remedial Design Work Plan* (RDWP) for the Newark Former Manufactured Gas Plant (MGP) Site located in Newark, New York (the site).

This FSP addresses field procedures and sample collection methods to be used during implementation of RDWP field activities. The FSP should be used in conjunction with the RDWP, the *Quality Assurance Project Plan* (QAPP), and an approved *Health and Safety Plan* (HASP). The QAPP (included as Appendix B of the RDWP) presents quality assurance/quality control (QA/QC) procedures to be used during field activities described in the RDWP, as well as a description of the general field and laboratory procedures.

1.2 Overview of Investigation Field Activates

The following activities may be conducted at the site:

- Advancing soil borings
- Excavating test pits
- Measuring water table elevations
- Collecting soil and groundwater samples

Sampling locations and rationale for each field sampling activity are described in the RDWP.

2 FIELD ACTIVITIES

This section describes field procedures and methods potentially used for site investigation work.

2.1 General Field Guidelines

2.1.1 Utilities

Underground utilities will be identified prior to any drilling or subsurface sampling. Public and privately-owned utilities will be located by contacting responsible agencies by phone so that their underground utilities can be marked at the site. Other potential on-site hazards, such as traffic, overhead power lines, and building hazards, will be identified during a site reconnaissance visit.

2.1.2 Equipment

The following is a general list of equipment necessary for sample collection:

- Stainless steel spoons and bowls or single-use disposable zip-top plastic bags for compositing soil samples
- Appropriate sample containers provided by the laboratory (kept closed and in laboratory-supplied coolers until the samples are collected)
- Pre-preserved sample containers (as required) for aqueous samples
- Chain of custody record forms
- Log book, field sampling records, and indelible ink pens and markers
- Laboratory-grade soap (such as Alconox®), reagent grade solvents, and distilled water to be used for decontaminating equipment between sampling stations
- Buckets, plastic wash bins, and scrub brushes for decontaminating equipment
- Digital camera and extra batteries
- Stakes, pin flags, and/or spray paint to identify sampling locations
- Shipping labels and forms
- Safety auto-retract knife
- Packing/shipping material for sample bottles
- Strapping tape
- Clear plastic tape
- Duct tape
- Aluminum foil

- Portable field instruments, including a photoionization detector (PID), water quality parameter meter, conductivity meter, and water-level indicator

2.1.3 Field Book

Field log books will be maintained by the field team leader and other team members to provide a daily record of significant events, observations, and measurements during the field investigation.

Information pertinent to the field investigation and/or sampling activities will also be recorded in the log books. The books will be bound with consecutively numbered pages. Entries in the log book will include, at a minimum, the following information:

- Name of author, date of entry, and physical/environmental conditions during field activity
- Purpose of sampling activity
- Location of sampling activity
- Name of field crew members
- Name of any site visitors
- Sample media (e.g., soil, groundwater)
- Sample collection method
- Number and volume of sample(s) taken
- Description of sampling point(s)
- Volume of groundwater removed before sampling (where appropriate)
- Preservatives used
- Date and time of collection
- Sample identification number(s)
- Field observations
- Any field measurements made, such as, but not limited to, pH, temperature, conductivity, water level

All original data recorded in field log books and chain of custody records will be written with indelible ink. If an error is made on an original document assigned to one individual, that individual will make all corrections simply by crossing a single line through the error and entering the correct information. The erroneous information will not be erased. Any subsequent error discovered on an original document will be corrected by the person who made the entry. All subsequent corrections will be initialed and dated.

2.2 Sample Labeling, Packing, and Shipping

Each sample will be given a unique identification. With this type of identification, no two samples will have the same label.

Samples will be promptly labeled upon collection with the following information:

- Project number and site
- Unique sample identification
- Analysis required
- Date and time sampled
- Sample type (composite or grab)
- Preservative, if applicable

Clear tape will be secured over the sample label and the chain of custody will be initiated. A sample chain of custody form is included on Attachment A.

Appropriate sample containers, preservation methods, and laboratory holding times for each sample type will be applied as identified in the QAPP.

If samples are to be shipped by commercial carrier (e.g., Federal Express), sample bottles/jars will be packed in coolers containing the following:

- A drain plug (if present) that has been sealed with duct tape
- 1 to 2 inches of bubble wrap on the bottom of the cooler
- Water ice packaged in re-sealable plastic bags
- Sufficient bubble wrap to fill in the remaining area
- The completed chain of custody in a re-sealable plastic bag, taped in place on the inside cover of the cooler

The cooler will then be sealed with tape. Appropriate shipping labels, such as "this-end-up" and "fragile" stickers will be affixed to the cooler. Samples will be hand delivered or delivered by an express carrier within 48 hours of sample collection. The express carrier will not be required to sign the chain of custody form; however, the shipping receipt should be retained by the sampler and forwarded to the project files.

All samples, whether solids, liquids or gases, being shipped by air or ground transport will be evaluated using a Shipping Determination process to determine if the material or equipment being shipped is hazardous for transport. All materials identified as HazMat will be shipped according to applicable United States Department of Transportation (USDOT) and International Air Transport Association (IATA) regulations and requirements. All employees collecting samples, preparing HazMat packages, or offering HazMat to a third-party carrier such as FedEx will have current HazMat training.

2.3 Equipment Decontamination

2.3.1 Drill Rig Decontamination

A decontamination pad will be lined with plastic sheeting on a surface sloped to a sump. The sump must also be lined and of sufficient volume to contain approximately 20 gallons of decontamination water. All drilling equipment, including rear-end of drilling rig, augers, bits, rods, tools, split spoon samplers, tremie pipe, etc., will be cleaned on the decontamination pad with a high-pressure hot water "steam cleaner" unit

and scrubbed with a wire brush, as needed, to remove dirt, grease, and oil before beginning work in the project area. If heavy accumulations of tars or oils are present on the downhole tools, a citrus-based cleaner (e.g., Citra-Solv®) may be used to aid in equipment cleaning. Tools, drill rods, and augers will be placed on sawhorses, decontaminated pallets, or polyethylene plastic sheets following steam cleaning. Direct contact with the ground will be avoided. The back of the drill rig and augers, rods, and tools will be decontaminated between each drilling location according to the above procedures. Decontamination water will be contained in a dedicated plastic tank or 55-gallon open-top drums located on site. All open-top drums will remain closed when not in use.

Following decontamination of all heavy site equipment, the decontamination pad will be decommissioned. The decommissioning will be completed by:

- Transferring the bulk of remaining liquids and solids into drums, tanks, and/or roll-offs to be provided by NYSEG or the drilling subcontractor for these materials.
- Rolling the sheeting used in the decontamination pad onto itself to prevent discharge of remaining materials to the ground surface. Once rolled up, the polyethylene sheeting will be placed in the roll-off or drums used for disposal of personal protective equipment (PPE) and disposable equipment.

2.3.2 Sampling Equipment Decontamination

The following equipment will be required for use during sampling equipment cleaning procedures:

- Appropriate PPE, as required in the site HASP
- Distilled water
- Non-phosphate detergent such as Alconox (or equivalent)
- Tap water
- Rinsate collection plastic containers
- USDOT-approved waste shipping container(s)
- Brushes
- Large heavy-duty garbage bags
- Spray bottles
- (Optional) – “pesticide grade” Methanol
- (Optional) – “ultra-pure grade” Nitric Acid
- (Optional) – Hexane
- Ziploc-type bags
- Plastic sheeting

Prior to collecting samples to be submitted for chemical analysis, if any, all non-dedicated bowls, spoons, hand augers, bailers, and filtering equipment will be washed with potable water and a detergent (such as Alconox®). Decontamination may take place at the sampling location as long as all liquids are contained

in pails and buckets. Sampling equipment will then be rinsed with potable water, followed by a 10 percent "pesticide-grade" methanol rinse, and finally a distilled water rinse. When sampling for inorganic constituents in an aqueous phase, an additional rinse step will be added prior to the rinse with methanol. The rinse step will entail a rinse with a 10 percent "ultra-pure-grade" nitric acid followed by a distilled water rinse. Between rinses, equipment will be placed on polyethylene sheets or aluminum foil, if necessary. At no time will washed equipment be placed directly on the ground. Equipment will either be used immediately or wrapped in plastic or aluminum foil for storage or transportation from the designated decontamination area to the sampling location.

2.4 Soil Boring Advancement and Sample Collection

Where required, soil borings will be advanced to the depths and at the locations defined in the RDWP. The following procedures will be used to advance borings.

2.4.1 Drilling and Geological Logging Methods

Drilling and geological logging methods to be completed for each soil boring are as follows:

- Boreholes in the overburden will be drilled using rotosonic technology, hollow-stem augers, direct-push technology (DPT) or other method identified in the NYSDEC-approved RDWP.
- Continuous soil sampling will be conducted during advancement of soil borings. The drilling contractor or Arcadis drill rig operator is responsible for obtaining accurate and representative samples; informing the supervising geologist of changes in drilling pressure; and keeping a separate general log of soils encountered.
- Split-spoon sampling and or Shelby tube sampling will be conducted during the advancement of soil borings for geotechnical data collection. Sampling will be performed in accordance with ASTM Specifications D1586 and D 1587 for standard penetration test and split-spoon sampling and Shelby tube sampling, respectively, unless otherwise authorized by the field geologist.
- The designated field geologist will log borehole geology in the field book and/or field forms. Records will also be kept of occurrences of premature refusal due to boulders or construction materials that may have been used as fill. Where a boring cannot be advanced to the desired depth, the boring will be abandoned and an additional boring will be advanced at an adjacent location to obtain the required sample. Where it is desirable to avoid leaving vertical connections between depth intervals, the borehole will be sealed using cement and/or bentonite. Multiple refusals may lead to a decision by the supervising geologist to abandon that sampling location.
- A plywood sheet or tub may be placed around the drill stem when drilling to contain cuttings.
- Soil cuttings will be placed in a drum or roll-off supplied by NYSEG or the drilling subcontractor. Decontamination water will be placed in plastic tanks/drums supplied by NYSEG or the drilling subcontractor. Soil cuttings and decontamination water will be picked up and containerized at the end of each work day. Roll-offs or open-top drums used to contain the solids will be covered when not in use.

2.4.2 Subsurface Soil Sampling Method

Continuous soil sampling will be conducted during soil boring advancement in the overburden. At locations designated for geotechnical data collection, the Standard Penetration Test (American Society for Testing and Materials [ASTM] D 1586 84) and hollow-stem augers or flush-joint casing will be used during drilling to collect split-spoon samples from the unconsolidated fill and soil beneath the site.

The supervising geologist or scientist will be responsible for documenting drilling events using a bound field notebook to record all relevant information in a clear and concise format. The record of drilling events will include:

- start and finish dates of drilling
- name and location of project
- project number, client, and site location
- sample number and depths
- blow counts and recovery
- depth to water
- type of drilling method
- drilling equipment specifications, including the diameter of drilling tools
- documentation of any elevated organic vapor readings
- names of drillers, inspectors, or other people onsite
- weather conditions

Soil samples are typically field screened with an FID or PID at sites where volatile organic compounds are present in the subsurface. Field screening is performed using one of the following methods:

- Upon opening the sampler, the soil is split open and the PID or FID probe is placed in the opening and covered with a gloved hand. Such readings should be obtained at several locations along the length of the sample
- A portion of the collected sample is placed in a re-sealable plastic bag or jar, sealed, and allowed to warm to room temperature. After warming, the cover is removed and a reading is obtained.

Samples selected for laboratory analysis will be handled, packed, and shipped in accordance with the procedures outlined in the this FSP. A geologist will be on-site during drilling and sampling operations to describe each soil sample on the soil boring log, including:

- percent recovery
- soil type
- color
- moisture condition

- density
- grain-size
- consistency
- other observations, particularly relating to the presence of potential impacts

Samples selected for laboratory analysis will be placed into appropriate containers provided by the laboratory. Sample containers for volatile organic analyses will be filled first. Soil samples collected for VOC analysis will be collected in a manner consistent with previous soil VOC analyses completed at the site to provide data comparability, if applicable (soil VOC samples will not be collected using methanol preservation or analyzed using United States Environmental Protection Agency Method 5035). Next, a sufficient amount of the remaining soil will be homogenized by mixing the sample in a decontaminated stainless-steel tray or bowl with a decontaminated stainless-steel trowel or disposable scoop. Laboratory-supplied sample containers for other analytes will then be filled. Duplicate samples will be collected at the frequency detailed in the QAPP by alternately filling two sets of sample containers.

Representative portions of each soil sample will be placed in a 1-pint jar or re-closable plastic bag, labeled, and stored on site. This container will be labeled with:

- Site
- Boring number
- Interval sampled
- Date
- Initials of sampling personnel

These soil samples will be screened for organic vapors using a PID. In addition, a geologist will be on site during drilling operations to describe each sample. Soil samples will be described using the methods described in the soil description standard operating procedure (SOP), included as Attachment B.

If required, samples selected for laboratory analysis will be based on:

- Their position in relation to potential source areas
- The visual presence of source materials
- The relative levels of volatile organics based on PID field screening measurements
- The discretion of the on-site geologist

For samples that may be submitted for chemical analysis, split-spoons, or any portion of the drilling rig that may contact the sample, will be decontaminated, as specified in Section 2.3.2, after each sample is collected. Sample descriptions, PID readings, and location will be recorded in the field book or on the field drilling log presented on Attachment C. The procedures to be followed will be dependent on the PID acquired for this project, as described in the equipment manual.

2.5 Test Pit Excavation

If required, test pits/trenches will be excavated using a backhoe equipped with a bucket. If residues are visually observed in the test pit/trenches, the contents may also be sampled.

The following materials will be available, as required, during test pit excavation:

- Backhoe with bucket
- Shovel
- Plastic sheeting
- Stainless steel hand trowel
- Stainless steel pan
- Appropriate sample containers and packing materials, if required
- Potable water
- Steam cleaning equipment
- Appropriate health and safety equipment, as required by the HASP
- PID
- Camera/video camera
- Test pit/trench log

The following procedures will be used to excavate test pits.

1. Identify the test pit/trench number on an appropriate log or in the designated field notebook, as well as with the temperature, weather, date, time, and personnel at the site.
2. Set up a decontamination station and decontaminate the backhoe, bucket, shovel, and other sampling apparatus with a high-pressure steam rinse using a tap water source.
3. Put on appropriate health and safety equipment as specified by the HASP.
4. Place plastic sheeting on the ground next to the test pit/trench location.
5. Position backhoe and personnel at upwind (to the extent feasible) locations with respect to the test pit/trench area.
6. Turn on the PID. Measure and record background PID readings on the test pit/trench log and/or in the field book.
7. Excavate soil with the backhoe in approximately 1-foot increments. At each interval, examine and classify soil according to applicable standards. Record these observations in the test pit/trench log or field book. Also, screen soil samples with a PID. Record these measurements in the test pit/trench log and/or field book.
8. If contents of the test pit/trench visually appear to consist of site residues, the test pit/trench contents may be sampled. If sampling is required, the test pit/trench will be sampled with a shovel if the test

pit/trench is less than 3 feet deep. If the test pit/trench is greater than 3 feet deep, then the test pit/trench will be sampled with the backhoe bucket. The contents of the bucket will then be sampled with a cleaned stainless-steel hand trowel.

9. If sampling is required, samples will be collected in appropriate containers and placed immediately in a cooler of wet ice to maintain a 4ºC temperature for preservation. Volatile organic samples will be collected immediately after sample retrieval. Next, a sufficient amount of remaining soil will be removed from the sampling device and homogenized by mixing thoroughly in a clean stainless-steel pan with a clean stainless-steel trowel. Samples will be selected for analytical characterization only if visible residues are present and/or relatively high PID screening readings are measured.
10. The test pit/trench will be terminated when significant residues are encountered, the top of the water table is reached, or to the maximum reach of the backhoe, whichever occurs first.
11. Soils generated during drilling will be staged on plastic during excavation, monitored for PID readings and visual observations, and then placed back into the test pit/trench. Clean fill will be placed at the surface.
12. A labeled stake will be placed at the test pit/trench location.
13. A photograph of each location before, during, and after each test pit/trench is excavated will be taken.
14. The backhoe, backhoe bucket, and all tools used at the test pit/trench area will be decontaminated using a high-pressure steam rinse using a tap water source. Decontamination water and residual materials associated with decontamination will be contained.

2.6 Measurement of Fluid Levels

The following procedure will be used to measure fluid-level depths at monitoring wells and surface-water gauges:

- Decontaminate the water-level probe or oil/water interface probe (for wells expected to contain NAPL).
- Measure the static fluid-level, fluid interfaces (i.e., NAPL/water interface), and sound the bottom of the well (if applicable) with reference to the surveyed elevation mark on the top of the PVC casing or surface-water gauge. Record all measurements to nearest 0.01 foot and record in the field book.

The measurements will be made in as short a timeframe as practical to minimize temporal fluctuations in hydraulic conditions.

Fluid levels will be measured using an electronic fluid-level indicator (sounder), steel tape, pressure transducer, or stream gauge at established reference points (e.g., top of casing, stream gauge).

The following materials will be available, as required:

- Appropriate health and safety equipment, as specified in the HASP.
- Laboratory-type soap (Alconox or equivalent)
- Electronic water-level indicator (sounder) or pressure transducer.

- PID.
- Analyte-free water.
- Indelible ink pen.
- 6-foot engineer's rule

The following procedures will be used to obtain fluid levels.

1. Measure the lengths between markers on the cable with a 6-foot engineer's rule or a fiberglass engineer's tape. The tape or cable associated with the electronic water-level probe should be checked for the length corresponding to the deepest total well depth to be monitored during the data collection event.
2. If the length designations on the tape or cable associated with the electronic water-level probe are found to be incorrect, the probe will not be used until it is repaired by the manufacturer.
3. Record verification of this calibration process in field logbook.
4. The detailed procedure for obtaining fluid level depth measurements is as follows. Field notes on logs will be treated as secured documentation and indelible ink will be used. As a general rule, the order of measuring should proceed from the least to most contaminated monitoring wells, based on available data.
5. Identify site and well number in field logbook using indelible ink, along with date, time, personnel, and weather conditions.
6. Field personnel will avoid activities that may introduce contamination into monitoring wells. Activities such as dispensing gasoline into vehicles or generators should be accomplished well in advance of obtaining field measurements.
7. Use PPE as required by the HASP.
8. Clean the water-level probe and cable in accordance with the appropriate cleaning procedures. Down-hole instrumentation should be cleaned prior to obtaining readings at the first monitoring well and upon completion of readings at each well.
9. Clean the water-level probe and cable with a soapy (Alconox) water rinse followed by a solvent rinse (if appropriate based on site-specific constituents of concern) an analyte-free water rinse. Contain rinse water in a portable container that will be transferred to an on-site container.
10. Put clean plastic sheeting on the ground next to the well.
11. Unlock and open the well cover while standing upwind from the well. Place the well cap on the plastic sheeting.
12. Locate a measuring reference point on the well casing. If one is not found, initiate a reference point at the highest discernable point on the inner casing (or outer if an inner casing is not present) by notching with a hacksaw, or using an indelible marker. All down-hole measurements will be taken from the reference point established at each well on the inner casing (on the outer only if an inner casing is not present).

13. Measure to the nearest hundredth of a foot and record the height of the inner and outer casings (from reference point, as appropriate) to ground level.
14. Record the inside diameter of the well casing in the field log.
15. Lower the probe until it emits a signal (tone and or light) indicating the top of the water surface. Gently raise and lower the instrument through this interface to confirm its depth. Measure and record the depth of the water surface, and the total well depth, to the nearest hundredth of a foot from the reference point at the top of the well. Lower the probe to the bottom of the well to obtain a total depth measurement.
16. Clean the water-level probe and cable in accordance with the appropriate cleaning procedures.
17. Compare the depth of the well to previous records, and note any discrepancy.
18. Lock the well when all activities are completed.

Fluid level measurement data will be recorded legibly in the field notebook in indelible pen. Field situations such as apparent well damage or suspected tampering, or other observations of conditions that may result in compromised data collection will be photographically documented where practicable.

2.7 Groundwater Sampling Procedures for Grab Samples

This protocol describes procedures to be used to collect groundwater samples by traditional purging and sampling techniques (i.e., non-low-flow) using a bailer. For newly installed wells, no wells will be sampled until well development has been performed. During precipitation events, groundwater sampling will not be conducted until precipitation ceases.

The following materials, as required, shall be available during groundwater sampling:

- Disposable Bailer.
- PID.
- Appropriate health and safety equipment, as specified in the HASP.
- Plastic sheeting (for each sampling location).
- New disposable polypropylene rope.
- Buckets to measure/contain purge water.
- Water-level probe.
- 6-foot rule with gradation in hundredths of a foot.
- Appropriate water sample containers.
- Appropriate blanks (trip blank supplied by the laboratory).
- Appropriate transport containers (coolers) with ice and appropriate labeling, packing, and shipping materials.
- Chain of custody forms.

- Indelible ink pens.
- Site map with well locations and groundwater contour maps.
- Keys to wells.

The following 16 steps detail monitoring well sampling procedures:

1. Identify site and well sampled infield book, including date, arrival time, and weather conditions. Identify the personnel and equipment.
2. Label all sample containers using an appropriate label.
3. Use safety equipment, as required in the HASP.
4. Place plastic sheeting adjacent to the well to use as a clean work area.
5. Establish a background reading with the PID and record reading on the field log.
6. Remove lock from the well; if rusted or broken, replace with a new keyed-alike lock.
7. Unlock and open the well cover while standing upwind of the well. Remove well cap and place on plastic sheeting. Insert PID probe in the breathing zone above the well casing following instructions in the HASP.
8. Set out on plastic sheeting the dedicated or disposable sampling device and meters.
9. Prior to sampling, groundwater elevations will be measured at the monitoring well and the presence of LNAPL or DNAPL (if any) within the well will be evaluated. Obtain a water-level depth and bottom of well depth using an electric well probe and record on the sampling log sheet. Clean the well probe after each use with a soapy (Alconox®) water wash and a tap water rinse.
10. Calculate the number of gallons of water in the well using the length of water column (in feet). Record the well volume on the sampling log sheet.
11. Remove the required purge volume of water from the well by measuring purge water volume in a measuring buckets. The required purge volume will be three well volumes (the water column in the well screen and casing) unless the well runs dry, in which case, when sufficient recharge has occurred to fill required sample bottles, sample collection will begin. If the well does not run dry, sample collection will commence following removal of three well volumes.
12. After the appropriate purge volume of groundwater in the well has been removed, or if the well has been bailed dry and allowed to recover, obtain the groundwater sample needed for analysis directly from the bailer in the appropriate container and tightly screw on the cap.
13. Secure with packing material and store at 4 degrees Celsius (°C) on wet ice in an insulated transport container provided by the laboratory.
14. Record the time sampling procedures were completed in the field book.
15. Place all disposable sampling materials (plastic sheeting, disposable bailers, and health and safety equipment) in appropriately labeled containers. Go to the next well and repeat Step 1 through Step 13 until all wells are sampled.

16. Complete the procedures for packaging, shipping, and handling with associated chain of custody forms (Section 2.2).

2.8 Air Monitoring

Air monitoring will be conducted during all intrusive activities and may require a PID and dust meter or only a PID. Specific air monitoring requirements that need to be conducted during intrusive activities are provided in the RDWP. The PID will be used to monitor organic vapors in the breathing zone and borehole and to screen samples for analysis.

PID readings will be recorded in the field book during trenching and drilling activities. The instrument will be calibrated at least once each day and more frequently, if needed. A detailed procedure for the PID calibration is included in section 3.1.

2.9 Investigation Derived Waste and Storage

Investigation-derived wastes (IDW) will be generated during site activities, which include, but are not limited to groundwater sampling, NAPL purging, and decontamination. IDW may include decontamination liquids, PPE, sorbent materials, purge water, recovered NAPLs and disposable sampling materials that may have come in contact with potentially impacted materials. IDW will be collected and staged at the point of generation. Waste materials will be analyzed for constituents of concern to evaluate proper disposal methods. Anticipated IDW will be labeled and stored in 55-gallon drums with bolt-sealed lids. Disposable equipment (PPE and disposable sampling equipment) typically does not require laboratory analysis.

Minimization of IDW will be considered by the Project Manager and may include techniques such as replacing solvent based cleaners with aqueous-based cleaners for decontamination of equipment, reuse of equipment (where it can be decontaminated), and sampling techniques that generate little waste.

The procedures for handling IDW are based on the USEPA's *Guide to Management of Investigation Derived Wastes* (USEPA, 1992). IDW is assumed to be contaminated with the site residuals until analytical evidence indicates otherwise. IDW will be managed to ensure the protection of human health and the environment and will comply with all applicable or relevant and appropriate requirements (ARARs). The following Laws and Regulations on Hazardous Waste Management are possible ARARs for this Site.

- 6 New York Codes, Rules, and Regulations (6 NYCRR) Part 364 "Waste Transporter Permits", Part 371 "Identification and Listing of Hazardous Wastes", and Part 372 "Hazardous Waste Manifest System and Related Standards for Generators, Transporters and Facilities".
- Resource Conservation and Recovery Act 42 USC Part 6901-6987
- Comprehensive Environmental Response, Compensation and Liability Act 42 USC Part 9601-9675
- Superfund Amendments and Reauthorization Act
- DOT Hazardous Materials Transportation

Waste characterization will be conducted in accordance with waste hauler, waste handling facility, and state/federal requirements following the laboratory requirements and methodologies outlined in the QAPP. IDW will be analyzed by methods appropriate for the known constituents that have been historically detected in the monitoring wells.

In the unexpected event that IDW is characterized as a hazardous waste (as defined in 6 NYCRR Part 371), RCRA and DOT requirements must be followed for packaging, labeling, transporting, storing, and record keeping as described in Title 40 of the Code of Federal Regulations Part (40 CFR) Part 262 and 49 CFR Part 171-178. Waste material classified as RCRA non-hazardous may be handled and disposed of as an industrial waste.

These procedures may be varied or changed as required, dependent upon site conditions, equipment limitations, or limitations imposed by the procedure. The ultimate procedure employed will be documented in the project work plans or reports. If changes to the sampling procedures are required due to unanticipated field conditions, the changes will be discussed with the Project Manager and NYSEG as soon as practicable and documented in the Periodic Review Report.

The following materials, as required, shall be available for IDW handling and storage:

- Appropriate PPE as specified by the HASP
- 55-gallon steel drums, DOT 1A2 or equivalent
- 15/16-inch socket wrench
- Hammer
- Leather gloves
- Drum dolly
- Appropriate drum labels (outdoor waterproof self-adhesive)
- Polyethylene storage tank
- Appropriate labeling, packing, chain-of-custody forms, and shipping materials
- Indelible ink and/or permanent marking pens
- Plastic sheeting
- Digital camera
- Field Logbook

2.9.1 Drum Storage

All 55-gallon drums will be stored at a secure, centralized onsite location that is readily accessible for vehicular pick-up. Drums confirmed as, or believed to contain hazardous waste will be stored over an impervious surface provided with secondary containment. The storage location will, for drums containing liquid, have a containment system that can contain at least the larger of 10% of the aggregate volume of staged materials or 100% of the volume of the largest container. Drums will be closed during storage and

be in good condition in accordance with the USEPA's 1992 *Guide to Management of Investigation-Derived Wastes*.

2.9.2 Drum Container Labelling

Drums will be labeled on both the side and lid of the drum using a permanent marking pen. Old drum labels must be removed to the extent possible, descriptions crossed out should any information remain, and new labels affixed on top of the old labels. Other containers used to store various types of waste (polyethylene tanks, roll-off boxes, end-dump trailers, etc.) will be labeled with an appropriate "Waste Container" or "Testing in Progress" label pending characterization. Drums and containers will be labeled as follows:

- Appropriate waste characterization label (Testing in Progress, Hazardous, or Non-Hazardous)
- Waste generator's name (e.g., client name)
- Project name
- Name and telephone number of Arcadis project manager
- Composition of contents (e.g., used oil, acetone 40%, toluene 60%)
- Media (e.g., solid, liquid)
- Accumulation date (i.e., date the waste is first placed in the container)
- Drum number of total drums as reconciled with the Drum Inventory maintained in the field log book

Immediately upon placing waste into the drum/container, an appropriate waste label will be filled out to include the information specified above, and affixed to the container. Containers with waste determined to be non-hazardous will be labeled with a green and white "Non-Hazardous Waste" label over the "Waste Container" label. Containers with waste determined to be hazardous will be stored in an onsite storage area and will be labeled with the "Hazardous Waste" label and affixed over the "Waste Container" label. DOT hazardous class labels must be applied to all hazardous waste containers for shipment offsite to an approved disposal or recycling facility. In addition, a DOT proper shipping name shall be included on the hazardous waste label. The transporter should be equipped with the appropriate DOT placards. However, placarding or offering placards to the initial transporter is the responsibility of the generator per 40 CFR Part 262.33.

2.9.3 Inspection and Documentation

All IDW will be documented as generated on a Drum Inventory Log maintained in the field log book. The Drum Inventory will record the generation date, type, quantity, matrix and origin (e.g. RW-1 through RW-10, MW-97-7) of materials in every drum, as well as a unique identification number for each drum. The drum inventory will be used during drum pickup to assist with labeling of drums. Digital photographs will be taken upon the initial generation and drumming/staging of waste, and final labeling after characterization to document compliance with labeling and storage protocols, and condition of the container. Evidence of damage, tampering or other discrepancy should be documented photographically.

2.9.4 Preparing Waste Shipment Documentation (Hazardous and Non-Hazardous)

Waste profiles will be prepared by Arcadis and forwarded, along with laboratory analytical data to NYSEG for approval/signature. NYSEG will then return the profile to Arcadis who will then forward to the waste removal contractor for preparation of a manifest. The manifest will be reviewed by Arcadis prior to forwarding to NYSEG for approval. Upon approval of the manifest, NYSEG will return the original signed manifest directly to the waste contractor.

Different profile numbers will be generated for different matrices or materials in the drums. For example, the profile number for disposable equipment will be different than the profile number for purge water. When there are multiple profiles it is critical that the proper label, with the profile number appropriate to a specific material be affixed to the proper drums. A copy of the Arcadis drum inventory will be provided to the waste transporter during drum pickup and to the facility receiving the waste.

2.9.5 Emergency Response and Notifications

Specific procedures for responding to site emergencies will be detailed in the HASP. In the event of a fire, explosion, or other release which could threaten human health outside of the site or when NYSEG or Arcadis has knowledge of a spill that has reached surface water, NYSEG or Arcadis must immediately notify the National Response Center (800-424-8802) in accordance with 40 CFR Part 262.34. Other notifications to state agencies may also be necessary.

3 FIELD INSTRUMENTS

All field-screening equipment will be calibrated immediately prior to each day's use and more frequently, if required. Additional calibration may be required if measurements appear erroneous. The calibration procedures will conform to the manufacturer's standard instructions. Records of all instrument calibration will be maintained by the field personnel. Copies of all of the instrument manuals will be maintained on site by the field personnel.

3.1 Portable Photoionization Analyzer

The photoionization analyzer (PID) will be a MiniRAE 3000 (or equivalent), equipped with a 10.6 electron volt (eV) lamp. The MiniRAE is capable of ionizing and detecting compounds with an ionization potential of less than 10.6 eV. This accounts for up to 73 percent of the VOCs on the Target Compound List. Calibration will be performed according to the following procedures:

1. Turn on the MiniRAE 3000 and monitor the ambient air. If there is any doubt of the air quality, then zero grade gas will be obtained.
2. Connect the regulator to the span gas cylinder. Hand-tighten the fittings.
3. Open the valve on the gas bag by turning the valve stem fully counterclockwise.
4. Attach the gas bag to the regulator. Hand-tighten the fittings.
5. Turn the regulator knob counterclockwise half a turn to start the gas flow.
6. Fill the gas bag half full and then close the regulator fully clockwise to turn off the flow of gas.
7. Fill the gas bag and then turn the valve clockwise.
8. Press “MODE” and “N” at the same time to enter the set-up screens. To cycle through the screens press “MODE.” Press “Y” for span cal and “Y” again for zero point. Press “Y” to set the zero point.
9. When screen displays “CAL GAS” press “Y” and calibrate the unit with isobutylene calibration gas.
10. Press and hold “MODE” for a few seconds and the display will return to normal screening mode.
11. After 7 hours of use, recharge the battery pack. Record the time the battery pack was charged.

Record the date, time, your initials, calibration gas, and concentration on the PID calibration log in Attachment D.

3.2 pH Meter

The pH meter will be calibrated at the start of each day of use and after very high or low readings, as required by this FSP. National Institute of Standards and Technology traceable standard buffer solutions that bracket the expected pH range will be used. The standards will most likely be a pH of 7.0 and 10.0 standard units.

3.3 Specific Conductivity Meter

Calibration checks using the appropriate conductivity standard for the meter will be performed at the start of each day of use and after very high or low readings, as required by this FSP. Readings must be within 5 percent to be acceptable.

3.4 Dissolved Oxygen Meter

The DO meter will be calibrated and the condition of the DO sensor will be checked at the start of each day of use. Calibration and maintenance of the DO meter will be conducted in accordance with the manufacturer's specifications. The calibration data will be recorded in field notebooks.

3.5 Water-Level Meter

The water-level cable will be checked once to a standard to assess if the meter has been correctly calibrated by the manufacturer or vendor. If the markers are incorrect, the meter will be sent back to the manufacturer or vendor.

3.6 Turbidity Meter

The turbidity meter will be calibrated daily prior to use. Calibration and maintenance will be conducted in accordance with the manufacturer's specifications. Calibration and maintenance information will be recorded in the field notebook.

3.7 Oxidation-Reduction Potential Meter

The ORP meter will be calibrated at the start of each day of use. Calibration and maintenance of the ORP meter will be conducted in accordance with the manufacturer's specifications. The calibration data will be recorded in the field notebook.

ATTACHMENT A

Laboratory Chain of Custody

ARCADIS

ID#:

CHAIN OF CUSTODY & LABORATORY ANALYSIS REQUEST FORM

Page ___ of ___

Lab Work Order #

Send Results to:

Contact & Company Name: | Telephone:

Address: | Fax:

City | State | Zip | E-mail Address:

Project Name/Location (City, State): | Project #:

Sampler's Printed Name: | Sampler's Signature:

Preservative							
Filtered (✓)							
# of Containers							
Container Information							

PARAMETER ANALYSIS & METHOD

Keys

Preservation Key:
A. H_2SO_4
B. HCL
C. HNO_3
D. NaOH
E. None
F. Other: _____
G. Other: _____
H. Other: _____

Container Information Key:
1. 40 ml Vial
2. 1 L Amber
3. 250 ml Plastic
4. 500 ml Plastic
5. Encore
6. 2 oz. Glass
7. 4 oz. Glass
8. 8 oz. Glass
9. Other: _____
10. Other: _____

Matrix Key:
SO - Soil | SE - Sediment | NL - NAPL/Oil
W - Water | SL - Sludge | SW - Sample Wipe
T - Tissue | A - Air | Other: _____

Sample ID	Collection Date	Collection Time	Type (✓) Comp	Type (✓) Grab	Matrix	REMARKS

Special Instructions/Comments:

☐ **Special QA/QC Instructions(✓):**

Laboratory Information and Receipt		Relinquished By	Received By	Relinquished By	Laboratory Received By
Lab Name:	Cooler Custody Seal (✓)	Printed Name:	Printed Name:	Printed Name:	Printed Name:
☐ Cooler packed with ice (✓)	☐ Intact ☐ Not Intact	Signature:	Signature:	Signature:	Signature:
Specify Turnaround Requirements:	Sample Receipt:	Firm:	Firm/Courier:	Firm/Courier:	Firm:
Shipping Tracking #:	Condition/Cooler Temp: _____	Date/Time:	Date/Time:	Date/Time:	Date/Time:

Distribution: **WHITE – Laboratory returns with results** **YELLOW – Lab copy** **PINK – Retained by Arcadis**

ATTACHMENT B

Soil Description Standard Operating Procedure

ARCADIS
Infrastructure, environment, facilities

Imagine the result

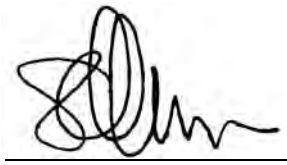
Soil Description

Rev. #: 0

Rev Date: May 20, 2008

Approval Signatures

Prepared by:  Date: 5/22/08

Reviewed by:  Date: 5/22/08
(Technical Expert)

Reviewed by  Date: 5/22/08
(Technical Expert)

I. Scope and Application

This ARCADIS standard operating procedure (SOP) describes proper soil description procedures. This SOP should be followed for all unconsolidated material unless there is an established client-required specific SOP or regulatory-required specific SOP. In cases where there is a required specific SOP, it should be followed and should be referenced and/or provided as an appendix to reports that include soil classifications and/or boring logs. When following a required non-ARCADIS SOP, additional information required by this SOP should be included in field notes with client approval.

This SOP has been developed to emphasize field observation and documentation of details required to:

- make hydrostratigraphic interpretations guided by depositional environment/geologic settings;
- provide information needed to understand the distribution of constituents of concern; properly design wells, piezometers, and/or additional field investigations; and develop appropriate remedial strategies.

This SOP incorporates elements from various standard systems such as ASTM D2488-06, Unified Soil Classification System, Burmister and Wentworth. However, none of these standard systems focus specifically on contaminant hydrogeology and remedial design. Therefore, although each of these systems contain valuable guidance and information related to correct descriptions, strict application of these systems can omit information critical to our clients and the projects that we perform.

This SOP does not address details of health and safety; drilling method selection; boring log preparation; sample collection; or laboratory analysis. Refer to other ARCADIS SOPS, the project work plans including the quality assurance project plan, sampling plan, and health and safety plan (HASP), as appropriate.

II. Personnel Qualifications

Soil descriptions will be completed only by persons who have been trained in ARCADIS soil description procedures. Field personnel will complete training on the ARCADIS soil description SOP in the office and/or in the field under the guidance of an experienced field geologist. For sites where soil descriptions have not previously been well documented, soil descriptions should be performed only by trained persons with a degree in geology or a geology-related discipline.

III. Equipment List

The following equipment should be taken to the field to facilitate soil descriptions:

- field book, field forms or PDA to record soil descriptions;
- field book for supplemental notes;
- this SOP for Soil Descriptions and any project-specific SOP (if required);
- field card showing Wentworth scale;
- Munsell® soil color chart;
- tape measure divided into tenths of a foot;
- stainless steel knife or spatula;
- hand lens;
- water squirt bottle;
- jar with lid;
- personal protective equipment (PPE), as required by the HASP; and
- digital camera.

IV. Cautions

Drilling and drilling-related hazards including subsurface utilities are discussed in other SOPs and site-specific HASPs and are not discussed herein.

Soil samples may contain hazardous substances that can result in exposure to persons describing soils. Routes for exposure may include dermal contact, inhalation and ingestion. Refer to the project specific HASP for guidance in these situations.

V. Health and Safety Considerations

Field activities associated with soil sampling and description will be performed in accordance with a site-specific HASP, a copy of which will be present on site during such activities. Know what hazardous substances may be present in the soil and understand their hazards. Always avoid the temptation to touch soils with bare hands, detect odors by placing soils close to your nose, or tasting soils.

VI. Procedure

1. Select the appropriate sampling method to obtain representative samples in accordance with the selected sub-surface exploration method, e.g. split-spoon or Shelby sample for hollow-stem drilling, Lexan or acetate sleeves for dual-tube direct push, etc.

2. Proceed with field activities in required sequence. Although completion of soil descriptions is often not the first activity after opening sampler, identification of stratigraphic changes is often necessary to select appropriate intervals for field screening and/or selection of laboratory samples.

3. Examine all of each individual soil sample (this is different than examining each sample selected for laboratory analysis), and record the following for each stratum:

- depth interval;
- principal component with descriptors, as appropriate;
- amount and identification of minor component(s) with descriptors as appropriate;
- moisture;
- consistency/density;
- color; and
- additional description or comments (recorded as notes).

The above is described more fully below.

DEPTH

To measure and record the depth below ground level (bgl) of top and bottom of each stratum, the following information should be recorded.

1. Measured depth to the top and bottom of sampled interval. Use starting depth of sample based upon measured tool length information and the length of sample interval.

2. Length of sample recovered, not including slough (material that has fallen into hole from previous interval), expressed as fraction with length of recovered sample as numerator over length of sampled interval as denominator (e.g. 14/24 for 14 inches recovered from 24-inch sampling interval that had 2 inches of slough discarded).

3. Thickness of each stratum measured sequentially from the top of recovery to the bottom of recovery.

4. Any observations of sample condition or drilling activity that would help identify whether there was loss from the top of the sampling interval, loss from the bottom of the sampling interval, or compression of the sampling interval. Examples: 14/24, gravel in nose of spoon; or 10/18 bottom 6 inches of spoon empty.

DETERMINATION OF COMPONENTS

Obtain a representative sample of soil from a single stratum. If multiple strata are present in a single sample interval, each stratum should be described separately. More specifically, if the sample is from a 2-foot long split-spoon where strata of coarse sand, fine sand and clay are present, then the resultant description should be of the three individual strata unless a combined description can clearly describe the interbedded nature of the three strata. Example: Fine Sand with interbedded lenses of Silt and Clay, ranging between 1 and 3 inches thick.

Identify principal component and express volume estimates for minor components on logs using the following standard modifiers.

Modifier	Percent of Total Sample (by volume)
and	36 - 50
some	21 - 35
little	10 - 20
trace	<10

Determination of components is based on using the Udden-Wentworth particle size classification (see below) and measurement of the average grain size diameter. Each size grade or class differs from the next larger grade or class by a constant ratio of ½. Due to visual limitations, the finer classifications of Wentworth's scale cannot be distinguished in the field and the subgroups are not included. Visual determinations in the field should be made carefully by comparing the sample to the field gauge card that shows Udden-Wentworth scale or by measuring with a ruler. Use of field sieves s

recommended to assist in estimating percentage of coarse grain sizes. Settling test or wash method (Appendix X4 of ASTM D2488) is recommended for determining presence and estimating percentage of clay and silt.

Udden-Wenworth Scale Modified ARCADIS, 2008			
Size Class	Millimeters	Inches	Standard Sieve #
Boulder	256 – 4096	10.08+	
Large cobble	128 - 256	5.04 -10.08	
Small cobble	64 - 128	2.52 – 5.04	
Very large pebble	32 – 64	0.16 - 2.52	
Large pebble	16 – 32	0.63 – 1.26	
Medium pebble	8 – 16	0.31 – 0.63	
Small pebble	4 – 8	0.16 – 0.31	No. 5 +
Granule	2 – 4	0.08 – 0.16	No.5 – No.10
Very coarse sand	1 -2	0.04 – 0.08	No.10 – No.18
Coarse sand	½ - 1	0.02 – 0.04	No.18 - No.35
Medium sand	¼ - ½	0.01 – 0.02	No.35 - No.60
Fine sand	1/8 -¼	0.005 – 0.1	No.60 - No.120
Very fine sand	1/16 – 1/8	0.002 – 0.005	No. 120 – No. 230
Silt (subgroups not included)	1/256 – 1/16	0.0002 – 0.002	Not applicable (analyze by pipette or hydrometer)
Clay (subgroups not included	1/2048 – 1/256	.00002 – 0.0002	

Identify components as follows. Remove particles greater than very large pebbles (64-mm diameter) from the soil sample. Record the volume estimate of the greater than very large pebbles. Examine the sample fraction of very large pebbles and smaller particles and estimate the volume percentage of the pebbles, granules, sand, silt and clay. Use the jar method, visual method, and/or wash method (Appendix X4 of ASTM D2488) to estimate the volume percentages of each category.

Determination of actual dry weight of each Udden-Wentworth fraction requires laboratory grain-size analysis using sieve sizes corresponding to Udden-Wentworth fractions and is highly recommended to determine grain-size distributions for each hydrostratigraphic unit.

Lab or field sieve analysis is advisable to characterize the variability and facies trends within each hydrostratigraphic unit. Field sieve-analysis can be performed on selected samples to estimate dry weight fraction of each category using ASTM D2488 Standard Practice for Classification of Soils for Engineering Purposes as guidance, but replace required sieve sizes with the following Udden-Wentworth set: U.S. Standard sieve mesh sizes 6; 12; 20; 40; 70; 140; and 270 to retain pebbles; granules; very coarse sand; coarse sand; medium sand; fine sand; and very fine sand, respectively.

PRINCIPAL COMPONENT

The principal component is the size fraction or range of size fractions containing the majority of the volume. Examples: the principal component in a sample that contained 55% pebbles would be “Pebbles”; or the principal component in a sample that was 20% fine sand, 30% medium sand and 25% coarse sand would be “Fine to coarse Sand” or for a sample that was 40% silt and 45% clay the principal component would be “Clay and Silt”.

Include appropriate descriptors with the principal component. These descriptors vary for different particle sizes as follows.

Angularity – Describe the angularity for very coarse sand and larger particles in accordance with the table below (ASTM D-2488-06). Figures showing examples of angularity are available in ASTM D-2488-06 and the ARCADIS Soil Description Field Guide.

Description	Criteria
Angular	Particles have sharp edges and relatively plane sides with unpolished surfaces.
Subangular	Particles are similar to angular description but have rounded edges.
Subrounded	Particles have nearly plane sides but have well-rounded corners and edges.
Rounded	Particles have smoothly curved sides and no edges.

Plasticity – Describe the plasticity for silt and clay based on observations made during the following test method (ASTM D-2488-06).

- As in the dilatancy test below, select enough material to mold into a ball about ½ inch (12 mm) in diameter. Mold the material, adding water if necessary, until it has a soft, but not sticky, consistency.

- Shape the test specimen into an elongated pat and roll by hand on a smooth surface or between the palms into a thread about 1/8 inch (3 mm) in diameter. (If the sample is too wet to roll easily, it should be spread into a thin layer and allowed to lose some water by evaporation.) Fold the sample threads and reroll repeatedly until the thread crumbles at a diameter of about 1/8 inch. The thread will crumble when the soil is near the plastic limit.

Description	Criteria
Nonplastic	A $^{1}/_{8}$ inch (3 mm) thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit

Dilatancy – Describe the dilatancy for silt and silt-sand mixtures using the following field test method (ASTM D-2488-06).

- From the specimen select enough material to mold into a ball about ½ inch (12 mm) in diameter. Mold the material adding water if necessary, until it has a soft, but not sticky, consistency.
- Smooth the ball in the palm of one hand with a small spatula.
- Shake horizontally, striking the side of the hand vigorously with the other hand several times.
- Note the reaction of water appearing on the surface of the soil.
- Squeeze the sample by closing the hand or pinching the soil between the fingers, and not the reaction as none, slow, or rapid in accordance with the table below. The reaction is the speed with which water appears while shaking and disappears while squeezing.

Description	Criteria
None	No visible change in the specimen.
Slow	Water appears slowly on the surface of the specimen during shaking and does not disappear or disappears slowly upon squeezing.
Rapid	Water appears quickly on the surface of the specimen during shaking and disappears quickly upon squeezing.

MINOR COMPONENT(S)

The minor component(s) are the size fraction(s) containing less than 50% volume. Example: the identified components are estimated to be 60% medium sand to granules, 25 % silt and clay; 15 % pebbles – there are two identified minor components: silt and clay; and pebbles.

Include a standard modifier to indicate percentage of minor components (see Table on Page 5) and the same descriptors that would be used for a principal component. Plasticity should be provided as a descriptor for the silt and clay. Dilatancy should be provided for silt and silt-sand mixtures. Angularity should be provided as a descriptor for pebbles and coarse sand. For the example above, the minor constituents with

modifiers could be: some silt and clay, low plasticity; little medium to large pebbles, sub-round.

SORTING

Sorting is the opposite of grading, which is a commonly used term in the USCS or ASTM methods to describe the uniformity of the particle size distribution in a sample. Well-sorted samples are poorly graded and poorly sorted samples are well graded. ARCADIS prefers the use of sorting for particle size distributions and grading to describe particle size distribution trends in the vertical profile of a sample or hydrostratigraphic unit because of the relationship between sorting and the energy of the depositional process. For soils with sand-sized or larger particles, sorting should be determined as follows:

- Well sorted – the range of particle sizes is limited (e.g. the sample is comprised of predominantly one or two grain sizes)
- Poorly sorted – a wide range of particle sizes are present

You can also use sieve analysis to estimate sorting from a sedimentological perspective; sorting is the statistical equivalent of standard deviation. Smaller standard deviations correspond to higher degree of sorting (see Remediation Hydraulics, 2008).

MOISTURE

Moisture content should be described for every sample since increases or decreases in water content is critical information. Moisture should be described in accordance with the table below (percentages should not be used unless determined in the laboratory).

Description	Criteria
Dry	Absence of moisture, dry to touch, dusty.
Moist	Damp but no visible water.
Wet (Saturated)	Visible free water, soil is usually below the water table.

CONSISTENCY or DENSITY

This can be determined by standard penetration test (SPT) blow counts (ASTM D-1586) or field tests in accordance with the tables below. For SPT blow counts the N-value is used. The N-value is the blows per foot for the 6" to 18" interval. Example: for 24-inch spoon, recorded blows per 6-inch interval are: 4/6/9/22. Since the second interval is 6" to12", the third interval is 12" to 18", the N value is 6+9, or 15. Fifty blow counts for less than 6 inches is considered refusal.

Fine-grained soil – Consistency

Description	Criteria
Very soft	N-value < 2 or easily penetrated several inches by thumb.
Soft	N-value 2-4 or easily penetrated one inch by thumb.
Medium stiff	N-value 9-15 or indented about ¼ inch by thumb with great effort.
Very stiff	N-value 16-30 or readily indented by thumb nail.
Hard	N-value > than 30 or indented by thumbnail with difficulty

Coarse-grained soil – Density

Description	Criteria
Very loose	N-value 1- 4
Loose	N-value 5-10
Medium dense	N-value 11-30
Dense	N-value 31- 50
Very dense	N-value >50

COLOR

Color should be described using simple basic terminology and modifiers based on the Munsell system. Munsell alpha-numeric codes are required for all samples. If the sample contains layers or patches of varying colors this should be noted and all representative colors should be described. The colors should be described for moist

samples. If the sample is dry it should be wetted prior to comparing the sample to the Munsell chart.

ADDITIONAL COMMENTS (NOTES)

Additional comments should be made where observed and should be presented as notes with reference to a specific depth interval(s) to which they apply. Some of the significant information that may be observed includes the following.

- **Odor** - You should not make an effort to smell samples by placing near your nose since this can result in unnecessary exposure to hazardous materials. However, odors should be noted if they are detected during the normal sampling procedures. Odors should be based upon descriptors such as those used in NIOSH "Pocket Guide to Chemical Hazards", e.g. "pungent" or "sweet" and should not indicate specific chemicals such as "phenol-like" odor or "BTEX" odor.
- Structure
- Bedding planes (laminated, banded, geologic contacts)
- Presence of roots, root holes, organic material, man-made materials, minerals, etc.
- Mineralogy
- Cementation
- NAPL presence/characteristics, including sheen (based on client-specific guidance)
- Reaction with HCl (typically used only for special soil conditions)
- Origin, if known (capital letters: LACUSTRINE; FILL; etc.)

EXAMPLE DESCRIPTIONS

51.4 to 54.0’ Clay, some silt, medium to high plasticity; trace small to large pebbles, subround to subangular up to 2” diameter; moist; stiff; dark grayish brown (10YR 4/2) NOTE: Lacustrine; laminated 0.01 to 0.02 feet thick, laminations brownish yellow (10 YR 4/3).

32.5 to 38.0’ Sand, medium to Pebbles, coarse; sub-round to sub-angular; trace silt; poorly sorted; wet; grayish brown (10YR5/2). NOTE: sedimentary, igneous and metamorphic particles.

Unlike the first example where a density of cohesive soils could be estimated, this rotosonic sand and pebble sample was disturbed during drilling (due to vibrations in a loose Sand and Pebble matrix) so no density description could be provided. Neither sample had noticeable odor so odor comments were not included.

The standard generic description order is presented below.

- Depth

- Principal Components
    - Angularity for very coarse sand and larger particles
    - Plasticity for silt and clay
    - Dilatancy for silt and silt-sand mixtures
- Minor Components
- Sorting
- Moisture
- Consistency or Density
- Color
- Additional Comments

VII. Waste Management

Project-specific requirements should be identified and followed. The following procedures, or similar waste management procedures are generally required.

Water generated during cleaning procedures will be collected and contained onsite in appropriate containers for future analysis and appropriate disposal. PPE (such as gloves, disposable clothing, and other disposable equipment) resulting from personnel cleaning procedures and soil sampling/handling activities will be placed in plastic bags. These bags will be transferred into appropriately labeled 55-gallon drums or a covered roll-off box for appropriate disposal.

Soil materials will be placed in sealed 55-gallon steel drums or covered roll-off boxes and stored in a secured area. Once full, the material will be analyzed to determine the appropriate disposal method.

VIII. Data Recording and Management

Upon collection of soil samples, the soil sample should be logged on a standard boring log and/or in the field log book depending on Data Quality Objectives (DQOs) for the task/project. Two examples of standard boring logs are presented below.

The general scheme for soil logging entries is presented above; however, depending on task/project DQOs, specific logging entries that are not applicable to task/project goals may be omitted at the project manager's discretion. In any case, use of a consistent logging procedure is required.

Completed logs and/or logbook will be maintained in the task/project field records file. Digital photographs of typical soil types observed at the site and any unusual features should be obtained whenever possible. All photographs should include a ruler or common object for scale. Photo location, depth and orientation must be recorded in the daily log or log book and a label showing this information in the photo is useful.

ARCADIS Page ____ of ____

Sample Log

Well/Boring _____ Project Name and No. _____

Site Location _____ Drilling Started _____ Drilling Completed _____

Total Depth Drilled _____ feet Hole Diameter _____ inches Sampling Interval _____ feet

Length and Diameter of Sampling Device _____ Type of Sampling Device _____

Drilling Method _____ Drilling Fluid Used _____

Drilling Contractor _____ Driller _____ Helper _____

Prepared By _____ Hammer Weight _____ Hammer Drop _____ Inches

Sample Depth (feet below land surface) From	To	Sample Recovery (feet)	Time/Hydraulic Pressure or Blows per 6 inches	Sample Description	PID (ppm)

http://team/Sites/Offices/North/Northeast Area/Northeast Area Geoscience Forms/Sample Core Log XLS - Sheet1

IX. Quality Assurance

Soil descriptions should be completed only by appropriately trained personnel. Descriptions should be reviewed by an experienced field geologist for content, format and consistency. Edited boring logs should be reviewed by the original author to assure that content has not changed.

X. References

ARCADIS Soil Description Field Guide, 2008 (in progress)

Munsell® Color Chart – available from Forestry Suppliers, Inc.- Item 77341 "Munsell® Color Soil Color Charts

Field Gauge Card that Shows Udden-Wentworth scale – available from Forestry Suppliers, Inc. – Item 77332 "Sand Grain Sizing Folder"

ASTM D-1586, Test Method for Penetration Test and Split-Barrel Sampling of Soils

ASTM D-2488-00, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)

United States Bureau of Reclamation. Engineering Geology Field Manual. United States Department of Interior, Bureau of Reclamation. http://www.usbr.gov/pmts/geology/fieldmap.htm

Petrology of Sedimentary Rocks, Robert L. Folk, 1980, p. 1-48

NIOSH Pocket Guide to Chemical Hazards

Remediation Hydraulics, Fred C. Payne, Joseph A. Quinnan, and Scott T. Potter, 2008, p 59-63

ATTACHMENT C

Soil Boring Log

Date Start/Finish: 8/9/2008 - 8/10/2008
Drilling Company: Drillers, Inc.
Driller's Name: Joe Smith
Drilling Method: Hollow Stem Auger
Auger Size: 4.25" ID
Rig Type: CME-55
Sampling Method: 2" Split Spoon

Northing: 617984.1848
Easting: 559115.8392
Casing Elevation: NA

Borehole Depth: 26' bgs
Surface Elevation: 682.35' AMSL

Descriptions By: Katherine Murray

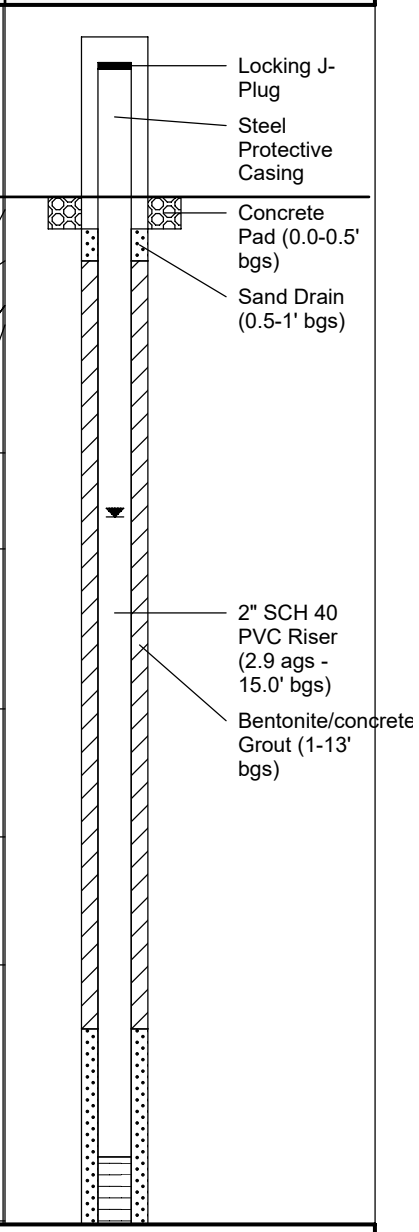
Well/Boring ID: **EXAMPLE BORING**

Client: XYZ Chemical Plant, An ABC Company

Location: Smith Street Site Syracuse, NY

DRAFT

DEPTH	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	Blow Counts	N - Value	PID Headspace (ppm)	Geologic Column	Stratigraphic Description
	685								
0		1	0-2	2.0	1 1 2 5	3	1.1		Asphalt surface. Black-gray coarse GRAVEL, some fine Sand, moist. Dark brown to brown fine SAND and Coal SLAG, some medium to coarse Sand, moist.
	680	2	2-4	1.2	1 2 3 5	5	0.0		Light gray to white ASH, little rust colored mottles, moist to wet. Dark gray fine SAND and SILT, trace Clay, slightly plastic, some rust colored layers, wet.
5		3	4-6	1.1	1 2 1 5	3	0.0		Dark gray SILT and CLAY, little fine Gravel, little coarse Sand, medium plasticity, soft, wet. Gravel content increasing to some below 4.7' bgs.
	675	4	6-8	1.3	7 8 1 8	9	0.0		Red to yellow-brown fine to medium GRAVEL and coarse SAND, little Silt, trace Clay, wet.
		5	8-10	0.3	1 2 5 4	7	0.0		Brown fine to coarse SAND, some fine Gravel, little Silt, moist.
10		6	10-12	0.0	6 18 50/0.3	NA	NA		No Recovery.
	670	7	12-14	1.4	6 5 4 6	9	3.5		Red to yellow-brown fine to medium GRAVEL and coarse SAND, little Silt, saturated.
15		8	14-16	1.5	2 9 1 2	10	4.5		Color change to brown below 14' bgs.



Remarks: bgs = below ground surface; NA = Not Applicable/Available; AMSL = Above Mean Sea Level.

ARCADIS
Infrastructure, environment, facilities

Client: XYZ Chemical Plant,
An ABC Company

Site Location:
Smith Street Site
Syracuse, NY

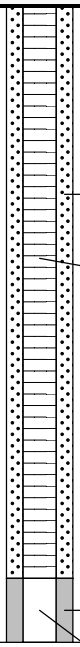
Well/Boring ID: **EXAMPLE BORING**

Borehole Depth: 26' bgs

DRAFT

DEPTH	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	Blows / 6 Inches	N - Value	PID Headspace (ppm)	Geologic Column	Stratigraphic Description
	665	9	16-18	2.0	3 2 1 1	3	0.0		Brown fine to medium GRAVEL and coarse SAND, little Silt, saturated.
		10	18-20	2.0	1 1 2 2	3	0.0		
20		11	20-22	2.0	5 4 1 2	5	0.0		
	660	12	22-24	1.6	4 13 12 9	15	87		
25		13	24-26	1.7	3 12 9 15	21	112		
	655								
30									
	650								
35									

Well/Boring Construction



#1 Silica Sand Pack (13-25' bgs)

2" Sch 40 PVC 0.010" Slot Screen (15-25' bgs)

Bentonite Seal (25-26' bgs)

Sump (25-26' bgs)

ARCADIS
Infrastructure, environment, facilities

Remarks: bgs = below ground surface; NA = Not Applicable/Available; AMSL = Above Mean Sea Level.

ATTACHMENT D

Calibration Log

PID Calibration Log

Zero Gas Source: ____________________ Instrument Type: ____________________ PAGE ____ of ____

Lot Number/Expiration Date: ____________________ Serial Number: ____________________

Calibration Gas Source: ____________________ Instrument Type: ____________________

Lot Number/Expiration Date: ____________________ Serial Number: ____________________

Concentration: ____________________ ____________________

Instrument Number	Date	Time	Zero Cal. OK (Y/N)	Calibration Gas Reading	Comments	Calibration w/in 2% (Y/N)?	Alarms Set (Yes/No)?	User Initials

APPENDIX B

Quality Assurance Project Plan

ARCADIS Design & Consultancy for natural and built assets

NYSEG

QUALITY ASSURANCE PROJECT PLAN

Newark Former Manufactured Gas Plant Site
Newark, New York Site No. 8-59-021

August 2017

QUALITY ASSURANCE PROJECT PLAN

Remedial Design Work Plan

Newark Former Manufactured Gas Plant Site Newark, New York Site No. 8-59-021

Prepared for:

NYSEG

Prepared by:

Arcadis U.S., Inc.

One Lincoln Center

110 West Fayette Street

Suite 300

Syracuse

New York 13202

Tel 315 446 9120

Fax 315 449 0017

Our Ref.:

B0013094.0006

Date:

August 2017

CONTENTS

TABLES

ATTACHMENT

ACRONYMS AND ABBREVIATIONS

ASP	Analytical Services Protocol
CLP	Contract Laboratory Program
DQO	data quality objective
EDD	electronic data deliverable
FS	feasibility study
FSP	*Field Sampling Plan*
HASP	*Health and Safety Plan*
MGP	manufactured gas plant
MS/MSD	matrix spike/matrix spike duplicate
NYSDEC	New York State Department of Environmental Conservation
NYSEG	New York State Electric & Gas Corporation
OM&M	operation, monitoring, and maintenance
ORP	oxidation-reduction potential
OSHA	Occupational Safety and Health Administration
PAH	polycyclic aromatic hydrocarbon
QA/QC	quality assurance/quality control
QA	Quality Assurance
QAPP	*Quality Assurance Project Plan*
RDWP	*Remedial Design Work Plan*
RPD	relative percent difference
SDG	sample delivery ground
SVOC	semivolatile organic compound
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound

1 INTRODUCTION

This *Quality Assurance Project Plan* (QAPP) was prepared to support the *Remedial Design Work Plan* (RDWP). This QAPP presents guidelines for the sampling and analytical methods and procedures that will be used during implementation of the RDWP at the Newark Former MGP Site (site) located in Newark, New York. This QAPP can be used as a guide for field personnel performing activities within potentially impacted areas of the site where the RDWP requires soil or water sampling.

This QAPP was prepared in a manner consistent with the following reference and guidance documents:

- United States Environmental Protection Agency's (USEPA's) Test Methods for Evaluating Solid Waste, SW-846 (USEPA, 1996, and subsequent method revisions).
- USEPA. 2001. EPA Requirements for QA Project Plans for Environmental Operations. EPA-QA/R-5. Office of Environmental Information. March 2001.
- USEPA. 2002. Guidance for QA Project Plans. EPA-QA/G-5. Office of Environmental Information. December 2002.
- National Enforcement Investigations Center *Policies and Procedures Manual* (USEPA, 1991).

2 PROJECT ORGANIZATION AND RESPONSIBILITIES

2.1 Project Organization

Intrusive work conducted within potentially impacted areas of the Newark Former Manufactured Gas Plant (MGP) Site (site), as identified in the RDWP will require integration of personnel from the organizations identified below, collectively referred to as the project team. A description of the responsibilities of each member of the project team is presented in Section 2.2.

Title	Company/Organization	Name	Phone Number
Project Manager	NYSEG	Jeremy Wolf	585.500.8392
Property Owners	NYSEG	TBD	TBD
NYSDEC Project Manager	NYSDEC	Alexandra Servis	518.402.9809

2.1.1 Analytical Laboratory Services and Subcontractors

The analytical services laboratory and contractors performing intrusive activities will be determined prior to initiation of field work.

2.1.2 Quality Assurance Staff

The following Arcadis individual has been assigned as Quality Assurance (QA) Manager for intrusive work within potentially MGP-impacted areas identified in the RDWP:

Title	Company/Organization	Name	Phone Number
QA Manager	Arcadis	Nicholas Beyrle	585.662.4044

2.2 Team Member Responsibilities

This section of the *Quality Assurance Project Plan* (QAPP) presents responsibilities and duties of project team members.

2.2.1 NYSEG

NYSEG Project Manager

1. Overall understanding of the nature and extent of MGP-related impacts remaining at the site.
2. Understands proposed intrusive activities within potentially MGP impacted areas.
3. Understand the RDWP, QAPP, and Field Sampling Plan (FSP) requirements.
4. Ensure RDWP requirements are implemented.

5. Review results, reports, and all documents prepared by contractors conducting work within potentially impacted areas.
6. Confirm that corrective actions are taken for deficiencies cited during audits of the field activities.

2.2.2 New York State Department of Environmental Conservation

New York State Department of Environmental Conservation (NYSDEC) Project Manager

1. Ensure that all the requirements of the RDWP, QAPP, and FSP are followed for all proposed work.
2. Review results, reports, and all documents.
3. Overall understanding of the nature and extent of MGP-related impacts remaining at the site.
4. Provide review and approval of work plans and reports.

2.2.3 Consultants

Consultant Project Manager/Field Personnel

5. Management and coordination of all aspects of the project with an attention on adhering to the requirements of the RDWP, QAPP, and FSP.
6. Communicate/notify the project team regarding proposed intrusive work to be conducted within potentially MGP-impacted areas.
7. Ensure that all the requirements of the RDWP, QAPP, and FSP are implemented for proposed intrusive work conducted within potentially MGP-impacted areas.
8. Oversight of required media sampling.
9. Oversight of field analysis and collection of QA samples.
10. Reduction of field data calibration and maintenance.
11. Review of the field instrumentation, maintenance, and calibration to maintain quality data.
12. Preparation of draft reports and other key documents.
13. Maintenance of field files or notebooks and logs and calculations.
14. Coordination of field and laboratory schedules.
15. Perform field procedures associated with the tasks and subtasks presented in Section 3.
16. Perform field analyses and collect QA samples Maintain sample custody.
17. Prepare field records and logs.
18. Calibrate, operate, and maintain field equipment.
19. Reduce field data.

Quality Assurance Manager

1. Review laboratory data packages.
2. Oversee and interface with the analytical laboratories.
3. Coordinate field quality assurance/quality control (QA/QC) activities with task managers, including audits of field activities, concentrating on field analytical measurements and practices to meet data quality objectives (DQOs).
4. Review field reports.
5. Review audit reports.
6. Prepare a QA/QC report that includes evaluation of field and laboratory data and data validation reports.

2.2.4 Laboratory Subcontractor (To Be Determined)

General responsibilities and duties include:

1. Perform sample analyses.
2. Supply sample containers and shipping cartons.
3. Maintain laboratory custody of samples.
4. Strictly adhere to laboratory protocols.

Laboratory Project Manager

1. Serve as primary communication link between Arcadis and laboratory staff.
2. Monitor workloads and confirm availability of resources.
3. Oversee preparation of analytical reports.
4. Supervise in-house chain of custody.

Quality Assurance Officer

1. Supervise technical staff in QA/QC procedures.
2. Conduct audits of all laboratory activities.

2.2.5 Data Validator

- Provide independent data review and validation of analytical data; provide documentation of results.

3 PROJECT BACKGROUND

The following briefly summarizes background information for the site. Additional information can be found in the RDWP.

3.1 Site Location and Description

The Site consists of land that the former MGP structures occupied. The majority of the Newark former MGP property is located on a parcel that is currently operated by a hotel chain. The former MGP property extends to the approximate northern boundary of what is now West Shore Boulevard. Additional properties that are considered part of the project area consist of a gravel and grass covered area north of West Shore Boulevard (i.e., on a commercial property which operates as a drywall business) and a vacant grass-covered lot located immediately west of the hotel property. The site is generally flat-lying with a gentle slope to the south.

The MGP reportedly operated from circa 1900 into the 1920's. During its peak operation, the MGP consisted of two gas holders, a retort house, a purifier house, a coal shed, two tar wells and two "pressure tanks".

3.2 Objectives

This QAPP was prepared to support the RDWP and presents QA/QC requirements for activities to be conducted associated with implementation of the RDWP and the Newark Former MGP site.

4 QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA

Data Quality Objectives (DQOs) are qualitative and quantitative statements that specify quality of data required to support decisions made during site-related activities and are based on end uses of data to be collected. Preliminary DQOs were identified to confirm that data generated during field activities will be of adequate quality and sufficient quantity to form a sound basis for decision making relative to the above objectives. DQOs have been specified for each data collection activity or investigation. The DQOs presented herein address investigation efforts only and do not cover health and safety issues, which will be addressed in detail in a task-specific HASP.

A DQO summary for field sampling efforts is presented below. The summary consists of stated DQOs relative to data uses, data types, data quantity, sampling and analytical methods, and data measurement performance criteria.

Three data categories have been defined to address various analytical data uses and associated QA/QC effort and methods required to achieve the desired levels of quality. These categories are:

Screening Data: Screening data affords a quick assessment of site characteristics or conditions. This objective for data quality is applicable to data collection activities that involve rapid, non-rigorous methods of analysis and QA. This objective is generally applied to physical and/or chemical properties of samples, degree of contamination relative to concentration differences, and preliminary health and safety assessment.

Screening Data with Definitive Confirmation: Screening data allows rapid identification and quantitation, although quantitation can be relatively imprecise. This objective for data quality is available for data collection activities that require qualitative and/or quantitative verification of a select portion of sample findings (10 percent or more). This objective can also be used to verify less rigorous laboratory-based methods.

Definitive Data: Definitive data are generated using analytical methods, such as approved United States Environmental Protection Agency (USEPA) reference methods. Data are analyte-specific, with confirmation of analyte identity and concentration. Methods produce raw data (e.g., chromatograms, spectra, digital values) in the form of paper printouts or computer-generated electronic files.

For this project, three levels of data reporting have been defined. They are as follows:

Level 1 – Minimal Reporting: Minimal or “results only” reporting is used for analyses that, either due to their nature (i.e., field monitoring) or the intended data use (i.e., preliminary screening), do not generate or require extensive supporting documentation.

Level 2 – Modified Reporting: Modified reporting is used for analyses that are performed following standard USEPA-approved methods and QA/QC protocols and that, based on intended data use, require some supporting documentation but not, however, full “Contract Laboratory Program-type” (CLP-type) reporting.

Level 3 – Full Reporting: Full "CLP-type" reporting is used for those analyses that, based on intended data use, require full documentation. This reporting level would include Analytical Services Protocol (ASP) Superfund and Category B reporting.

The analytical methods to be used during intrusive soil and/or groundwater sampling activities will be USEPA SW-846 methods with NYSDEC ASP Revision 2000, QA/QC requirements, and Category B reporting deliverables, where required.

4.1 Data Quality Objectives for Intrusive Soil and Staged Soil Sampling

When required, it is anticipated that excavation/drilling will be advanced to varying depths. Subsurface soil samples will be visually characterized and may not require laboratory analyses. However, in the event laboratory analyses are required, soil samples may be collected from excavation/drilling or staged sources. In this instance, required analyses should be confirmed with NYSEG and the NYSDEC; however, for the purposes of this QAPP, it is anticipated that samples may be collected for analysis of:

- Semivolatile organic compounds (SVOCs) by USEPA SW-846 Method 8270.

Table 1 presents the parameters to be analyzed under each of the methods described above with the laboratory quantitation limits. Additional analyses may be required by NYSEG or the NYSDEC. The number of required QA/QC samples is summarized in **Table 2**.

4.2 Data Quality Objectives for Groundwater

Groundwater samples are not anticipated to be collected as part of the field activities associated with the RDWP. In the event, groundwater samples are required it is assumed that the samples may be analyzed for:

- Benzene, toluene, ethylbenzene, xylene (BTEX) by USEPA SW-846 Method 8260.
- Polycyclic Aromatic Hydrocarbon (PAH) by USEPA SW-846 Method 8270.

If applicable, the number of groundwater QA/QC samples is summarized in **Table 2**. **Table 1** presents parameters to be analyzed under each of the methods described above with laboratory quantitation limits. In addition, during collection of groundwater samples, the following data may be collected; water-level information and water quality field parameters, including pH, oxidation-reduction potential (ORP), turbidity, temperature, conductivity, and dissolved oxygen.

Groundwater level measurement procedures, field parameter measurement procedures, and groundwater sampling methods are provided in the FSP.

4.3 Data Quality Objectives for Waste Characterization

In the event activities create either liquid or soil waste requiring off-site disposal, NYSEG and the disposal facility will be consulted to determine required analyses. However, for the purposes of this QAPP, it is assumed that samples may be collected and analyzed for:

- Volatile organic compounds (VOCs) by USEPA SW-846 Method 8260.
- Toxicity Characteristic Leachate Protocol (TCLP) VOCs by USEPA SW-846 Method 8260
- Semivolatile organic compounds (SVOCs) by USEPA SW-846 Method 8270.
- TCLP SVOCs by USEPA SW-846 Method 8270.
- Polychlorinated Biphenyls (PCBs) by USEPA SW-846 Method 8082.
- Inorganics (TAL Metals) by USEPA SW-846 Method 6010/6000/7000.
- TCLP RCRA 8 Metals by USEPA SW-846 Method 6010.
- TCLP Mercury by USEPA Method 7471
- Pesticides by USEPA SW-846 Method 1311/8081B
- Herbicides using USEPA SW-846 Method 1311/8150A
- Reactive Cyanide by USEPA SW-846 Method 9012.
- Reactive Sulfide by USEPA SW-846 Method 9034.
- Percent Sulphur by American Society for Testing Materials (ASTM) Method D129-64
- BTU by ASTM Method D240-87
- Total Petroleum Hydrocarbons (TPH – Diesel Range Organics (DRO) / Gasoline Range Organics (GRO)) by USEPA SW-846 8015
- Total Cyanide by USEPA SW-846 9010/9012
- Flashpoint by USEPA Method 101
- pH
- Hardness by USEPA 130.1/SM2340B,C
- Total Toxic Organics (TTO) by EPA Methods 624 and 625 only
- Oil and Grease by USEPA Method 1664A/SM5520B
- Total Suspended Solids (TSS) by SM2540D
- Total Dissolved Solids (TDS) by SM2540C
- 5-Day Biological Oxygen Demand (BOD5) by SM5210B
- Chemical Oxygen Demand (COD) by USEPA 410.4/SM5220C, D

5 SPECIAL TRAINING REQUIREMENTS/CERTIFICATION

Compliant with Occupational Safety and Health Administration's (OSHA's) final rule, *Hazardous Waste Operations and Emergency Response*, 29 Code of Federal Regulations Part 1910.120(e), all personnel performing work in potentially MGP-impacted areas will have completed the requirements for OSHA 40-hour Hazardous Waste Operations and Emergency Response training. Persons in field supervisory positions will have also completed the additional OSHA 8-hour Supervisory Training.

6 DOCUMENTATION AND RECORDS

6.1 General

Samples of various media may be collected, as described in the RDWP or other task-specific work plans. Detailed descriptions of the documentation and reporting requirements are presented below.

6.2 Field Documentation

Field personnel will provide comprehensive documentation covering all aspects of field sampling, field analysis, and sample chain of custody. This documentation constitutes a record that allows reconstruction of all field events to aid in the data review and interpretation process. All documents, records, and information relating to the performance of the field work will be retained in the project file.

Various forms of documentation to be maintained throughout the action include:

- Daily Production Documentation – A field notebook consisting of a waterproof, bound notebook that will contain a record of all activities performed at the site.
- Sampling Information – Detailed notes will be made as to the exact site of sampling, physical observations, and weather conditions (as appropriate).
- Sample Chain of Custody – Chain of custody forms will provide record of responsibility for sample collection, transport, and submittal to the laboratory. Chain of custody forms will be filled out at each sampling site, at a group of sampling sites, or at the end of each day of sampling by Arcadis field personnel designated to be responsible for sample custody. In the event samples are relinquished by the designated sampling person to other field personnel, the chain of custody form will be signed and dated by the appropriate personnel to document the sample transfer. The original chain of custody form will accompany samples to the laboratory, and copies will be forwarded to the project files. A sample chain of custody form is included in Attachment A.

  Persons will have custody of samples when samples are in their physical possession, in their view after being in their possession, or in their physical possession and secured so they cannot be tampered with. In addition, when samples are secured in a restricted area accessible only to authorized personnel, they will be deemed to be in the custody of such authorized personnel.
- Field Equipment, Calibration, and Maintenance Logs – To document the calibration and maintenance of field instrumentation, calibration and maintenance logs will be maintained for each piece of field equipment that is not factory calibrated.

6.3 Laboratory Documentation

6.3.1 Laboratory Project Files

The laboratory will establish a file for all pertinent data. The file will include all correspondence, faxed information, phone logs, and chain of custody forms. The laboratory will retain all project files and data packages for a period of 5 years.

6.3.2 Laboratory Logbooks

Workbooks, bench sheets, instrument logbooks, and instrument printouts will be used to trace the history of samples through the analytical process and document and relate important aspects of the work, including the associated QCs. As such, all logbooks, bench sheets, instrument logs, and instrument printouts will be part of the permanent record of the laboratory.

Each page or entry will be dated and initialed by the analyst at the time of entry. Errors in entry will be crossed out in indelible ink with a single stroke, corrected without the use of whiteout or by obliterating or writing directly over the erroneous entry, and initialed and dated by the individual making the correction. Pages of logbooks that are not used will be completed by lining out unused portions.

Information regarding the sample, analytical procedures performed, and results of testing will be recorded on laboratory forms or personal notebook pages by the analyst. These notes will be dated and will also identify the analyst, the instrument used, and instrument conditions.

Laboratory notebooks will be periodically reviewed by the laboratory group leaders for accuracy, completeness, and compliance to this QAPP. All entries and calculations will be verified by the laboratory group leader. If all entries on the pages are correct, then the laboratory group leader will initial and date the pages. Corrective action will be taken for incorrect entries before the laboratory group leader signs.

6.3.3 Computer Tape and Hard Copy Storage

All electronic files will be maintained on CD-ROM for 5 years; hard copy data packages will be maintained in files for 5 years.

6.4 Field Data Reporting

6.4.1 Field Data Reporting

Information collected in the field through visual observation, manual measurement, and/or field instrumentation will be recorded in field notebooks or data sheets and/or on forms. Such data will be reviewed by the appropriate Task Manager for adherence to the work plan and for consistency. Concerns identified as a result of this review will be discussed with the field personnel, corrected if possible, and, as necessary, incorporated into the data evaluation process.

Where appropriate, field data forms and calculations will be processed and included in appendices to a Site Report (when generated). Original field logs, documents, and data reductions will be kept in the project file.

6.4.2 Laboratory Data Reporting

The laboratory is responsible for preparing ASP Category B data packages for SVOC data, reduced data packages and case narratives may be acceptable for all other analyses; the task-specific work plan should specify laboratory reporting requirements.

All data reports for parameters will include, at a minimum, the following items:

Narrative – Summary of activities that took place during the course of sample analysis, including the following information:

- Laboratory name and address
- Date of sample receipt
- Cross reference of laboratory identification number to consultant's sample identification
- Analytical methods used
- Deviations from specified protocol
- Corrective actions taken

Included with the narrative will be any sample handling documents, including field and internal chain of custody forms, air bills, and shipping tags.

Analytical Results – Reported according to analysis type, including the following information, as acceptable:

- Sample ID
- Laboratory ID
- Date of collection
- Date of receipt
- Date of extraction
- Date of analysis
- Detection limits

Sample results on report forms will be collected for dilutions. Soil samples will be reported on a dry weight basis. Unless otherwise specified, results will be reported uncorrected for blank contamination.

Data for semi-volatile analyses will be expanded to include all supporting documentation necessary to provide a Category B package. This additional documentation will include, but is not limited to, all raw data required to recalculate any result, including printouts, chromatograms, and quantitation reports. The report also will include standards used in calibration and calculation of analytical results; sample extraction, digestion, and other preparation logs; standard preparation logs; instrument run logs; and moisture content calculations.

6.5 Project File

Project documentation will be placed in project files for document management. Project files typically consist of the following components:

1. Agreements/Proposals (filed chronologically)
2. Change Orders/Purchase Orders (filed chronologically)
3. Invoices (filed chronologically)
4. Project Management (filed by topic)
5. Correspondence (filed chronologically)
6. Notes and Data (filed by topic)
7. Public Relations Information (filed by topic)
8. Regulatory Documents (filed chronologically)
9. Marketing Documents (filed chronologically)
10. Final Reports/Presentations (filed chronologically)
11. Draft Reports/Presentations (filed chronologically)
12. Documents Prepared by Others (filed chronologically)

Final reports (including QA Reports) are filed in a designated folder within the project file. Analytical laboratory documentation (when received) and field data will also be filed in a designated folder within the project file. Filed materials may be removed and signed out by authorized personnel on a temporary basis only. Electronic storage of reports in a client folder is also acceptable.

7 SAMPLING PROCESS DESIGN

Information regarding sampling design and rationale and associated sampling locations can be found in the RDWP or other task-specific work plans.

8 SAMPLING METHOD REQUIREMENTS

Soil, sediment, wastewater, and/or groundwater samples will be collected, as necessary, as described in the RDWP. Sampling procedures are included in the FSP. The FSP also contains procedures that will be followed to install monitoring wells; measure water levels; perform field measurements; and handle, package, and ship collected samples.

9 SAMPLE HANDING AND CUSTODY REQUIREMENTS

9.1 Sample Containers and Preservation

Appropriate sample containers, preservation methods, and laboratory holding times for the samples are shown in Table 3.

The analytical laboratory will supply appropriate sample containers and preservatives, as necessary. Containers will be purchased pre-cleaned to USEPA Office of Solid Waste and Emergency Response Directive 9240.05A requirements. The field personnel will be responsible for properly labeling containers and preserving samples (as appropriate).

9.2 Packing, Handling, and Shipping Requirements

Sample packaging and shipment procedures are designed to confirm that samples will arrive at the laboratory, with the chain of custody intact.

Samples will be packaged for shipment as outlined below:

- Confirm that all sample containers have sample labels securely affixed to the container with clear packing tape.
- Check the caps on sample containers to confirm that they are properly sealed.
- Wrap the sample container cap with clear packing tape to prevent it from becoming loose.
- Complete the chain of custody form with required sampling information and confirm that recorded information matches sample labels. (Note: If the designated sampler relinquishes samples to other sampling or field personnel for packing or other purposes, the sampler will complete the chain of custody prior to this transfer. The appropriate personnel will sign and date the chain of custody form to document the sample custody transfer.)
- Using duct tape, secure the outside drain plug at the bottom of the cooler.
- Wrap sample containers in bubble wrap or other cushioning material.
- Place 1 to 2 inches of cushioning material at the bottom of the cooler.
- Ice layer.
- Place the sealed sample containers into the cooler.
- Place ice in plastic bags and seal. Place loosely in the cooler.
- Fill the remaining space in the cooler with cushioning material.
- Place chain of custody forms in a plastic bag and seal. Tape the forms to the inside of the cooler lid.
- Close the lid of the cooler, lock, and secure with duct tape.
- Wrap strapping tape around both ends of the cooler at least twice.

- Mark the cooler on the outside with the following information: shipping address, return address, “Fragile” labels, and arrows indicating “this side up.” Cover the labels with clear plastic tape. Place a signed custody seal over the cooler lid.

All samples will be packaged by field personnel and transported as low-concentration environmental samples. Samples will be hand-delivered or delivered by an express carrier within 48 hours of the time of collection. All shipments will be accompanied by the chain of custody form identifying the contents. The original form will accompany the shipment; copies will be retained by the sampler for the sampling office records. If the samples are sent by common carrier, a bill of lading should be used. Receipts or bills of lading will be retained as part of the permanent project documentation. Commercial carriers are not required to sign off on the chain of custody form, as long as the forms are sealed inside the sample cooler and the custody seals remain intact.

Sample custody seals and packing materials for filled sample containers will be provided by the analytical laboratory. The filled, labeled, and sealed containers will be placed in a cooler on ice and carefully packed to eliminate the possibility of container breakage. Trip blank(s) of analyte-free water will be provided by the laboratory and included in each cooler containing aqueous samples to be analyzed for VOCs.

Procedures for packing, handling, and shipping environmental samples are included in the FSP.

9.3 Field Custody Procedures

The objective of field sample custody is to confirm that samples are not tampered with from the time of sample collection through the time of transport to the analytical laboratory. Persons will have “custody of samples” when the samples are in their physical possession, in their view after being in their possession, or in physical possession and secured so they cannot be tampered with. In addition, when samples are secured in a restricted area accessible only to authorized personnel, they will be deemed to be in the custody of such authorized personnel.

Field custody documentation consists of both field logbooks and field chain of custody forms.

9.3.1 Field Logbooks

Field logbooks will provide the means of recording data collecting activities performed. As such, entries will be described in as much detail as possible so that persons going to the site could reconstruct a particular situation without reliance on memory.

Field logbooks will be bound field survey books or notebooks. Logbooks will be assigned to field personnel, but will be stored in a secure location when not in use. Each logbook will be identified by the project-specific document number. The title page of each logbook will contain the following:

- Person to whom the logbook is assigned
- Logbook number
- Project name
- Project start date

- End date

Entries into the logbook will contain a variety of information. At the beginning of each entry, the date, start time, weather, names of all sampling team members present, level of personal protection being used, and the signature of the person making the entry will be entered. Names of visitors to the site, field sampling or investigation team personnel, and the purpose of their visit will also be recorded in the field logbook.

Measurements made and samples collected will be recorded. All entries will be made in ink, and no erasures will be made. If an incorrect entry is made, information will be crossed out with a single strike mark. Whenever a sample is collected or a measurement is made, a detailed description of the location of the station shall be recorded. The number of the photographs taken of the station, if any, will also be noted. All equipment used to make measurements will be identified, as well as with the date of calibration.

Samples will be collected following sampling procedures documented in the FSP. Equipment used to collect samples will be noted, as well as with the time of sampling, sample description, depth at which the sample was collected, volume, and number of containers. Sample identification numbers will be assigned prior to sample collection. Field duplicate samples, which will receive an entirely separate sample identification number, will be noted under sample description.

9.3.2 Sample Labelling

Preprinted sample labels will be affixed to sample bottles prior to delivery at the sampling site. The following information is required in each sample label.

- Project
- Date collected
- Time collected
- Location
- Sampler
- Analysis to be performed
- Preservative
- Sample number

9.3.3 Field Chain of Custody Forms

Completed chain of custody forms will be required for all samples to be analyzed. Chain of custody forms will be initiated by the sampling crew in the field. The chain of custody forms will contain the sample's unique identification number, sample date and time, sample description, sample type, preservation (if any), and analyses required. The original chain of custody form will accompany the samples to the laboratory. Copies of the chain of custody will be made prior to shipment (or multiple copy forms used) for field documentation. The chain of custody forms will remain with the samples at all times. The

samples and signed chain of custody forms will remain in the possession of the sampling crew until the samples are delivered to the express carrier (e.g., FedEx) or hand delivered to a mobile or permanent laboratory, or placed in secure storage.

Sample labels will be completed for each sample using waterproof ink, unless prohibited by weather conditions. The labels will include sample information, such as sample number and location, type of sample, date and time of sampling, sampler's name or initials, preservation, and analyses to be performed. The completed sample labels will be affixed to each sample bottle and covered with clear tape.

Whenever samples are collocated with a source or government agency, a separate Sample Receipt will be prepared for those samples and marked to indicate with whom the samples are being collocated. The person relinquishing the samples to the facility or agency should request the representative's signature, acknowledging sample receipt. If the representative is unavailable or refuses, this is noted in the "Received By" space.

9.4 Management of Investigation-Derived Materials and Wastes

Disposable equipment, debris, and decontamination rinsate (e.g., tap and distilled water containing small amounts of solvent) will be containerized during the sampling events and labeled for appropriate disposal.

9.5 Laboratory Procedures

9.5.1 General

Upon sample receipt, laboratory personnel will be responsible for sample custody. A field chain of custody form will accompany all samples requiring laboratory analysis. Samples will be kept secured in the laboratory until all stages of analysis are complete. All laboratory personnel having samples in their custody will be responsible for maintaining sample integrity.

9.5.2 Sample Receipt and Storage

Upon sample receipt, the laboratory sample custodian will verify the package seal, open the package, verify the sample integrity, and compare the contents against the field chain of custody. If a sample container is broken, the sample is in an inappropriate container, has not been preserved by appropriate means, or if there is a discrepancy between the chain of custody and the sample shipment, Arcadis will be notified. The laboratory sample custodian will then log the samples in, assign a unique laboratory identification number to each, and label the sample bottle with the laboratory identification number. The project name, field sample code, date sampled, date received, analysis required, storage location and date, and action for final disposition will be recorded in the laboratory information management system. If the sample container is broken, the sample is in an inappropriate container, or has not been preserved by appropriate means, Arcadis will be notified.

9.5.3 Sample Chain of Custody and Documentation

Laboratory chain of custody and documentation will follow procedures consistent with Exhibit F of the NYSDEC ASP 2005.

9.5.4 Sample Analysis

Analysis of an acceptable sample will be initiated by worksheets that contain all pertinent information for analysis. The analyst will sign and date the laboratory chain of custody form when removing the samples from storage.

Samples will be organized into sample delivery groups (SDGs) by the laboratory. An SDG may contain up to 20 field samples (field duplicates, trip blanks, and rinse blanks are considered field samples for the purposes of SDG assignment). All field samples assigned to a single SDG shall be received by the laboratory over a maximum of 7 calendar days, and must be processed through the laboratory (preparation, analysis, and reporting) as a group. Every SDG must include a minimum of one site-specific matrix/matrix spike duplicate (MS/MSD) pair, which shall be received by the laboratory at the start of the SDG assignment.

Each SDG will be self-contained for all of the required QC samples. All parameters within an SDG will be extracted and analyzed together in the laboratory. At no time will the laboratory be allowed to run any sample (including QC samples) at an earlier or later time than the rest of the SDG. These rules for analysis will confirm that the QC samples for an SDG are applicable to the field samples of the same SDG and that the best possible comparisons can be made.

9.5.5 Sample Storage Following Analysis

Remaining material from the samples will be maintained by the laboratory for 1 month after the final report is delivered to Arcadis. After this period, all sample material will be disposed of in accordance with applicable rules and regulations.

10 ANALYTICAL PROCEDURES

10.1 Field Analytical Procedures

Field analytical procedures may include measurement of pH, ORP, turbidity, temperature, conductivity, dissolved oxygen, and groundwater levels. Specific field measurement protocols are provided in the FSP.

10.2 Laboratory Analytical Procedures

Laboratory analytical requirements presented in the subsections below include a general summary of requirements, specifics related to each sample medium that may be analyzed, and details of the methods to be used for this project. SW-846 methods with NYSDEC, ASP, 2005 Revision, QA/QC and reporting deliverables requirements will be used for all analytes.

10.2.1 General

The following tables summarize general analytical requirements:

Table	Title
Table 1	Parameters, Methods, and Quantitation Limits
Table 2	Environmental and Quality Control Samples Analyses
Table 3	Sample Containers, Preservation Methods, and Holding Times Requirements

10.2.2 Sample Metrics

10.2.2.1 Soil

Analyses in this category will relate to soil samples. Analyses will be performed following the methods listed in **Table 2**. Results will be reported as dry weight, in units presented in **Table 1**. Moisture content will be reported separately.

10.2.3 Analytical Requirements

Primary sources to describe analytical methods to be used during OM&M or field sampling are provided in USEPA SW-846 Test Methods for Evaluating Solid Waste, Third Edition and USEPA Methods for Chemical Analysis of Water and Waste with NYSDEC ASP 2005 Revision, QA/QC and reporting deliverables requirements. Detailed information regarding QC procedures, including MS/MSDs, MS blanks, and surrogate recoveries is provided in NYSDEC, ASP 2005 Revision, Exhibit E.

11 QUALITY CONTROL REQUIREMENTS

11.1 Quality Assurance Indicators

The overall QA objective for this QAPP is to develop and implement procedures for sampling, chain of custody, laboratory analysis, instrument calibration, data reduction and reporting, internal QC, audits, preventive maintenance, and corrective action such that valid data will be generated. These procedures are presented or referenced in the following sections of the QAPP. Specific QC checks are discussed in Section 10.3.

QA indicators are generally defined in terms of five parameters:

1. Representativeness
2. Comparability
3. Completeness
4. Precision
5. Accuracy

Each parameter is defined below. Specific objectives for the site actions are set forth in other sections of this QAPP, as referenced below.

11.1.1 Representativeness

Representativeness is the degree to which sampling data accurately and precisely represent site conditions, and is dependent on sampling and analytical variability. Field sampling activities have been designed to assess the presence of constituents at the time of sampling. The FSP and this QAPP present field sampling methodologies and laboratory analytical methodologies. The use of the prescribed field and laboratory analytical methods with associated holding times and preservation requirements are intended to provide representative data.

11.1.2 Comparability

Comparability is the degree of confidence with which one data set can be compared to another. Comparability between field investigation data, to the extent possible, with existing data will be maintained through consistent sampling and analytical methodology set forth in the FSP and this QAPP, SW-846 analytical methods with NYSDEC ASP Revision 2005 QA/QC requirements and Category B reporting deliverables, and through use of QA/QC procedures and appropriately trained personnel.

11.1.3 Completeness

Completeness is defined as a measure of the amount of valid data obtained from an event and/or investigation compared to the amount that was expected to be obtained under normal conditions. This will be determined upon assessment of the analytical results, as discussed in Section 10.6.

11.1.4 Precision

Precision is the measure of reproducibility of sample results. The goal is to maintain a level of analytical precision consistent with project objectives. To maximize precision, sampling and analytical procedures will be followed. Checks for analytical precision will include analysis of MSDs, laboratory duplicates, and field duplicates. Checks for field measurement precision will include obtaining duplicate field measurements. Further discussion of precision QC checks is provided in Section 11.2.

11.1.5 Accuracy

Accuracy is the deviation of a measurement from the true value of a known standard. Both field and analytical accuracy will be monitored through initial and continuing calibration of instruments. In addition, internal standards, MS, blank spikes, and surrogates (system monitoring compounds) will be used to assess the accuracy of the laboratory analytical data. Further discussion of these QC samples is provided in Section 10.5.

11.2 Field Quality Control Checks

11.2.1 Field Measurements

To verify quality of data using field instrumentation, duplicate measurements will be obtained and reported for all field analytical measurements.

11.2.2 Sample Containers

Certified, clean sample containers in accordance with Exhibit I of the NYSDEC ASP Revision 2005 (Eagle Picher pre-cleaned containers or equivalent) will be supplied by the laboratory.

11.2.3 Field Duplicates

Field duplicates will be collected for groundwater and soil samples to check reproducibility of sampling methods. Field duplicates will be prepared as discussed in the FSP. In general, soil and groundwater sample field duplicates will be analyzed at a 5 percent frequency (every 20 samples). **Table 2** provides an estimated number of field duplicates for each applicable parameter and matrix.

11.2.4 Rinse Blanks

Rinse blanks are used to monitor cleanliness of sampling equipment and effectiveness of cleaning procedures. Rinse blanks will be prepared and submitted for analysis at a frequency of 1 per day (when sample equipment cleaning occurs) or once for every 20 samples collected, whichever is less. Rinse blanks will be prepared by filling sample containers with analyte-free water (supplied by the laboratory), which has been routed through a cleaned sampling device. When dedicated sampling devices are used or sample containers are used to collect the samples, rinse blanks will not be necessary. **Table 2** provides an estimated number of rinse blanks collected during the investigation activities.

11.2.5 Trip Blanks

Trip blanks will be used to assess whether site samples have been exposed to non-site-related volatile constituents during storage and transport. Trip blanks will be analyzed at a frequency of once per day, per cooler containing groundwater samples to be analyzed for VOCs. A trip blank will consist of a container filled with analyte-free water (supplied by the laboratory), which remains unopened with field samples throughout the sampling event. Trip blanks will only be analyzed for aqueous VOCs. **Table 2** provides an estimated number of trip blanks collected for each matrix and parameter during the investigation activities.

11.3 Analytical Laboratory Quality Control Checks

Internal QC procedures are specified in the analytical methods. These specifications include the types of QC checks required (method blanks, reagent/preparation blanks, MS/MSDs, calibration standards, internal standards, surrogate standards, the specific calibration check standards, laboratory duplicate/replicate analysis), compounds and concentrations to be used, and the QC acceptance criteria.

11.3.1 Method Blanks

Method blanks will serve as a measure of contamination attributable to a variety of sources, including glassware, reagents, and instrumentation. The method blank will be initiated at the beginning of an analytical procedure and is carried through the entire process.

11.3.2 Matrix Spike/Matrix Spike Duplicates

The MS will serve as a measure of method accuracy in a given matrix. The MS and the MSDs together will serve as a measure of method precision.

11.3.3 Surrogate Spikes

Surrogate spikes are organic compounds that have similar properties to those being tested. They will serve as indicators of method performance and accuracy in organic analyses.

11.3.4 Laboratory Duplicates

Laboratory duplicates will serve to measure method precision in inorganic and supplemental analyses.

11.3.5 Calibration Standards

Calibration check standards analyzed within a particular analytical series provide insight regarding the instruments' stability. A calibration check standard will be analyzed at the beginning and end of an analytical series, or periodically throughout a series containing a large number of samples.

In general, calibration check standards will be analyzed after every 12 hours or more frequently, as specified in the applicable analytical method. In analyses where internal standards are used, a calibration check standard will only be analyzed in the beginning of an analytical series. If results of the calibration

check standard exceed specified tolerances, then all samples analyzed since the last acceptable calibration check standard will be reanalyzed.

Laboratory instrument calibration standards will be selected utilizing guidance provided in the analytical methods, as summarized in Section 12.

11.3.6 Internal Standards

Internal standard areas and retention times will be monitored for organic analyses performed by gas chromatograph/mass spectrometer methods. Method-specified internal standard compounds will be spiked into all field samples, calibration standards, and QC samples after preparation and prior to analysis. If internal standard areas in one or more samples exceed the specified tolerances, then cause will be investigated, the instrument will be recalibrated, if necessary, and all affected samples will be reanalyzed.

The acceptability of internal standard performance will be determined using the guidance provided within the analytical methods.

11.3.7 Reference Standards/Control Samples

Reference standards are standards of known concentration and independent in origin from calibration standards. The intent of reference standard analysis is to provide insight into analytical proficiency within an analytical series. This includes preparation of calibration standards, validity of calibration, sample preparation, instrument set up, and premises inherent in quantitation. Reference standards will be analyzed at frequencies specified within the analytical methods.

11.4 Data Precision Assessment Procedures

Field precision is difficult to measure because of temporal variations in field parameters. However, precision will be controlled through use of experienced field personnel, properly calibrated meters, and duplicate field measurements. Field duplicates will be used to assess precision for the entire measurement system, including sampling, handling, shipping, storage, preparation, and analysis.

Laboratory data precision for organic analyses will be monitored through use of MSDs, laboratory duplicate, and field duplicates as identified in **Table 2**.

Precision of data will be measured by calculation of the relative percent differences (RPDs) of duplicate sample sets.

The RPD can be calculated by the following equation:

$$RPD = \frac{(A-B)}{(A+B)/2} \times 100$$

Where:

A = analytical result from one of two duplicate measurements

B = analytical result from the second measurement

Precision objectives for MSD and laboratory duplicate analyses are identified in the NYSDEC ASP Revision 2005.

11.5 Data Accuracy Assessment Procedures

Accuracy of field measurements will be controlled by experienced field personnel, properly calibrated field meters, and adherence to established protocols. Accuracy of field meters will be assessed by review of calibration and maintenance logs.

Laboratory accuracy will be assessed via use of MS, surrogate spikes, and internal standards. Where available and appropriate, QA performance standards will be analyzed periodically to assess laboratory accuracy. Accuracy will be calculated as a percent recovery as follows:

$$\text{Accuracy} = \frac{A-X}{B} \times 100$$

Where:

A = value measured in spiked sample or standard

X = value measured in original sample

B = true value of amount added to sample or true value of standard

This formula is derived under the assumption of constant accuracy over original and spiked measurements. If any accuracy calculated by this formula is outside of acceptable levels, data will be evaluated to determine whether the deviation represents unacceptable accuracy, or variable, but acceptable accuracy. Accuracy objectives for MS recoveries and surrogate recovery objectives are identified in the NYSDEC ASP, 2005 Revision.

11.6 Data Completeness Assessment Procedures

Completeness of a field or laboratory data set will be calculated by comparing the number of samples collected or analyzed to the proposed number.

$$\text{Completeness} = \frac{\text{No. Valid Samples Collected or Analyzed}}{\text{No. Proposed Samples Collected or Analyzed}} \times 100$$

As general guidelines, overall project completeness is expected to be at least 90 percent. Assessment of completeness will require professional judgment to determine data usability for intended purposes.

12 INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE REQUIREMENTS

Preventive maintenance schedules have been developed for both field and laboratory instruments. A summary of maintenance activities to be performed is presented below.

12.1 Field Instruments and Equipment

Prior to any field sampling, each piece of field equipment will be inspected to confirm that it is operational. If equipment is not operational, it must be serviced prior to use. All meters that require charging or batteries will be fully charged or have fresh batteries. If instrument servicing is required, it is the responsibility of the field Task Manager to follow the maintenance schedule and arrange for prompt service.

Field instrumentation that may be used during field activities includes meters to measure pH, ORP, turbidity, temperature, conductivity, dissolved oxygen, and groundwater levels. Field equipment also includes sampling devices for groundwater. A logbook will be kept for each field instrument. Each logbook contains records of operation, maintenance, calibration, and any problems and repairs. The field Task Manager will review calibration and maintenance logs.

Field equipment returned from a site will be inspected to confirm it is in working order. This inspection will be recorded in the logbook or field notebooks as appropriate. It will also be the obligation of the last user to record any equipment problems in the logbook.

12.2 Laboratory Instruments and Equipment

12.2.1 General

Only qualified personnel will service instruments and equipment. Repairs, adjustments, and calibrations are documented in the appropriate logbook or data sheet.

12.2.2 Instrument Maintenance

Preventive maintenance of laboratory equipment will follow the guidelines recommended by the manufacturer. A malfunctioning instrument will be repaired by in-house staff or through a service call by the manufacturer, as appropriate.

The laboratory will maintain a sufficient supply of spare parts for its instruments to minimize downtime. Whenever possible, backup instrumentation will be retained.

Whenever practical, analytical equipment will be maintained under a service contract. The contract allows for preventative system maintenance and repair on an “as-needed” basis. The laboratory has sufficiently trained staff to allow for the day-to-day maintenance of equipment.

12.2.3 Equipment Monitoring

On a daily basis, operation of balances, incubators, ovens, refrigerators, and water purification systems will be checked and documented. Any discrepancies will be immediately reported to the appropriate laboratory personnel for resolution.

13 INSTRUMENT CALIBRATION AND FREQUENCY

13.1 Field Instrument Calibration Procedures and Frequency

Specific procedures for performing and documenting calibration and maintenance for equipment measuring conductivity, temperature, pH, groundwater levels, and surface-water levels are provided in the FSP. Calibration checks will be performed daily when measuring pH, ORP, turbidity, temperature, conductivity, and dissolved oxygen. Field equipment operation, calibration, and maintenance procedures are provided in the FSP.

13.2 Laboratory Equipment Calibration Procedures and Frequency

Instrument calibration will follow the specifications provided by the instrument manufacturer or specific analytical method used. The analytical methods for target constituents are identified separately below.

Semivolatile Organics

Equipment calibration procedures will follow guidelines presented in NYSDEC ASP 2005 Revision, Exhibit D, specific methodology.

Supplemental Parameters

If required, additional parameters will be calibrated according to their respective methods, following the guidance presented in NYSDEC ASP 2005, Exhibit D.

14 INSPECTION/ACCEPTANCE REQUIREMENTS FOR SUPPLIES AND CONSUMABLES

The laboratory shall inspect/test all supplies and consumables prior to use with samples. Documentation shall be maintained for all associated testing and analyses.

15 DATA MANAGEMENT

The purpose of data management is to confirm that all necessary data are accurate and readily accessible to meet analytical and reporting objectives of the project. Field activities will generate a large number of samples and analytes. From the large amount of resulting data, the need arises for a structured, comprehensive, and efficient program for management of data.

The data management program established for the site includes field documentation and sample QA/QC procedures, methods for tracking and managing the data, and a system for filing all site-related information. More specifically, data management procedures will be employed to efficiently process information collected such that data are readily accessible and accurate. These procedures are described in detail in the following section.

The data management plan has five elements:

1. Sample Designation System
2. Field Activities
3. Sample Tracking and Management
4. Data Management System
5. Document Control and Inventory

15.1 Sample Designation System

A concise and easily understandable sample designation system is an important part of the project sampling activities. It provides a unique sample number that will facilitate both sample tracking and easy resampling of select locations to evaluate data gaps, if necessary. The sample designation system to be employed during the sampling activities will be consistent, yet flexible enough to accommodate unforeseen sampling events or conditions. A combination of letters and numbers will be used to yield a unique sample number for each field sample collected.

15.2 Field Activities

OM&M activities designed to gather information necessary to make decisions require consistent documentation and accurate record keeping. During site activities, standardized procedures will be used for documentation of field activities, data security, and QA. These procedures are described in further detail in the following subsections.

15.2.1 Field Documentation

Complete and accurate record keeping is a critical component of field activities. When interpreting analytical results and identifying data trends, investigators realize that field notes are an important part of the review and validation process. To confirm that all aspects of the field investigation are thoroughly

documented, several different information records, each with its own specific reporting requirements, will be maintained, including:

- Field logs
- Instrument calibration records
- Chain-of-custody forms

A description of each of these types of field documentation is provided below.

Field Logs

The personnel performing field activities will keep field logs that detail all observations and measurements made during field activities. Data will be recorded directly into site-dedicated, bound notebooks, with each entry dated and signed. To confirm at any future date that notebook pages are not missing, each page will be sequentially numbered. Erroneous entries will be corrected by crossing out the original entry, initialing it, and then documenting the proper information.

Instrument Calibration Records

As part of data quality assurance procedures, field monitoring and detection equipment will be routinely calibrated. Instrument calibration confirms that equipment used is of the proper type, range, accuracy, and precision to provide data compatible with the specified requirements and desired results. Calibration procedures for the various types of field instrumentation are described in Section 12. To demonstrate that established calibration procedures have been followed, calibration records will be prepared and maintained to include, as appropriate, the following:

- Calibration date and time
- Type and identification number of equipment
- Calibration frequency and acceptable tolerances
- Identification of individual(s) performing calibration
- Reference standards used
- Calibration data
- Information on calibration success or failure

The calibration record will serve as a written account of monitoring or detection equipment QA. All erratic behavior or failures of field equipment will be subsequently recorded in the calibration log.

Chain of Custody Forms

Chain of custody forms are used as a means of documenting and tracking sample possession from time of collection to the time of disposal. A chain of custody form will accompany each field sample collected, and one copy of the form will be filed in the field office. Field personnel will be briefed on the proper use of the chain of custody procedure. A more thorough description of the chain of custody forms is located in the Standard Operating Procedures.

15.2.2 Data Security

Measures will be taken during the field investigation to confirm samples and records are not lost, damaged, or altered. When not in use, all field notebooks will be stored at the field office in a locked, fireproof cabinet. Access to these files will be limited to the field personnel who utilize them.

15.3 Sample Management and Training

A record of all field documentation, as well as analytical and QA/QC results, will be maintained to confirm validity of data used in the site analysis. To effectively execute such documentation, carefully constructed sample tracking and data management procedures will be used throughout the sampling program.

Sample tracking will begin with the completion of chain of custody forms, as described in Section 9.3. On a daily basis, the completed chain of custody forms associated with samples collected that day will be faxed from the project office to the QA Manager. Copies of all completed chain of custody forms will be maintained in the field office. On the following day, the QA Manager will telephone the laboratory to verify receipt of samples.

When analytical data are received from the laboratory, the QA Manager will review the incoming analytical data packages against information on the chains of custody to confirm that the correct analyses were performed for each sample and results for all samples submitted for analysis were received. Any discrepancies noted will be promptly followed-up by the QA Manager.

15.4 Data Management System

In addition to the sample tracking system, a data management system may be implemented. The central focus of the data management system will be the development of a personal computer-based project database. The project database, to be maintained by the Database Administrator, will combine pertinent geographical, field, and analytical data.

15.4.1 Computer Hardware

If required, the database will be constructed on Pentium®-based personal computer work stations connected through a network server (or similar). The network will provide access to various hardware peripherals, such as, but not limited to, printers, backup storage devices, image scanners, and modems. Computer hardware will be maintained to industrial and corporate standards.

15.4.2 Field Observations

An important part of the information that will ultimately reside in the data management system for use during the project will originate in the observations that are recorded in the field.

Following each sampling event, a data entry may be prepared by the field personnel who performed the sampling activities. The purpose of the data entry is to present a summary and a record of the sampling event. Topics to be discussed include the locations sampled, the sampling methodologies used, QA/QC procedures, blind duplicate and MS/MSD sample identification numbers, equipment decontamination procedures, personnel involved in the activity, and any other noteworthy events that occurred.

Tables are typically attached to the data entry, as required, and are used to summarize measurements that were recorded in field books. It is anticipated that these tables will be developed using a personal computer spreadsheet program to reduce possible transcription error and to facilitate the transfer of information to the data management system.

Status memos, if required, are valuable tools to keep project personnel informed on the details of the field activities and are also invaluable during the development of the final report. Each status memo will be reviewed for accuracy and completeness by the respective sampling activity manager. Following the approval and finalization of each memo, the status memo will be used to transfer field observations into the data management system.

All pertinent field data will be manually entered into the appropriate database tables from the chain of custody forms and field notebooks.

15.4.3 Analytical Results

Analytical results provided by the laboratory will be available in both a digital and a hard copy format. Upon receipt of each analytical package, the original chain of custody form will be placed in the project files. Data packages will be examined to confirm that the correct analyses were performed for each sample submitted and that all of the analyses requested on the chain of custody form were performed. If discrepancies are noted, the laboratory will be notified and will promptly resolve any issues.

Where appropriate, data packages will be validated in accordance with procedures presented in Section 18. Any data that does not meet the specified standards will be flagged pending resolution of the issue. The flag will not be removed from the data until the issue associated with the sample results is resolved. Although flags may remain for certain data, the use of that data may not necessarily be restricted.

Following completion of the data validation (if necessary), the digital files of analytical data will be processed to populate the appropriate database tables. Specific fields include:

- Sample identification number
- Date sampled
- Date analyzed
- Parameter name
- Analytical result
- Units
- Detection limit
- Qualifier(s)

Individual electronic data deliverables (EDDs) supplied by the laboratory in a Microsoft Excel worksheet, will be loaded into the appropriate database table. Any analytical data that cannot be provided by the laboratory in electronic format will be entered manually.

After entry into the database, the EDD data will be compared to field information previously entered into the database to confirm that all requested analytical data have been received.

15.4.4 Data Analysis and Reporting

The database management system will have several functions to facilitate review and analysis of the data. Data entry screens will be developed to assist in keypunching of field observations. Routines will also be developed to permit the user to scan analytical data from a given site for a given media.

A valuable function of the data management system will be generation of tables of analytical results from the project databases. The capability of the data management system to directly produce tables reduces redundant manual entry of analytical results during report preparation and precludes transcription errors that may occur otherwise. Tables of analytical data will be produced as part of data interpretation tasks and the reporting of data.

Another function of the data management system will be to create digital files of analytical results and qualifiers suitable for transfer to mapping/presentation software. This routine greatly reduces the redundant keypunching of analytical results and facilitates the efficient production of interpretative and presentation graphics.

15.5 Document Control and Inventory

Arcadis maintains project files in its Syracuse, New York office. Each client project is assigned a file/job number (e.g., for the remedial activities, 130.42). Each file is then broken down into the following sub-files:

1. Agreements/Proposals
2. Change Orders/Purchase Orders
3. Invoices
4. Project Management
5. Correspondence
6. Notes and Data
7. Public Relations Information
8. Regulatory Documents
9. Marketing Documents
10. Final Reports/Presentations
11. Draft Reports/Presentations
12. Documents Prepared by Others

Originals, when possible, are placed in these central files.

16 ASSESSMENT AND RESPONSE ACTIONS

Performance and systems audits will be completed in the field and the laboratory, as described below.

16.1 Field Audits

The following field performance and systems audits will be completed.

16.1.1 Performance Audits

The Task Manager will monitor field performance, as appropriate. Field performance summaries will contain field measurements and field meter calibrations to verify that measurements are taken according to established protocols. The project QA Manager will review all field reports and communicate concerns to the Project Manager and/or Task Managers, as appropriate. In addition, the QA Manager will review the rinse and trip blank data to identify potential deficiencies in field sampling and cleaning procedures.

16.1.2 Internal Systems Audits

A field internal systems audit is a qualitative evaluation of all components of field QA/QC. The systems audit compares scheduled QA/QC activities from this document with actual QA/QC activities completed. The appropriate QA Manager will periodically confirm that work is being performed consistent with the RDWP, FSP, and HASP.

16.2 Laboratory Audits

The laboratory will perform internal audits consistent with NYSDEC ASP, 2005 Revision, Exhibit E.

In addition to the laboratory's internal audits and participation in state and federal certification programs, the laboratory sections at the laboratory are audited by representatives of the regulatory agency issuing certification. Audits are usually conducted on an annual basis and focus on laboratory conformance to the specific program protocols for which the laboratory is seeking certification. The auditor reviews sample handling and tracking documentation, analytical methodologies, analytical supportive documentation, and final reports. The audit findings are formally documented and submitted to the laboratory for corrective action, if necessary.

NYSEG reserves the right to conduct an on-site audit of the laboratory prior to the start of analyses for the project. Additional audits may be performed during the course of the project, as deemed necessary.

16.3 Corrective Action

Corrective actions are required when field or analytical data are not within objectives specified in this QAPP or the FSP. Corrective actions include procedures to promptly investigate, document, evaluate, and correct data collection and/or analytical procedures. Field and laboratory corrective action procedures are described below.

16.3.1 Field Procedures

When conducting field work, if a condition is noted that would have an adverse effect on data quality, corrective action will be taken so as not to repeat this condition. Condition identification, cause, and corrective action implemented will be documented on a Corrective Action Report Form and reported to the appropriate Project Manager and Task Manager.

Examples of situations that would require corrective actions are provided below:

1. Protocols, as defined by this QAPP or the FSP have not been followed.
2. Equipment is not in proper working order or properly calibrated.
3. QC requirements have not been met.
4. Issues resulting from performance or systems audits.

Project personnel will continuously monitor ongoing work performance in the normal course of daily responsibilities.

16.3.2 Laboratory Procedures

In the laboratory, when a condition is noted to have an adverse effect on data quality, corrective action will be taken so as not to repeat this condition. Condition identification, cause, and corrective action to be taken will be documented and reported to the appropriate Project Manager and Task Manager.

Corrective action may be initiated, at a minimum, under the following conditions:

1. Specific laboratory analytical protocols have not been followed.
2. Predetermined data acceptance standards are not obtained.
3. Equipment is not in proper working order or calibrated.
4. Sample and test results are not completely traceable.
5. QC requirements have not been met.
6. Issues resulting from performance or systems audits.

Laboratory personnel will continuously monitor ongoing work performance in the normal course of daily responsibilities.

17 REPORTS TO MANAGEMENT

17.1 Internal Reporting

The analytical laboratory will submit analytical reports to the Contractor for review. If required, the Contractor, or Arcadis will, in turn, submit the reports to the data validator for review. The QA Manager will incorporate results of the data validation reports (if required) and assessments of data usability into a summary report (if required) that will be submitted to the Project Manager. If required, this summary report will be filed in the project file and will include the following:

1. Assessment of data accuracy, precision, and completeness for both field and laboratory data.
2. Results of the performance and systems audits.
3. Significant QA/QC problems, solutions, corrections, and potential consequences.
4. Analytical data validation report.

17.2 Reporting

Upon sample transport to the laboratory, a copy of the chain of custody will be forwarded to NYSEG. Upon receipt of the data package from the laboratory, the QA Manager will determine if the data package has met the required DQOs. The analytical data package will be submitted to NYSEG's Project Manager and will also be incorporated into required reports.

18 DATA REVIEW, VALIDATION, AND VERIFICATION

After field and laboratory data are obtained, these data may be subject to:

1. Validation of the data.
2. Reduction or manipulation of the data mathematically or otherwise into meaningful and useful forms.
3. Organization, interpretation, and reporting of the data.

18.1 Field Data Reduction, Validation, and Reporting

18.1.1 Field Data Reduction

Information that is collected in the field through visual observation, manual measurement, and/or field instrumentation will be recorded in field notebooks, log sheets, and/or other appropriate forms. Such data will be reviewed by the appropriate Task Manager for adherence to the work plan and consistency of data. Any concerns identified as a result of this review will be discussed with the field personnel, corrected if possible, and, as necessary, incorporated into the data evaluation process.

18.1.2 Field Data Validation

Field data calculations, transfers, and interpretations will be conducted by the field personnel and reviewed for accuracy by the appropriate Task Manager and the QA Manager. Task Managers will recalculate at least 5 percent of all data reductions. Field documentation and data reduction prepared by field personnel will be reviewed by the QA Manager. All logs and documents will be checked for:

4. General completeness.
5. Readability.
6. Usage of appropriate procedures.
7. Appropriate instrument calibration and maintenance.
8. Reasonableness in comparison to present and past data collected.
9. Correct sample locations.
10. Correct calculations and interpretations.

18.1.3 Field Data Reporting

Where appropriate, field data forms and calculations will be processed and included in appendices to the reports. The original field logs, documents, and data reductions will be kept in the project file.

18.2 Laboratory Data Reduction, Review, and Reporting

18.2.1 Laboratory Data Reduction

Laboratory analytical data will be directly transferred from the instrument to the computer or the data reporting form (as applicable). Calculation of sample concentrations will be performed using the appropriate regression analysis program, response factors, and dilution factors (where applicable).

18.2.2 Laboratory Data Review

All data will be subject to multi-level review by the laboratory. The group leader will review all data reports prior to release for final data report generation, and the laboratory director will review a cross section of the final data reports. All final data reports are reviewed by the laboratory QA Manager prior to shipment.

If discrepancies or deficiencies exist in the analytical results, then corrective action will be taken, as discussed in Section 16.3. Deficiencies discovered as a result of internal data review, as well as the corrective actions to be used to rectify the situation, will be documented on a Corrective Action Form. This form will be submitted to the Project Manager.

19 VALIDATION AND VERIFICATION METHODS

Data validation entails a review of QC data and raw data to verify that the laboratory was operating within required limits, analytical results are correctly transcribed from the instrument, and which, if any, environmental samples are related to any out-of-control QC samples. The objective of data validation is to identify any questionable or invalid laboratory measurements.

If required, data validation will consist of data screening, checking, reviewing, editing, and interpreting to document analytical data quality and determine if the quality is sufficient to meet the DQOs. The data validation will also include a review of completeness and compliance, including the elements provided in Table 4.

The data validator will use the most recent versions of the USEPA functional guidelines for data validation with NYSDEC ASP 2005 Revision, QA/QC and reporting deliverables requirements available at the time of project initiation and for the entire duration of the project, as guidance, where appropriate.

The data validator will verify reduction of laboratory measurements and laboratory reporting of analytical parameters are in accordance with the procedures specified for each analytical method (i.e., perform laboratory calculations in accordance with the method-specific procedure).

If required, upon receipt of the laboratory data, the following reduction, validation, and reporting scheme will be executed by the data validator:

1. Laboratory data will be screened to confirm that necessary QC procedures (e.g., detection limit verification, initial calibration, continuing calibration, duplicates, spikes, blanks) have been performed. QC information not included or of insufficient frequency will be identified in the validation report, including a discussion of the implications.
2. QC supporting information will subsequently be screened to identify QC data outside established control limits. If out-of-control data are discovered, documentation of appropriate corrective action will be reviewed. Out-of-control data without appropriate corrective action shall result in designation of the affected data as qualified or rejected, as appropriate.

   It should be noted that the existence of qualified results does not automatically invalidate data. This point is repeatedly emphasized in the USEPA functional guidelines for data validation and is inherently acknowledged by the very existence of the data validation/flagging guidelines. The goal to produce the best possible data does not necessarily mean producing data without QC qualifiers. Qualified data can provide useful information.

Resolution of any issues regarding laboratory performance or deliverables will be handled between the data validator, laboratory Project Manager, and the Contractor's Project Manager.

Upon completion of the data validation (if required), a data usability summary report addressing the following topics will be prepared.

1. Assessment of the data package.
2. Description of any protocol deviations.
3. Failures to reconcile reported and/or raw data.

4. Assessment of any compromised data.
5. Laboratory case narrative.
6. Overall appraisal of the analytical data.
7. Table of site name, sample quantities, data submitted to the laboratory, year of protocol used, matrix, and fractions analyzed.

20 RECONCILIATION WITH USER REQUIREMENTS

Data results will be examined to determine the performance that was achieved for each data usability criteria. The performance will then be compared with the project objectives. Of particular note will be samples at or near action levels. All deviations from objectives will be noted. Additional action may be warranted when performance does not meet performance objectives for critical data. Action options may include any or all of the following:

- Retrieval of missing information.
- Request for additional explanation or clarification.
- Reanalysis of sample from extract (when appropriate).
- Recalculation or reinterpretation of results by the laboratory.

These actions may improve data quality, reduce uncertainty, and may eliminate the need to qualify or reject data.

If these actions do not improve data quality to an acceptable level, the following actions may be taken:

- Extrapolation of missing data from existing data points.
- Use of historical data.
- Evaluation of the critical/noncritical nature of the sample.

If the data gap cannot be resolved by these actions, an evaluation of the data bias and potential for false negatives and positives can be performed. If the resultant uncertainty level is unacceptable, then the following action must be taken:

- Additional sample collection and analysis.

21 REFERENCES

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TABLES

Table 1
Parameter, Methods, and Quantitation Limits

Quality Assurance Project Plan
NYSEG
Newark Former MGP Site

Parameter	Quantitation Limit[1]	
Volatile Organics Method 8260	**Water (µg/L)**	**Soil (µg/kg)[2]**
Chloromethane	5	5
Bromomethane	5	5
Vinyl Chloride	5	5
Chloroethane	5	5
Methylene Chloride	3	3
Acetone	5	5
Carbon Disulfide	5	5
1,1-Dichloroethylene	5	5
1,1-Dichloroethane	5	5
1,2-Dichloroethylene (total)	5	5
Chloroform	5	5
1,2-Dichloroethane	2	2
2-Butanone	5	5
1,1,1-Trichloroethane	5	5
Carbon Tetrachloride	2	2
Bromodichloromethane	1	1
1,2-Dichloropropane	1	1
cis-1,3-Dichloropropene	5	5
Trichloroethane	5	5
Dibromochloromethane	5	5
1,1,2-Trichloroethane	3	3
Benzene	1	1
trans-1,3-Dichloropropene	5	5
Bromoform	4	4
4-Methyl-2-pentanone	5	5
2-Hexanone	5	5
Tetrachloroethene	1	1
Toluene	5	5
1,1,2,2-Tetrachloroethane	1	1
Chlorobenzene	5	5
Ethylbenzene	4	4
Styrene	5	5
2-Chloroethyl Vinyl Ether	5	5
1,2-Dichlorobenzene	5	5
1,3-Dichlorobenzene	5	5
1,4-Dichlorobenzene	5	5
Vinyl Acetate	5	5
Total Xylenes	5	5
Semivolatile Organics Method 8270	**Water (µg/L)**	**Soil (µg/kg)**
1,2,4-Trichlorobenzene	5	33
1,2-Dichlorobenzene	10	330
1,2-Diphenylhydrazine	10	330
1,3-Dichlorobenzene	10	330
1,4-Dichlorobenzene	10	330
1,4-Dioxane	10	330
2,4,5-Trichlorophenol	10	330
2,4,6-Trichlorophenol	10	330
2,4-Dichlorophenol	10	330

Table 1
Parameter, Methods, and Quantitation Limits

Quality Assurance Project Plan
NYSEG
Newark Former MGP Site

Parameter	Quantitation Limit[1]	
Semivolatile Organics Method 8270 (Cont'd.)	Water (µg/L)	Soil (µg/kg)
2,4-Dimethylphenol	10	330
2,4-Dinitrophenol	40	1300
2,4-Dinitrotoluene	2	67
2,6-Dinitrotoluene	2	67
2-Chloronaphthalene	10	330
2-Chlorophenol	10	330
2-Methylnaphthalene	10	330
2-Methylphenol	10	330
2-Nitroaniline	20	670
2-Nitrophenol	10	330
3,3'-Dichlorobenzidene	20	670
3-Nitroaniline	20	670
4,6-Dinitro-2-methylphenol	40	1300
4-Bromophenyl-phenylether	10	330
4-Chloro-3-methylphenol	10	330
4-Chloroaniline	10	330
4-Chlorophenyl-phenylether	10	330
4-Methylphenol	10	330
4-Nitroaniline	20	670
4-Nitrophenol	40	1300
Acenaphthene	10	330
Acenaphthylene	10	330
Acetophenone	10	330
Aniline	10	330
Anthracene	10	330
Atrazine	10	330
Benzaldehyde	10	330
Benzidine	40	1300
Benzo(a)anthracene	5	33
Benzo(a)pyrene	5	33
Benzo(b)fluoranthene	5	33
Benzo(g,h,i)perylene	10	330
Benzo(k)fluoranthene	5	33
Benzoic Acid	10	330
Benzyl Alcohol	10	330
bis(2-chloroethoxy)methane	10	330
bis(2-chloroethyl)ether	5	33
bis(2-chloroisopropyl)ether	10	330
bis(2-ethylhexyl)phthalate	10	330
Butylbenzylphthalate	10	330
Caprolactam	10	330
Carbazole	10	330
Chrysene	10	330
Dibenzo(a,h)anthracene	5	33
Dibenzofuran	10	330
Diethylphthalate	10	330
Dimethylphthalate	10	330
Di-n-butyl phthalate	10	330
Di-n-octyl phthalate	10	330

Table 1
Parameter, Methods, and Quantitation Limits

Quality Assurance Project Plan
NYSEG
Newark Former MGP Site

Parameter	Quantitation Limit[1]	
Semivolatiles Method 8270 (Cont'd.)	Water (µg/L)	Soil (µg/kg)
Diphenyl	10	330
Fluoranthene	10	330
Fluorene	10	330
Hexachlorobenzene	5	33
Hexachlorobutadiene	2	67
Hexachlorocyclopentadiene	10	330
Hexachloroethane	5	33
Indeno(1,2,3-cd)pyrene	5	33
Isophorone	10	330
N,N-Dimethylaniline	5	33
Naphthalene	10	330
Nitrobenzene	5	33
N-Nitrosodimethylamine	10	330
N-Nitroso-di-n-propylamine	5	33
N-Nitrosodiphenylamine	10	330
Pentachlorophenol	40	1300
Phenanthrene	10	330
Phenol	10	330
Pyrene	10	330
Pyridine	10	330

Notes:
[1] Specific quantitation limits are highly matrix dependent. The quantitation limits listed are for guidance and may not always be achievable due to matrix interference.
[2] Quantitation limits for source materials/soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for source materials/soil/sediment (calculated on a dry weight basis) will be higher.
* To be determined with lab prior to analysis.
µg/L = micrograms per liter
µg/kg = micrograms per kilogram
mg/kg = milligrams per kilogram

Table 2
Environmental and Quality Control Analyses

Quality Assurance Project Plan
NYSEG
Newark Former MGP Site

Environmental Sample Matrix/ Laboratory Parameters	Field QC Analyses					Laboratory QC Analyses[1,2]	
	Trip Blank	Field Duplicate	Rinse Blank[3]	MS	MSD	MSB	Lab Duplicate
Soils							
Semivolatile Organics Method 8270	--	1/20	1/20	1/20	1/20	1/20	--
Groundwater							
Volatile Organics Method 8260	1/cooler	1/20	1/20	1/20	1/20	1/20	--
Semivolatile Organics Method 8270	--	1/20	1/20	1/20	1/20	1/20	--

Notes:
[1] The number of laboratory QC analyses is based on the frequencies given for the number of environmental samples estimated, not including field QC analyses (i.e., rinse and trip blanks).
[2] Laboratory QC analyses are listed only for those parameters that must be performed on site samples. The laboratory is required to analyze QC samples for the remaining parameters at the frequency listed in the associated analytical method.
[3] Rinse blank samples will be collected only when nondedicated sampling devices are used. Rinse blanks will be collected at a frequency of one per day of use or one per 20 samples, whichever is less.
QC = quality control
MS = matrix spike
MSB = matrix spike blank
MSD = matrix spike duplicate

Table 3
Sample Containers, Preservation, and Holding Times Requirements

Quality Assurance Project Plan
NYSEG
Newark Former MGP Site

Parameter	Container	Preservation	Maximum Holding Time from VTSR
Soil Samples			
Semivolatile Organics	(1) 4-oz container (glass)	Cool 4ºC	5 days extraction; 40 days analysis
Groundwater Samples			
Volatile Organics	(2) 40-mL Teflon®-lined septa (glass)	Cool 4ºC HCl to pH <2	7 days (unpreserved) 10 days (preserved)
Semivolatile Organics	(2) 1-liter containers (glass)	Cool 4ºC	5 days extraction; 40 days analysis

Notes:
VTSR = Verifiable time of sample receipt. Samples must be delivered to laboratory within 48 hours from day of collection.
mL = milliliters
oz = ounce
ºC = degrees Celsius
HCL = hydrochloric acid

Table 4
Data Validation Checklist – Laboratory Analytical Data

Quality Assurance Project Plan
NYSEG
Newark Former MGP Site

REVIEW FOR COMPLETENESS	
1.	Chain of custody forms included.
2.	Sample preparation and analysis summary tables included.
3.	Quality assurance/quality control (QA/QC) summaries of analytical data included.
4.	Relevant calibration data included with analytical data.
5.	Instrument and method performance data included.
6.	Method detection limits documented.
7.	Data report forms of examples for calculations of concentrations.
8.	Raw data used in identification and quantification of the analysis required.
REVIEW OF COMPLIANCE	
1.	Data package completed.
2.	Quality Assurance Project Plan requirements for data met.
3.	QA/QC criteria met.
4.	Instrument type and calibration procedures met.
5.	Initial and continuing calibration met.
6.	Data reporting forms completed.
7.	Problems and corrective actions documented.

ATTACHMENT A

Sample Chain of Custody Form

ARCADIS

ID#:

CHAIN OF CUSTODY & LABORATORY ANALYSIS REQUEST FORM

Page ___ of ___

Lab Work Order #

Send Results to:

Contact & Company Name: | Telephone:

Address: | Fax:

City | State | Zip | E-mail Address:

Project Name/Location (City, State): | Project #:

Sampler's Printed Name: | Sampler's Signature:

Preservative							
Filtered (✓)							
# of Containers							
Container Information							

PARAMETER ANALYSIS & METHOD

Keys

Preservation Key:
A. H_2SO_4
B. HCL
C. HNO_3
D. NaOH
E. None
F. Other: _____
G. Other: _____
H. Other: _____

Container Information Key:
1. 40 ml Vial
2. 1 L Amber
3. 250 ml Plastic
4. 500 ml Plastic
5. Encore
6. 2 oz. Glass
7. 4 oz. Glass
8. 8 oz. Glass
9. Other: _____
10. Other: _____

Matrix Key:
SO - Soil | SE - Sediment | NL - NAPL/Oil
W - Water | SL - Sludge | SW - Sample Wipe
T - Tissue | A - Air | Other: _____

Sample ID	Collection Date	Collection Time	Type (✓) Comp	Type (✓) Grab	Matrix	REMARKS

Special Instructions/Comments:

☐ **Special QA/QC Instructions(✓):**

Laboratory Information and Receipt		Relinquished By	Received By	Relinquished By	Laboratory Received By
Lab Name:	Cooler Custody Seal (✓)	Printed Name:	Printed Name:	Printed Name:	Printed Name:
☐ Cooler packed with ice (✓)	☐ Intact ☐ Not Intact	Signature:	Signature:	Signature:	Signature:
Specify Turnaround Requirements:	Sample Receipt:	Firm:	Firm/Courier:	Firm/Courier:	Firm:
Shipping Tracking #:	Condition/Cooler Temp: _____	Date/Time:	Date/Time:	Date/Time:	Date/Time:

Distribution: **WHITE – Laboratory returns with results** **YELLOW – Lab copy** **PINK – Retained by Arcadis**

APPENDIX C

Health and Safety Plan

Site Specific Health and Safety Plan

Revision 14, 1/16/2017

Project Name: Newark Former MGP Site

Project Number: B0013094.0000
Client Name: NYSEG
Date: 3/31/2017
HASP Expires 3/31/2018
Revision:

Approvals:

HASP Developer: Nicholas (Klaus) Beyrle

Project Manager: Jason Golubski

HASP Reviewer:

X

Emergency Information

Site Address: 125 N Main St
Newark, New York 14513

Emergency Phone Numbers:

Emergency (fire, police, ambulance)		911
Emergency (facility specific, if applicable):		
Emergency Other (specify)		
Client Contact	Jeremy Wolf	585-500-8392
WorkCare (non-life-threatening injury/illness)		1-888-449-7787
Project H&S	Nicholas (Klaus) Beyrle	585-662-4044
Task Manager	Jason Golubski	315-671-9437
Project Manager	Jason Golubski	315-671-9437
Corporate H&S Specialist	Julie Santaniello	978-551-0033
Corporate H&S Director	Denis Balcer	614-778-9171

Hospital Name and Address: Newark-Wayne Community Hospital
1200 Driving Park Ave
Newark, New York 14513

Hospital Phone Number: 315-332-2022

Incident Notification Process

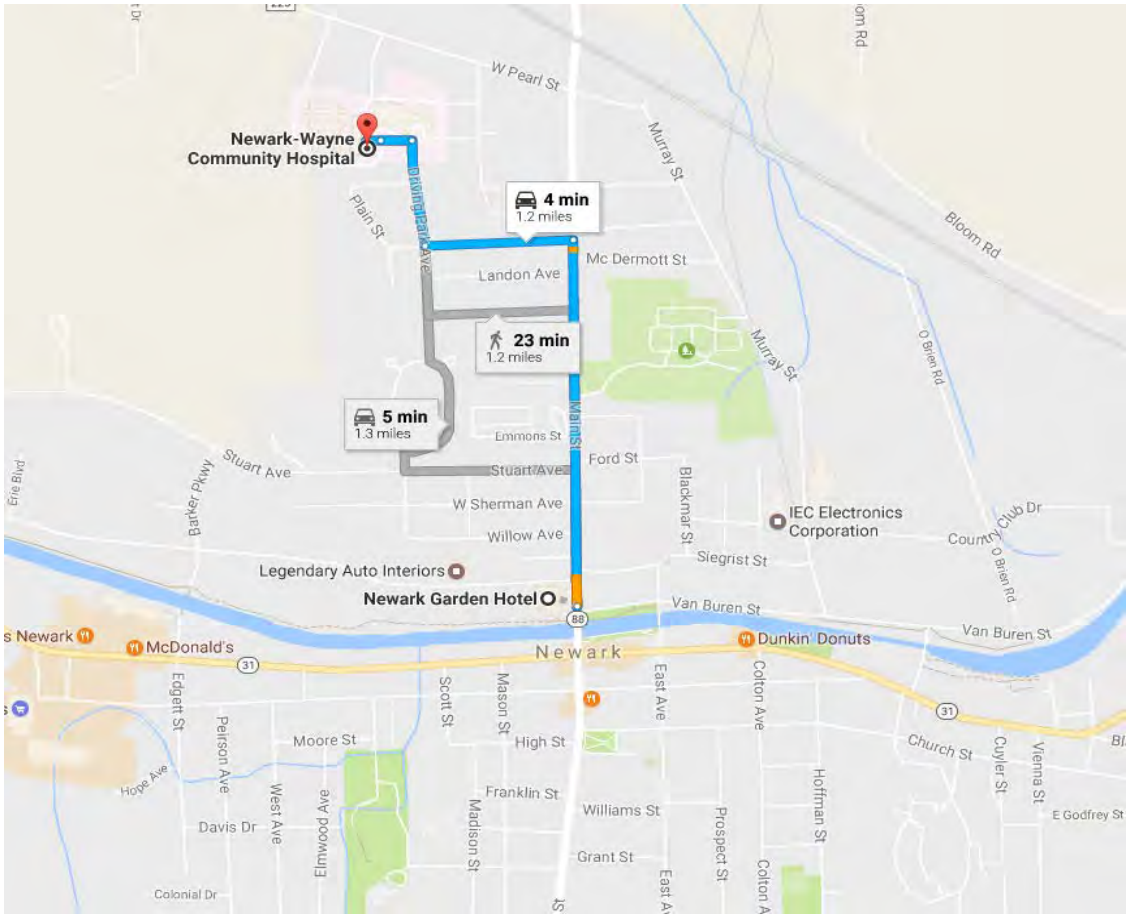
1	Dial 911/Facility Emergency Number/WorkCare as applicable	
2	Contact PM/Supervisor	Jason Golubski
3	Contact Corporate H&S	Denis Balcer
4	Contact Client	Jeremy Wolf

Complete below, as applicable, or clear cell contents:

Location of Assembly Area(s): Hotel awning/hotel lobby.

Nearest AED location: NA
Nearest Storm Shelter: Lobby of Hotel

Route to the Hospital



Newark Garden Hotel

125 N Main St, Newark, NY 14513

1. Head north on Main St toward W Shore Blvd — 0.7 mi
2. Turn left onto Stuerwald Ave — 0.2 mi
3. Turn right at the 1st cross street onto Driving Park Ave — 0.2 mi
4. Turn left onto Sunset Dr — 272 ft
5. Continue straight
   Destination will be on the left — 207 ft

Newark-Wayne Community Hospital

1200 Driving Park Ave, Newark, NY 14513

General Information

Site Type (select all applicable where work will be conducted):

- ☐ Active
- ☐ Bridge
- ☑ Buildings
- ☑ Commercial
- ☐ Construction
- ☐ Military Installation
- ☐ Inactive Industrial
- ☐ Active Industrial
- ☐ Landfill
- ☐ Marine
- ☐ Mining
- ☑ Parking Lot/Private Roadway
- ☐ Railroad
- ☐ Remote Area
- ☐ Residential
- ☐ Retail
- ☑ Roadway (public, including right-of-way)
- ☐ Water Treatment Plant
- ☐ Unknown
- ☐ Security Risk Site/Location
- ☐ Utility
- ☐ Other (specify): _____

Work in the public right of way requires preparation of a Traffic Control Plan (TCP). Work with exposure to vehicular traffic on private property requires preparation of a Site Traffic Awareness and Response (STAR) Plan.

Surrounding Area and Topography (select one):

- ☑ Surrounding area and topography are presented in the project work plan
- ☐ Surrounding area and topography (*briefly describe*):
  Generally flat and either paved or maintained grass.

Simultaneous Operations (SimOps)

- ☑ Not applicable
- ☐ SimOps will exist on this project

Site Background (select one):

- ☑ Site background is presented in the project work plan
- ☐ Site background (*briefly describe)* :
  Site is former manufactured gas plant (MGP) and currently a hotel chain.

Project Tasks

The following tasks are identified for this project:

Examples: "Drilling/soil sampling", "Surveying", "General Inspections", "Construction Management/Inspections"

1 General Site Work
2 Driling/Soil Sampling
3 Test Pitting
4
5

☐ Subcontractor H&S information is attached
☑ Utility clearance required.
☐ Journey Management Plan attached
☐ State specific H&S required:

☑ The following H&S Standards are attached:
Utility Clearance HS Standard
Excavation and Trenching

Comments:

Roles and Responsibilities

	Name	*Role*	*Additional Responsibilities (Describe)*
1	Jason Golubski	PM	
2	Jason Golubski	TM	
3	Ryan Clare	Field Lead	
4	Ryan Clare	SSO	
5			
6			

Training

All Arcadis employees are required to have the following training to be on site:	*Selected Arcadis employees are required to have the following additional training:*	Names or Numbers from above
H&S Program Orientation	BBP (Bloodborne Pathogens)	3
HAZCOM GHS/EAP	DOT HazMat #1	3
Defensive Driving - Smith On-Line	First Aid/CPR	3
Hazwoper 8-Hour Annual Refresher	None	
None	None	
None	None	
None	None	
None	None	
None	None	
None	None	
None	None	
None	None	
None	None	
None	None	
None	None	
Client specific:	None	
	None	
Other:	Other:	

Hazard Analysis

Risk Assessment Matrix		Likelihood Ratings** (likelihood that incident would occur)			
Consequences Ratings*		A	B	C	D
People	Property	0 Almost impossible	1 Possible but unlikely	2 Likely to happen	3 Almost certain to happen
1 - Slight or no health	Slight or no damage	0 - Low	1 - Low	2 - Low	3 - Low
2 - Minor health effect	Minor damage	0 - Low	2 - Low	4 - Medium	6 - Medium
3 - Major health effect	Local damage	0 - Low	3 - Low	6 - Medium	9 - High
4 - Fatalities	Major damage	0 - Low.	4 - Medium.	8 - High	12 - High

Business Line

Environment

Business Unit

ENV Non-Office Work

Task 1: General Site Work

Hazardous Activity #1

Chemical-Toxic contaminants or chemicals - exposure to these materials

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low): Suggested FHSHB Ref: III K, III AG

Biological	-	Chemical	M	Driving	-	Electrical	-
Environmental	M	Gravity	-	Mechanical	-	Motion	-
Personal Safety	-	Pressure	-	Radiation	-	Sound	-

Overall Unmitigated Risk: Medium Mitigated Risk: Low if utilizing:

Controls that should be Considered: Primary: TRACK JSAs Engineering Controls (specify below) Secondary: HASP Job Briefing/Site Awareness Hazcom Training MSDS/SDS (see also HASP Hazcom/GHS section) Admin. Controls (specify below) Specialized Equipment (specify below) Housekeeping PPE (see HASP "PPE" section)

Enter Required Controls: TRACK, PPE

Hazardous Activity #2

Field-Mobilization/Demobilization - from a site

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low): Suggested FHSHB Ref: #N/A

Biological	-	Chemical	L	Driving	M	Electrical	-
Environmental	-	Gravity	M	Mechanical	-	Motion	L
Personal Safety	-	Pressure	-	Radiation	-	Sound	-

Overall Unmitigated Risk: Medium Mitigated Risk: Low if utilizing:

Controls that should be Considered: Primary: TRACK Field H&S Handbook (see ref. above) Engineering Controls (specify below) Secondary: JSAs Job Briefing/Site Awareness PPE (see HASP "PPE" section) Admin. Controls (specify below)

Enter Required Controls: TRACK, Smith Driving

Hazardous Activity #3

General-Vehicle -motor vehicle operation (all types on roadways)

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low): Suggested FHSHB Ref: III V

Biological	-	Chemical	-	Driving	M	Electrical	-
Environmental	-	Gravity	-	Mechanical	-	Motion	-
Personal Safety	-	Pressure	-	Radiation	-	Sound	-

Overall Unmitigated Risk: High Mitigated Risk: Low if utilizing:

Controls that should be Considered: Primary: TRACK Smith System (on line) Inspections Secondary: JSAs Admin. Controls (specify below)

Enter Required Controls: TRACK, Smith Driving

Hazardous Activity #4

Field-Traffic - parking lots

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low): Suggested FHSHB Ref: III AM, V F

Biological	-	Chemical	-	Driving	M	Electrical	-
Environmental	-	Gravity	-	Mechanical	-	Motion	H
Personal Safety	M	Pressure	-	Radiation	-	Sound	-

Overall Unmitigated Risk: Medium Mitigated Risk: Low if utilizing:

Controls that should be Considered: Primary: TRACK STAR Plan Engineering Controls (specify below) Secondary: Job Briefing/Site Awareness

Enter Required Controls: TRACK, Smith Driving

Risk Assessment Matrix		Likelihood Ratings** (likelihood that incident would occur)			
Consequences Ratings*		A	B	C	D
People	Property	0 Almost impossible	1 Possible but unlikely	2 Likely to happen	3 Almost certain to happen
1 - Slight or no health	Slight or no damage	0 - Low	1 - Low	2 - Low	3 - Low
2 - Minor health effect	Minor damage	0 - Low	2 - Low	4 - Medium	6 - Medium
3 - Major health effect	Local damage	0 - Low	3 - Low	6 - Medium	9 - High
4 - Fatalities	Major damage	0 - Low.	4 - Medium.	8 - High	12 - High

Task 2: Driling/Soil Sampling

Hazardous Activity #1

Field-Drilling - Mechanical method (drill rig, DPT, etc)

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low): Suggested FHSHB Ref: III E, III F, III AD, III AN

Biological	-	Chemical	L	Driving	-	Electrical	M
Environmental	-	Gravity	H	Mechanical	H	Motion	H
Personal Safety	-	Pressure	M	Radiation	-	Sound	H

Overall Unmitigated Risk: High Mitigated Risk: Medium if utilizing:

Controls that should be Considered: Primary: TRACK Engineering Controls (specify below) Admin. Controls (specify below) JSAs Inspections
Secondary: Job Briefing/Site Awareness H&S Standards Cont./Emerg. Planning PPE (see HASP "PPE" section)

Enter Required Controls: TRACK, JSA

Hazardous Activity #2

Field - Sampling - split spoon, continuous sampling tool, sonic

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low): Suggested FHSHB Ref: III H

Biological	-	Chemical	L	Driving	-	Electrical	-
Environmental	-	Gravity	L	Mechanical	M	Motion	M
Personal Safety	L	Pressure	L	Radiation	-	Sound	M

Overall Unmitigated Risk: Medium Mitigated Risk: Low if utilizing:

Controls that should be Considered: Primary: TRACK JSAs Job Briefing/Site Awareness Job Rotation Secondary: PPE (see HASP "PPE" section)

Enter Required Controls: TRACK, JSA

Hazardous Activity #3

Field-Utilities - drilling, digging or excavating in the vicinity of subsurface utilities

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low): Suggested FHSHB Ref: III AN

Biological	-	Chemical	H	Driving	-	Electrical	H
Environmental	-	Gravity	-	Mechanical	-	Motion	L
Personal Safety	-	Pressure	M	Radiation	-	Sound	-

Overall Unmitigated Risk: High Mitigated Risk: Medium if utilizing:

Controls that should be Considered: Primary: TRACK H&S Standards Engineering Controls (specify below) Admin. Controls (specify below) Inspections Specialized Equipment (specify below) Secondary: JSAs Field H&S Handbook (see ref. above) Job Briefing/Site Awareness Cont./Emerg. Planning Engineering Controls (specify below) Admin. Controls (specify below)

Enter Required Controls: TRACK, JSA, Utility Clearance Standard and checklist

Hazardous Activity #4

Field-Contaminated media (contact with impacted soil, water, air, sediment, etc)

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low): Suggested FHSHB Ref: III E, III F, III AH

Biological	-	Chemical	H	Driving	-	Electrical	-
Environmental	M	Gravity	-	Mechanical	-	Motion	-
Personal Safety	-	Pressure	-	Radiation	M	Sound	-

Overall Unmitigated Risk: High Mitigated Risk: Low if utilizing:

Controls that should be Considered: Primary: TRACK JSAs Engineering Controls (specify below) Secondary: H&S Standards HASP Admin. Controls (specify below) HAZWOPER Training PPE (see HASP "PPE" section)

Enter Required Controls: TRACK

Risk Assessment Matrix		Likelihood Ratings** (likelihood that incident would occur)			
Consequences Ratings*		A	B	C	D
People	Property	0 Almost impossible	1 Possible but unlikely	2 Likely to happen	3 Almost certain to happen
1 - Slight or no health	Slight or no damage	0 - Low	1 - Low	2 - Low	3 - Low
2 - Minor health effect	Minor damage	0 - Low	2 - Low	4 - Medium	6 - Medium
3 - Major health effect	Local damage	0 - Low	3 - Low	6 - Medium	9 - High
4 - Fatalities	Major damage	0 - Low.	4 - Medium.	8 - High	12 - High

Task 3: Test Pitting

Hazardous Activity #1

Field-Excavations - working adjacent to or within trenches and excavations

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low): Suggested FHSHB Ref: IV D

Biological	-	Chemical	-	Driving	-	Electrical	-
Environmental	-	Gravity	H	Mechanical	-	Motion	-
Personal Safety	-	Pressure	-	Radiation	-	Sound	-

Overall Unmitigated Risk: High Mitigated Risk: Medium. if utilizing:

Controls that should be Considered: Primary: TRACK Competent Person Required (designated person) H&S Standards Excavation Awareness Training Engineering Controls (specify below) Secondary: JSAs Job Briefing/Site Awareness Specialized Equipment (specify below) Housekeeping Inspections

Enter Required Controls: TRACK, JSA

Hazardous Activity #2

Field-Excavation - soil removal, installation or removal piping, tanks or utilities, geologic investigations, etc

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low): Suggested FHSHB Ref: IV D

Biological	-	Chemical	-	Driving	-	Electrical	-
Environmental	-	Gravity	H	Mechanical	H	Motion	H
Personal Safety	-	Pressure	-	Radiation	-	Sound	M

Overall Unmitigated Risk: High Mitigated Risk: Medium if utilizing:

Controls that should be Considered: Primary: TRACK H&S Standards Excavation Awareness Training Excavation Competent Person Training (designated person) Engineering Controls (specify below) Secondary: JSAs HASP Job Briefing/Site Awareness Client Training/Briefing Cont./Emerg. Planning PPE (see HASP "PPE" section) Specialized Equipment (specify below) Housekeeping Inspections

Enter Required Controls: TRACK, JSA

Hazardous Activity #3

None

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low): Suggested FHSHB Ref: NA

Biological		Chemical		Driving		Electrical	
Environmental		Gravity		Mechanical		Motion	
Personal Safety		Pressure		Radiation		Sound	

Overall Unmitigated Risk: Not Ranked Mitigated Risk: Not Ranked if utilizing:

Controls that should be Considered: Primary: Secondary:

Enter Required Controls:

Hazardous Activity #4

None

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low): Suggested FHSHB Ref: NA

Biological		Chemical		Driving		Electrical	
Environmental		Gravity		Mechanical		Motion	
Personal Safety		Pressure		Radiation		Sound	

Overall Unmitigated Risk: Not Ranked Mitigated Risk: Not Ranked if utilizing:

Controls that should be Considered: Primary: Secondary:

Enter Required Controls:

Risk Assessment Matrix		Likelihood Ratings** (likelihood that incident would occur)			
Consequences Ratings*		A	B	C	D
People	Property	0 Almost impossible	1 Possible but unlikely	2 Likely to happen	3 Almost certain to happen
1 - Slight or no health	Slight or no damage	0 - Low	1 - Low	2 - Low	3 - Low
2 - Minor health effect	Minor damage	0 - Low	2 - Low	4 - Medium	6 - Medium
3 - Major health effect	Local damage	0 - Low	3 - Low	6 - Medium	9 - High
4 - Fatalities	Major damage	0 - Low.	4 - Medium.	8 - High	12 - High

Task 4: 0

Hazardous Activity #1

None

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low): Suggested FHSHB Ref: NA

Biological		Chemical		Driving		Electrical	
Environmental		Gravity		Mechanical		Motion	
Personal Safety		Pressure		Radiation		Sound	

Overall Unmitigated Risk: Not Ranked Mitigated Risk: Not Ranked if utilizing:

Controls that should be Considered: Primary: Secondary:

Enter Required Controls:

Hazardous Activity #2

None

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low): Suggested FHSHB Ref: NA

Biological		Chemical		Driving		Electrical	
Environmental		Gravity		Mechanical		Motion	
Personal Safety		Pressure		Radiation		Sound	

Overall Unmitigated Risk: Not Ranked Mitigated Risk: Not Ranked if utilizing:

Controls that should be Considered: Primary: Secondary:

Enter Required Controls:

Hazardous Activity #3

None

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low): Suggested FHSHB Ref: NA

Biological		Chemical		Driving		Electrical	
Environmental		Gravity		Mechanical		Motion	
Personal Safety		Pressure		Radiation		Sound	

Overall Unmitigated Risk: Not Ranked Mitigated Risk: Not Ranked if utilizing:

Controls that should be Considered: Primary: Secondary:

Enter Required Controls:

Hazardous Activity #4

None

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low): Suggested FHSHB Ref: NA

Biological		Chemical		Driving		Electrical	
Environmental		Gravity		Mechanical		Motion	
Personal Safety		Pressure		Radiation		Sound	

Overall Unmitigated Risk: Not Ranked Mitigated Risk: Not Ranked if utilizing:

Controls that should be Considered: Primary: Secondary:

Enter Required Controls:

Risk Assessment Matrix		Likelihood Ratings** (likelihood that incident would occur)			
Consequences Ratings*		A	B	C	D
People	Property	0 Almost impossible	1 Possible but unlikely	2 Likely to happen	3 Almost certain to happen
1 - Slight or no health	Slight or no damage	0 - Low	1 - Low	2 - Low	3 - Low
2 - Minor health effect	Minor damage	0 - Low	2 - Low	4 - Medium	6 - Medium
3 - Major health effect	Local damage	0 - Low	3 - Low	6 - Medium	9 - High
4 - Fatalities	Major damage	0 - Low.	4 - Medium.	8 - High	12 - High

Task 5: 0

Hazardous Activity #1

None

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low): Suggested FHSHB Ref: NA

Biological		Chemical		Driving		Electrical	
Environmental		Gravity		Mechanical		Motion	
Personal Safety		Pressure		Radiation		Sound	

Overall Unmitigated Risk: Not Ranked Mitigated Risk: Not Ranked if utilizing:

Controls that should be Considered: Primary: Secondary:

Enter Required Controls:

Hazardous Activity #2

None

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low): Suggested FHSHB Ref: NA

Biological		Chemical		Driving		Electrical	
Environmental		Gravity		Mechanical		Motion	
Personal Safety		Pressure		Radiation		Sound	

Overall Unmitigated Risk: Not Ranked Mitigated Risk: Not Ranked if utilizing:

Controls that should be Considered: Primary: Secondary:

Enter Required Controls:

Hazardous Activity #3

None

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low): Suggested FHSHB Ref: NA

Biological		Chemical		Driving		Electrical	
Environmental		Gravity		Mechanical		Motion	
Personal Safety		Pressure		Radiation		Sound	

Overall Unmitigated Risk: Not Ranked Mitigated Risk: Not Ranked if utilizing:

Controls that should be Considered: Primary: Secondary:

Enter Required Controls:

Hazardous Activity #4

None

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low): Suggested FHSHB Ref: NA

Biological		Chemical		Driving		Electrical	
Environmental		Gravity		Mechanical		Motion	
Personal Safety		Pressure		Radiation		Sound	

Overall Unmitigated Risk: Not Ranked Mitigated Risk: Not Ranked if utilizing:

Controls that should be Considered: Primary: Secondary:

Enter Required Controls:

Hazard Communication (HazCom)/Global Harmonization System (GHS)

☐ HAZCOM/GHS for this project is managed by the client or general contractor

List the chemicals anticipated to be used by Arcadis on this project per HazCom/GHS requirements.
(Modify quantities as needed)

	Preservatives	Qty
☐	Not applicable	
☑	Hydrochloric acid	<500 ml
☑	Nitric acid	<500 ml
☐	Sulfuric acid	<500 ml
☑	Sodium hydroxide	<500 ml
☑	Zinc acetate	<500 ml
☐	Ascorbic acid	<500 ml
☐	Acetic acid	<500 ml
☐	Isopropyl alcohol	< 4 gal.
☐	Formalin (<10%)	< 4 gal.
☐	Methanol	<500 ml
☐	Sodium bisulfate	<500 ml

	Decontamination	Qty
☐	Not applicable	
☑	Alconox	≤ 5 lbs
☐	Liquinox	≤ 1 gal
☐	Acetone	≤ 1 gal
☐	Methanol	≤ 1 gal
☐	Hexane	≤ 1 gal
☑	Isopropyl alcohol	≤ 4 gal
☐	Nitric acid	≤ 1 L
☐	Other:	
	_____	
	_____	
	_____	

	Calibration	Qty.
☐	Not applicable	
☑	Isobutylene/air	1 cyl
☐	Methane/air	1 cyl
☐	Pentane/air	1 cyl
☐	Hydrogen/air	1 cyl
☐	Propane/air	1 cyl
☐	Hydrogen sulfide/air	1 cyl
☐	Carbon monoxide/air	1 cyl
☑	pH standards (4,7,10)	≤ 1 gal
☑	Conductivity standards	≤ 1 gal
☐	Other:	
	_____	

	Fuels	Qty.
☑	Not applicable	
☐	Gasoline	≤ 5 gal
☐	Diesel	≤ 5 gal
☐	Kerosene	≤ 5 gal
☐	Propane	1 cyl
☐	Other:	
	_____	

	Kits
☑	Not applicable
☐	Hach (specify):
☐	DTECH (specify):
☐	Other:
	_____
	_____
	_____

Qty.
1 kit
1 kit
1 kit

	Remediation	Qty.
☐	Not applicable	
☐	_____	
☐	_____	
☐	_____	
☐	_____	
☐	_____	

	Other:	Qty.
☐	Not applicable	
☑	Spray paint	≤ 6 cans
☐	WD-40	≤ 1 can
☐	Pipe cement	≤ 1 can
☐	Pipe primer	≤ 1 can
☐	Mineral spirits	≤ 1 gal
☐	_____	

DOT(1):	Qty.
MOT eligible soils	
MOT eligible water	
MOT eligible solids	
MOT eligible liquids	

(1) Attach applicable Materials of Trade (MOT) generic shipping determination. SDS not generally applicable to this category.

Safety Data Sheets (SDSs) must be available to field staff. Indicate below how SDS information will be provided:

☐ Not applicable
☐ Printed copy in company vehicle
☐ Printed copy in the project trailer/office
☑ Printed copy attached
☐ Electronic copy on field computer

☐ Contractor SDSs are not applicable
☐ Contractor SDSs are attached
☐ Contractor SDSs will be on site and located:
_____

☐ Bulk quantities of the following materials will be stored: _____

Contact the project H&S contact for information in determining code and regulatory requirements associated with bulk storage of materials.

Monitoring

☐ Chemical air monitoring is not required for this project or is the responsibility of contractor.

For projects requiring air monitoring, list the relevant constituents representing a hazard to site workers.

Constituent	Max. Conc.	Units	TWA	Units	STEL	Units	IDLH	Units	LEL/UEL (%)	RGD Air=1	IP (eV)
Benzene	0.5	ppm	0.5	p	2.5	p	500	p,N	1.2/7.8	NA	9.24
Ethylbenzene	0.5	ppm	20	p	125	p	800	p,N	0.8/6.7	NA	8.76
Toluene	0.5	ppm	20	p	150	p,N	500	p,N	1.1/7.1	NA	8.82
Xylenes	0.5	ppm	100	p	150	p	900	p,N	1.1/7.0	NA	8.44
None			9999	-	0	-	0	-	0	0	0
None			9999	-	0	-	0	-	0	0	0

Notes: TWAs are ACGIH 8 hr.-TLVs unless noted.

p-ppm m-mg/m3 c2- ceiling (2 hr.) se-sensitizer A - Arcadis specific TWA*
s- skin c-ceiling "9999" - NA O-OSHA PEL "#N/A"-Manually
r- respirable i-inhalable N-NIOSH 10 hr. REL enter

Monitoring Equipment and General Protocols

Air monitoring is required for any task or activity where employees have potential exposure to vapors or particulates above the TWA. Action levels below are appropriate for most situations. Contact the project H&S contact for all stop work situations. Select monitoring frequency and instruments to be used.

Monitoring Frequency: 15 Minute intervals
Indicator Tube/Chip Frequency: >PID/FID action level at 30 minute intervals

	Instrument	Action Levels			Actions
☑	Photoionization Detector Lamp (eV): 10.6		< 1.892		Continue work
		1.892	-	3.784	Sustained >5 min. continuous monitor, review eng. controls and PPE, proceed with caution
			> 3.784		Sustained >5 min. stop work, contact SSO
☐	Flame Ionization Detector (FID)		< 0.0		Continue work
		0.0	-	0.0	Sustained >5 min. continuous monitor, review eng. controls and PPE, use caution
			> 0.0		Sustained >5 min. stop work, contact SSO
☐	LEL/O2 Meter	0-5% LEL			Continue work
		>5-10% LEL			Continuous monitor, review eng. controls, proceed with caution
		>10% LEL			Stop work, evacuate, contact SSO
		19.5%-23.5% O2			Normal, continue work
		<19.5% O2			O2 deficient, stop work, evacuate, cont.
		>23.5% O2			O2 enriched, stop work, evacuate, contact
☑	Indicator: ☐ tube ☑ chip	≤ 0.5 ppm			Continue work
		> 0.5			Stop work, review eng. controls and PPE, contact SSO
	Compound(s): Benzene				
☐	Particulate Monitor (mists, aerosols, dusts in mg/m^3)		< 1.5		Continue work
		1.5	-	3.000	Use engineering controls, monitor continuou
			> 3.000		Stop work, review controls, contact SSO
☐	Other:	Specify:			Specify:

* Arcadis administrative TWAs ensure mixture component TWAs are not exceeded that would require additional monitoring or medical surveillance.

Personal Protective Equipment (PPE)

See JSA or Permit for the task being performed for required PPE. *If work is not conducted under a JSA or Permit, refer to the governing document for PPE requirements. At a minimum, the following checked PPE is required for all tasks during field work (outside of field office trailers and vehicles) not covered by a JSA or Permit on this project:*

Minimum PPE required to be worn by all staff on project:

							Specify Type:
☑	Hard hat	☐	Snake chaps/guards	☐	Coveralls:		
☑	Safety glasses	☐	Briar chaps	☐	Apron:		
☐	Safety goggles	☐	Chainsaw chaps	☑	Chem. resistant gloves:		Nitrile
☐	Face shield	☐	Sturdy boot	☐	Gloves other:		
☐	Hearing protection	☑	Steel or comp. toe boot	☐	Chemical boot:		
☐	Rain suit	☐	Metatarsal boot	☐	Boot other:		
☐	Other:			☑	Traffic vest, shirt or coat:		Class II
				☐	Life vest:		

Task specific PPE:

Comments:

Medical Surveillance (*check all that apply*)

- ☐ Medical Surveillance is not required for this project.
- ☑ HAZWOPER medical surveillance applies to all Arcadis site workers on the project.
- ☑ HAZWOPER medical surveillance applies to all subcontractors on the project.
- ☐ HAZWOPER medical surveillance applies to all site workers on the project except:

- ☐ Other medical surveillance required (describe type and who is required to participate):

- ☐ Client drug and/or alcohol testing required.

Hazardous Materials Shipping and Transportation (*check all that apply*)

- ☐ Not applicable, no materials requiring a Shipping Determination (SD) will be transported or shipped
- ☑ A SD has been reviewed and provided to field staff
- ☐ A SD is attached
- ☐ All HazMat will be transported under Materials of Trade by Arcadis (see generic MOT SD Form)
- ☐ Other (specify):

Roadway Work Zone Safety (*check all that apply*)

- ☐ Not applicable for this project
- ☐ All or portions of the work conducted under a TCP
- ☐ All or portions of the work conducted under a STAR Plan
- ☐ TCP or STAR Plan provided to field staff
- ☑ TCP or STAR Plan attached
- ☐ Other (specify):

Arcadis Commercial Motor Vehicles (CMVs)

This section is applicable to Arcadis operated vehicles only

☑ This project will **not** utilize CMV drivers ☐ This project will utilize CMV drivers

This project will NOT utilize vehicles (alone or in combination with a trailer) with a gross vehicle weight rating (GVWR) of 10,001 pounds or more. GVWR Truck + GVWR Trailer = <10,001 pounds

Site Control (*check all that apply*)

- ☐ Not applicable for this project.
- ☐ Site control protocols are addressed in JSA or other supporting document (attach)
- ☑ Maintain an exclusion zone of 10 ft. around the active work area
- ☑ Site control is integrated into the STAR Plan or TCP for the project
- ☐ Level C site control - refer to Level C Supplement attached
- ☐ Other (specify):

Decontamination (*check all that apply*)

- ☐ Not applicable for this project.
- ☐ Decontamination protocols are addressed in JSA or other governing document (attach)
- ☑ Wash hands and face prior to consuming food, drink or tobacco.
- ☐ Remove gloves and coveralls and contain, wash hands and face prior to consuming food, drink or tobacco. Ensure footwear is clean of site contaminants
- ☐ Respiratory protection- refer to the Level C supplement attached.
- ☐ Other (specify):

Sanitation *(check all that apply)*

- ☑ Mobile operation with access to off-site restrooms and potable water
- ☐ Restroom facilities on site provided by client or other contractor
- ☐ Project to provide portable toilets (1 per 20 workers)
- ☐ Potable water available on site
- ☐ Project to provide potable water (assume 1 gal./person/day)
- ☐ Project requires running water (hot and cold, or tepid) with soap and paper towels

Safety Briefings (*check all that apply*)

- ☑ Safety briefing required daily
- ☐ Safety briefing required twice a day
- ☐ Safety briefings required at the following frequency: _____
- ☑ Subcontractors to participate in Arcadis safety briefings
- ☐ Arcadis to participate in client/contractor safety briefings
- ☐ Other (specify):

Safety Equipment and Supplies

***Safety equipment/supply requirements are addressed in the JSA or Permit for the task being performed**. If work is not performed under a JSA or Permit, the following safety equipment is required to be present on site in good condition (Check all that apply):*

- ☑ First aid kit
- ☐ Bloodborne pathogens kit
- ☑ Fire extinguisher
- ☐ Eyewash (ANSI compliant)
- ☑ Eyewash (bottle)
- ☑ Drinking water
- ☐ Other: _____
- ☐ Insect repellent
- ☑ Sunscreen
- ☐ Air horn
- ☐ Traffic cones
- ☐ 2-way radios
- ☐ Heat stress monitor _____

International Travel

☑ This project does not involve international travel
☐ This project involves international travel

Behavior Based Safety Program (*check all that apply*)

☑ TIP required at the following frequency on this project:
Select One: _____ mhrs per week time(s) _____ Define: _____
☐ H&S Field Assessment required at the following frequency on this project:
Select One: _____ mhrs _____ time(s) _____ Define: _____
☐ Other (specify):

Signatures

I have read, understand and agree to abide by the requirements presented in this health and safety plan. I understand that I have the absolute right to stop work if I recognize an unsafe condition affecting my work until corrected.

Printed Name	Signature	Date

Add additional sheets if necessary

You have an absolute right to STOP WORK if unsafe conditions exist!

Attachment A - SDS

Safety Data Sheet
according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), and GHS

Printing date: 31.12.2013 **Revision:** 31.12.2013

1 Identification of the substance/mixture and of the company/undertaking

· **1.1 Product identifier**

· **Trade name: ALCONOX**

· **1.2 Relevant identified uses of the substance or mixture and uses advised against**
No further relevant information available.

· **Application of the substance / the mixture:** Cleaning material/ Detergent

· **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 Emergency telephone 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**

GHS05 corrosion

Eye Dam. 1; H318: Causes serious eye damage.

GHS07

Skin Irrit. 2; H315: Causes skin irritation.

· **Classification according to Directive 67/548/EEC or Directive 1999/45/EC**

Xi; Irritant

R38-41: Irritating to skin. Risk of serious damage to eyes.

· **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.

· **Classification system:**
The classification is according to the latest editions of the EU-lists, and extended by company and literature data.
The classification is in accordance with the latest editions of international substances lists, and is supplemented by information from technical literature and by information provided by the company.

· **2.2 Label elements**

· **Labelling according to Regulation (EC) No 1272/2008**
The product is classified and labelled according to the CLP regulation.

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Safety Data Sheet
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Trade name: ALCONOX

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· **Hazard pictograms**

GHS05

· **Signal word:** Danger

· **Hazard-determining components of labelling:**
sodium dodecylbenzene sulfonate
· **Hazard statements**
H315: Causes skin irritation.
H318: Causes serious eye damage.
· **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.
P310: Immediately call a POISON CENTER or doctor/physician.
P321: Specific treatment (see on this label).
P362: Take off contaminated clothing and wash before reuse.
P332+P313: If skin irritation occurs: Get medical advice/attention.
P302+P352: IF ON SKIN: Wash with plenty of soap and water.
· **Hazard description:**
· **WHMIS-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

· **HMIS Long Term Health Hazard Substances**
None of the ingredients is listed.

· **2.3 Other hazards**
· **Results of PBT and vPvB assessment**
· **PBT:** Not applicable.
· **vPvB:** Not applicable.

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Safety Data Sheet
according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), and GHS

Printing date: 31.12.2013 **Revision:** 31.12.2013

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3 Composition/information on ingredients

· **3.2 Mixtures**
· **Description:** Mixture of substances listed below with nonhazardous additions.

· **Dangerous components:**

CAS: 68081-81-2	sodium dodecylbenzene sulfonate Xn R22; Xi R36 Acute Tox. 4, H302; Eye Irrit. 2, H319	10-25%
CAS: 497-19-8 EINECS: 207-838-8 Index number: 011-005-00-2	Sodium Carbonate Xi R36 Eye Irrit. 2, H319	2,5-10%
CAS: 7722-88-5 EINECS: 231-767-1	tetrasodium pyrophosphate substance with a Community workplace exposure limit	2,5-10%
CAS: 151-21-3 EINECS: 205-788-1	sodium dodecyl sulphate Xn R21/22; Xi R36/38 Acute Tox. 4, H302; Acute Tox. 4, H312; Skin Irrit. 2, H315; Eye Irrit. 2, H319	2,5-10%

· **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**
· **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.
· **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 further relevant information available.
· **4.3 Indication of any immediate medical attention and special treatment needed**
No further relevant 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.

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Safety Data Sheet
according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), and GHS

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· **5.2 Special hazards arising from the substance or mixture:** No further relevant information available.
· **5.3 Advice for firefighters**
· **Protective equipment:**
Wear self-contained respiratory protective device.
Wear fully protective suit.
· **Additional information:** No further relevant information available.

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 to enter sewers/ surface or ground water.
· **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**
Prevent formation of dust.
Keep receptacles tightly sealed.
· **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:** Not required.
· **Further information about storage conditions:** Protect from humidity and water.
· **7.3 Specific end use(s):** No further relevant information available.

8 Exposure controls/personal protection

· **Additional information about design of technical facilities:** No further data; see item 7.

· **8.1 Control parameters**

· **Ingredients with limit values that require monitoring at the workplace:**	
7722-88-5 tetrasodium pyrophosphate	
REL (USA)	5 mg/m³
TLV (USA)	TLV withdrawn
EV (Canada)	5 mg/m³

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· **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/ the substance/ the preparation.
Due to missing tests no recommendation to the glove material can be given for the product/ the preparation/ the chemical mixture.
Selection of the glove material on consideration of the penetration times, rates of diffusion and the degradation.
· **Material of gloves**
Butyl rubber, BR
Nitrile rubber, NBR
Natural rubber, NR
Neoprene gloves
The selection of the suitable gloves does not only depend on the material, but also on further marks of quality and varies from manufacturer to manufacturer. As the product is a preparation of several substances, the resistance of the glove material cannot be calculated in advance and has therefore to be checked prior to the application.
· **Penetration time of glove material**
The exact break through time has to be found out by the manufacturer of the protective gloves and has to be observed.
· **Eye protection:**


Safety glasses

· **Body protection:** Protective work clothing

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9 Physical and chemical properties

· **9.1 Information on basic physical and chemical properties**	
· **General Information**	
· **Appearance:**	
Form:	Powder
Colour:	White
· **Odour:**	Odourless
· **Odour 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:	Undetermined.
· **Flash point:**	Not applicable.
· **Flammability (solid, gaseous):**	Not determined.
· **Ignition temperature:**	
Decomposition temperature:	Not determined.
· **Self-igniting:**	Product is not self-igniting.
· **Danger of explosion:**	Product does not present an explosion hazard.
· **Explosion limits:**	
Lower:	Not determined.
Upper:	Not determined.
· **Vapour pressure:**	Not applicable.
· **Density at 20 °C:**	1,1 g/cm³
· **Relative density**	Not determined.
· **Vapour density**	Not applicable.
· **Evaporation rate**	Not applicable.
· **Solubility in / Miscibility with water:**	Soluble.
· **Partition 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 further relevant information available.

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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 further relevant information available.
· **10.5 Incompatible materials:** No further relevant 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**
· **Acute toxicity:**
· **Primary irritant effect:**
· **On the skin:** Irritant to skin and mucous membranes.
· **On the eye:** Strong irritant with the danger of severe eye injury.
· **Sensitization:** No sensitizing effects known.
· **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 of esophagus and stomach.

12 Ecological information

· **12.1 Toxicity**
· **Aquatic toxicity:** No further relevant information available.
· **12.2 Persistence and degradability:** No further relevant information available.
· **12.3 Bioaccumulative potential:** Not worth-mentioning accumulating in organisms
· **12.4 Mobility in soil:** No further relevant information available.
· **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.

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· **vPvB:** Not applicable.
· **12.6 Other adverse effects:** No further relevant 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, if necessary together with cleansing agents.

14 Transport information

· **14.1 UN-Number** · **DOT, ADR, IMDG, IATA, ICAO**	Not Regulated
· **14.2 UN proper shipping name** · **DOT, ADR, IMDG, IATA, ICAO**	Not Regulated
· **14.3 Transport hazard class(es)** · **DOT, ADR, IMDG, IATA, ICAO** · **Class**	Not Regulated
· **14.4 Packing group** · **DOT, ADR, IMDG, IATA, ICAO**	Not Regulated
· **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

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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 ingredients is listed.
· **Section 313 (Specific toxic chemical listings):**
None of the ingredients is listed.
· **TSCA (Toxic Substances Control Act):**
All ingredients are listed.

· **Proposition 65 (California):**

· **Chemicals known to cause cancer:**
None of the ingredients is listed.
· **Chemicals known to cause reproductive toxicity for females:**
None of the ingredients is listed.
· **Chemicals known to cause reproductive toxicity for males:**
None of the ingredients is listed.
· **Chemicals known to cause developmental toxicity:**
None of the ingredients is listed.

· **Carcinogenic Categories**

· **EPA (Environmental Protection Agency)**
None of the ingredients is listed.
· **IARC (International Agency for Research on Cancer)**
None of the ingredients is listed.
· **TLV (Threshold Limit Value established by ACGIH)**
None of the ingredients is listed.
· **NIOSH-Ca (National Institute for Occupational Safety and Health)**
None of the ingredients is listed.
· **OSHA-Ca (Occupational Safety & Health Administration)**
None of the ingredients is listed.

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· **Canada**

· **Canadian Domestic Substances List (DSL)**	
All ingredients are listed.	
· **Canadian Ingredient Disclosure list (limit 0.1%)**	
None of the ingredients is listed.	
· **Canadian Ingredient Disclosure list (limit 1%)**	
497-19-8	Sodium Carbonate
7722-88-5	tetrasodium pyrophosphate
151-21-3	sodium dodecyl sulphate

· **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**
H302: Harmful if swallowed.
H312: Harmful in contact with skin.
H315: Causes skin irritation.
H319: Causes serious eye irritation.

R21/22: Harmful in contact with skin and if swallowed.
R22: Harmful if swallowed.
R36: Irritating to eyes.
R36/38: Irritating to eyes and skin.

· **Abbreviations and acronyms:**
ADR: Accord européen sur le transport des marchandises dangereuses par Route (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)

Material Safety Data Sheet

Section 1 – Chemical Product and Company Identification

Catalog Numbers: CS7000-A, CS7000-B, CS7000-C, CS7000-D, CS7000-P, CS7000-Q, CS7000-G, CS7000-T
Product Identity: Conductivity Std., 7000 umho/cm

Chemical Family: Not Applicable
Synonyms: Not Applicable
Recommended Use: Laboratory chemicals

Manufacturer's Name: AquaPhoenix Scientific, Inc., 9 Barnhart Dr., Hanover, PA 17331, (866) 632-1291
Emergency Contact Number (24hr): Chemtel (800) 255-3924

Issue Date: 01/08/07
Revision Date: 06/05/08, 05/12/10, 02/19/12

Section 2 – Hazard Identification

Emergency Overview: Non-flammable, non-corrosive, non-toxic. Does not present significant health hazards. Wash areas of contact with water.
Appearance: Clear, colorless liquid **Odor:** Odorless
Target Organs: Eyes, skin
Potential Health Effects/ Routes of Exposure:
Eyes: May cause slight irritation.
Skin: May cause slight irritation.
Ingestion: Large doses may cause upset stomach.
Inhalation: Not likely to be a hazard.
Chronic Effect / Carcinogenicity: None (IARC, NTP, OSHA)
Aggravated Medical Conditions No information available
These chemicals are not considered hazardous by OSHA.
See section 11 for toxicological information. See section 12 for potential environmental effects.

Section 3 – Composition, Information on Ingredients

Potassium Chloride, CAS# 7447-40-7, < 0.5% w/v
Water, purified, CAS# 7732-18-5, >99% w/v

Section 4 – First Aid

Eyes: Immediately flush eyes with water for at least 15 minutes. Immediately get medical assistance.
Skin: Flush with water for 15 minutes. Get medical assistance if irritation develops.
Ingestion: DO NOT induce vomiting. Dilute with water or milk. Get medical assistance.
Inhalation: Remove to fresh air. Give artificial respiration if necessary. If breathing is difficult, give oxygen.
Notes to Physician Treat symptomatically.

Section 5 – Fire Fighting Measures

Flash Point: Not Applicable **Autoignition Temperature** No information available.
Explosion Limits Upper No data available **Lower** No data available
Extinguishing Media: Use means suitable to extinguishing surrounding fire.
Unsuitable Extinguishing Media: No information available
Fire & Explosion Hazards: Not considered to be a fire or explosion hazard.
Fire Fighting Instructions / Equipment: Use normal procedures. Use protective clothing. Use NIOSH-approved breathing equipment.

Hazardous Combustion Products: No information Available
Sensitivity to mechanical impact No information available.
Sensitivity to static discharge No information available.
Specific Hazards Arising from the Chemical: No information available
NFPA Rating: (estimated) Health: 1; Flammable: 0; Reactivity: 0

Section 6 – Accidental Release Measures

Personal Precautions Use personal protective equipment. Ensure adequate ventilation. Avoid contact with skin, eyes and clothing.
Environmental Precautions Not relevant considering the small amounts used.
Methods for Containment and Clean Up Absorb with suitable material. Always obey local regulations. Always obey local regulations.

Section 7 – Handling and Storage

Handling: Wash hands after handling. Avoid contact with skin and eyes.
Storage: Protect from freezing and physical damage.

Section 8 – Exposure Controls, Personal Protection

Potassium Chloride, CAS# 7447-40-7, ACGIH TLV: NA, OSHA PEL: NA
Water, purified, CAS# 7732-18-5, ACGIH TLV: NA, OSHA PEL: NA

Engineering Measures/ General Hygiene: Normal ventilation is adequate. Ensure eyewash and safety showers are available.
Personal Protection Equipment: Skin Protection: Chemical resistant gloves.
Eye/Face Protection: Safety Glasses or goggles. **Respiratory Protection:** Normal ventilation is adequate

Section 9 – Physical and Chemical Properties

Appearance/Physical State: Clear, colorless liquid
Odor: Odorless
Boiling Point: Approx 100.1C
Melting Point: Approx (-6)-0 C
Vapor Density: No Information Available
Evaporation Rate: No Information Available
pH: Not Available
Flammability: No Information Available
Solubility: Infinite
Relative Density: No Information Available
% Volatility: No Information Available
Specific Gravity: 1-1.01
Vapor Pressure: No Information Available
Flash Point: Not Applicable
Coefficient of water/oil distribution: Not Available
Odor Threshold: Not Available
Decomposition Temperature: No Information Available
Partition Coefficient n-octanol/water: No data available
Molecular Weight: Not available

Section 10 – Stability and Reactivity

Chemical Stability: Stable under normal conditions of use and storage.
Incompatible Materials Strong Oxidizing agents, Lithium, Bromine, Trifluoride.
Conditions to Avoid: No Information Available.
Hazardous Decomposition Products: Oxides of Sodium and fumes of Chloride.
Hazardous Polymerization: Does not occur
Hazardous Reactions: None under normal processing.

Section 11 – Toxicological Information

Routes of Exposure/Symptoms/Corrosiveness – See Section 2
LD50 orl-rat: 3020 mg/kg LC50 inhalation-rat: Not Available
Irritation: No Information Available
Toxicologically Synergistic: No Information Available
Chronic Exposure

Carcinogenicity No Information Available
Sensitization No information available.
Mutagenic Effects No information available.
Reproductive Effects No information available.
Developmental Effects (Immediate/Delayed) No information available.
Teratogenicity No information available.
Other Adverse Effects No Information Available.
Endocrine Disruptor Information No information available

Section 12 – Ecological Information

Ecotoxicity: Not Available.
Persistence and Degradability: No Information Available **Mobility:** No Information Available
Bioaccumulation/ Accumulation: No Information Available

Section 13 – Disposal Considerations

Waste Disposal/Waste Disposal of Packaging: Dilute with water.
All chemical waster generators must determine whether a discarded chemical is classified as hazardous waste. Comply with all local, state, and federal regulations.

Section 14 – Transport Information

DOT - Not Regulated

Section 15 – Regulatory Information (not meant to be all inclusive)

OSHA Status: These chemicals are not considered hazardous by OSHA.
Canada DSL: These chemicals are listed on the Canada DSL list.
TSCA: The components of this solution are listed on the TSCA Inventory
SARA Title III Section 313: Not Applicable
RCRA Status: Not Applicable
CERCLA Reportable Quantity: Not Applicable
WHMIS: Not Applicable.
This product has been classified in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR

Section 16 – Additional Information

Disclaimer: The information on this MSDS applies to this specific material as supplied. It may not be valid for this material if it is used in combination with any other materials. It is the user's responsibility to determine the suitability and completeness of this information for his own particular use. No warranty is implied regarding the accuracy of the data or the results to be obtained from the products use.

Material Safety Data Sheet Collection
Genium group inc.
1171 RiverFront Center, Amsterdam, NY 12010
(518) 842-4111

Issue Date: 2006-06

Hydrochloric Acid
HYD2200

Section 1 - Chemical Product and Company Identification 61

Material Name: Hydrochloric Acid **CAS Number:** 7647-01-0
Chemical Formula: ClH
Structural Chemical Formula: HCl
EINECS Number: 231-595-7
ACX Number: X1002202-3
Synonyms: 4-D BOWL SANITIZER; ACIDE CHLORHYDRIQUE; ACIDO CLORHIDRICO; ACIDO CLORIDRICO; ANHYDROUS HYDROCHLORIC ACID; ANHYDROUS HYDROGEN CHLORIDE; AQUEOUS HYDROGEN CHLORIDE; BOWL CLEANER; CHLOORWATERSTOF; CHLOROHYDRIC ACID; CHLOROWODOR; CHLORURE D'HYDROGENE; CHLORURE D'HYDROGENE ANHYDRE; CHLORURO DE HIDROGENO; CHLORWASSERSTOFF; CLORURO DE HIDROGENO ANHIDRO; EMULSION BOWL CLEANER; EPA PESTICIDE CHEMICAL CODE 045901; HYDROCHLORIC ACID; HYDROCHLORIC ACID GAS; HYDROCHLORIDE; HYDROGEN CHLORIDE; HYDROGEN CHLORIDE (HCL); HYGEIA CREME MAGIC BOWL CLEANER; MURIATIC ACID; MURIATIC ACID); NOW SOUTH SAFTI-SOL BRAND CONCENTRATED BOWL CLEANSE WITHMAGIC ACTIO; PERCLEEN BOWL AND URINAL CLEANER; SPIRITS OF SALT; VARLEY'S OCEAN BLUE SCENTED TOILET BOWL CLEANER; VARLEY POLY-PAK BOWL CREME; WHITE EMULSION BOWL CLEANER; WUEST BOWL CLEANER SUPER CONCENTRATED
General Use: Hydrogen chloride is used to produce pharmaceutical hydrochlorides; vinyl chloride from acetylene; alkyl chlorides from olefins and arsenious chloride from arsenious oxide; electronic grade for etching semiconductor crystals. Used in the chlorination of rubber; in organic reactions involving isomerization, polymerization and alkylation; as a catalyst and condensing agent; for making chlorine where economical; in the separation of cotton from wool and cotton de-linting; as flux in the babbitt type of metal alloy; etching semi-conductor crystals.
Hydrochloric acid is used for pickling and heavy duty cleaning of metal parts; rust and scale removal. The production of chlorides; neutralizing bases; a laboratory reagent. For hydrolyzing starch and proteins in preparations for food. As a catalyst and solvent in organic synthesis. As "spirits of salts" for cleaning of lime and masonry from new brickwork. As flux or flux component for soldering; manufacture of "killed spirits".

Section 2 - Composition / Information on Ingredients

Name	CAS	%
hydrogen chloride	7647-01-0	> 99.0

OSHA PEL
Ceiling: 5 ppm, 7 mg/m^3.

NIOSH REL
Ceiling: 5 ppm (7 mg/m^3).

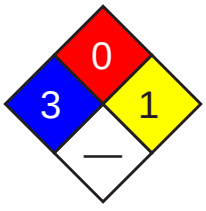
DFG (Germany) MAK
TWA: 5 ppm; PEAK: 5 ppm.

ACGIH TLV
Ceiling: 2 ppm.

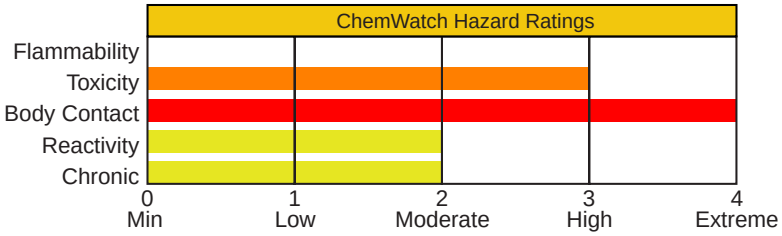
IDLH Level
50 ppm.

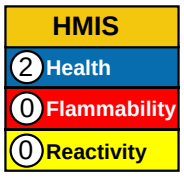
EU OEL
TWA: 5 ppm; STEL: 10 ppm.

Section 3 - Hazards Identification



Fire Diamond





ANSI Signal Word

Danger!


Corrosive Compressed Gas

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless gas; characteristic suffocating, pungent odor. Corrosive. Stored as compressed gas which may cause frostbite. Chronic Effects: erosion of teeth.

Potential Health Effects

Target Organs: eyes, skin, respiratory system, liver (in animals)
Primary Entry Routes: inhalation, skin contact, eye contact
Acute Effects

Inhalation: The vapor is extremely discomforting to the upper respiratory tract, may cause severe mucous membrane damage and may be harmful if inhaled.
Inhalation of quantities of liquid mist may be extremely hazardous, even lethal due to spasm, extreme irritation of larynx and bronchi, chemical pneumonitis and pulmonary edema.
A single severe exposure may cause coughing and choking; bleeding of nose, inflammation and occasionally ulceration of the nose, throat and larynx. Fluid on the lungs followed by generalized lung damage may follow.
Breathing of vapor may aggravate asthma and inflammatory or fibrotic pulmonary disease.
High concentrations cause necrosis of the tracheal and bronchial epithelium, pulmonary edema, atelectasis and emphysema and damage to the pulmonary blood vessels and liver.
Inhalation hazard is increased at higher temperatures.
The vapor from heated material is extremely discomforting to the upper respiratory tract and lungs if inhaled.
Continued severe exposure can result in pulmonary edema and corrosion of tissues in the nose and throat.

Eye: Hydrogen Chloride: The vapor is extremely discomforting to the eyes 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.
The material may be irritating to the eye, with prolonged contact causing inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.
Hydrochloric Acid: Eye contact is extremely painful and may cause rapid corneal damage. The liquid is extremely corrosive to the eyes and is capable of causing severe damage with loss of sight.
The vapor is highly discomforting and may be corrosive to the eyes. The vapor from heated material is extremely discomforting to the eyes.

Skin: The material is corrosive to the skin and may cause chemical burns.
Toxic effects may result from skin absorption. Bare unprotected skin should not be exposed to this material. The material may accentuate any pre-existing skin condition.
The vapor is discomforting to the skin.

Ingestion: Considered an unlikely route of entry in commercial/industrial environments.
The liquid is extremely corrosive if swallowed and is capable of causing burns to mouth, throat, esophagus, with extreme discomfort, pain and may be fatal if swallowed in quantity. Ingestion may result in nausea, abdominal irritation, pain and vomiting.

Carcinogenicity: NTP - Not listed; IARC - Group 3, Not classifiable as to carcinogenicity to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Not listed; MAK - Not listed.

Chronic Effects: Chronic exposure may cause discoloration or erosion of the teeth, bleeding of the nose and gums; and ulceration of the nasal mucous membranes.
Repeated exposures of animals to concentrations of about 34 ppm produced no immediate toxic effects.
Workers exposed to hydrochloric acid suffered from gastritis and a number of cases of chronic bronchitis have also been reported.
Repeated or prolonged exposure to dilute solutions may cause dermatitis. Repeated exposure to low vapor concentrations can cause skin tenderness, bleeding of the nose and gums, chronic bronchitis, gastritis.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.
Lay patient down. Keep warm and rested.
If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor.

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water. Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.
Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately flush body and clothes with large amounts of water, using safety shower if available.
Quickly remove all contaminated clothing, including footwear.
Wash affected areas with water (and soap if available) for at least 15 minutes. Transport to hospital or doctor.

Ingestion: Contact a Poison Control Center. Rinse mouth out with plenty of water. Do NOT induce vomiting. Give a glass of water.

After first aid, get appropriate in-plant, paramedic, or community medical support.

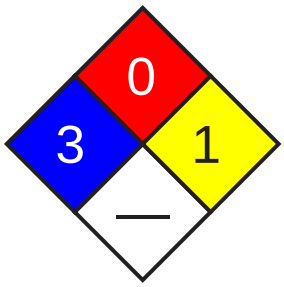
Note to Physicians: For acute or short-term repeated exposures to strong acids:
1.Airway problems may arise from laryngeal edema and inhalation exposure.
Treat with 100% oxygen initially.
2.Respiratory distress may require cricothyroidotomy if endotracheal intubation is contraindicated by excessive swelling.

3. Intravenous lines should be established immediately in all cases where there is evidence of circulatory compromise.
4.Strong acids produce a coagulation necrosis characterized by formation of a coagulum (eschar) as a result of the desiccating action of the acid on proteins in specific tissues.
INGESTION:
1.Immediate dilution (milk or water) within 30 minutes post-ingestion is recommended.
2.Do not attempt to neutralize the acid since exothermic reaction may extend the corrosive injury.
3.Be careful to avoid further vomiting since re-exposure of the mucosa to the acid is harmful. Limit fluids to one or two glasses in an adult.
4.Charcoal has no place in acid management.
5.Some authors suggest the use of lavage within 1 hour of ingestion.
SKIN:
1.Skin lesions require copious saline irrigation. Treat chemical burns as thermal burns with non-adherent gauze and wrapping.
2.Deep second-degree burns may benefit from topical silver sulfadiazine.
EYE:
1.Eye injuries require retraction of the eyelids to ensure thorough irrigation of the conjunctival cul-de-sacs. Irrigation should last at least 20-30 minutes. Do not use neutralizing agents or any other additives. Several liters of saline are required.
2.Cycloplegic drops (1% cyclopentolate for short-term use or 5% homatropine for longer term use), antibiotic drops, vasoconstrictive agents, or artificial tears may be indicated dependent on the severity of the injury.
3.Steroid eye drops should only be administered with the approval of a consulting ophthalmologist.

Section 5 - Fire-Fighting Measures

Flash Point: Nonflammable
Autoignition Temperature: Not applicable
LEL: Not applicable
UEL: Not applicable
Extinguishing Media: Water spray or fog; foam; Bromochlorodifluoromethane (BCF) (where regulations permit); Dry agent; Carbon dioxide.

See DOT ERG



Fire Diamond

General Fire Hazards/Hazardous Combustion Products: Noncombustible liquid. Will not burn, but heat produces highly toxic fumes/vapors.
Heating may cause expansion or decomposition leading to violent rupture of containers. Decomposes on heating and produces toxic fumes of hydrogen chloride. Decomposition may produce toxic fumes of chlorine.
Reacts with metals producing flammable/explosive hydrogen gas. Contact with moisture or water may generate heat causing ignition. Reacts vigorously with alkalis. Moderate fire hazard when in contact with reducing agents.
Fire Incompatibility: Reacts with metals producing flammable/explosive hydrogen gas.
Avoid reactions with metals, metal oxides, hydroxides, amines, carbonates, alkaline materials, acetic anhydride, cyanides, sulphides, sulphites, phosphides, acetylides, borides, carbides, silicides, vinyl acetate, formaldehyde and potassium permanganate, unsaturated organics, metal acetylides, sulphuric acid.
Note: Compatibility with plastics should be confirmed prior to use.
Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
Wear full body protective clothing with breathing apparatus. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation. Cool fire-exposed containers with water spray from a protected location. If safe to do so, remove containers from path of fire. Equipment should be thoroughly decontaminated after use. Water spray or fog may be used to disperse vapor. Do not approach cylinders suspected to be hot. If safe to do so, stop flow of gas.

Section 6 - Accidental Release Measures

Small Spills: DO NOT touch the spill material. Clean up all spills immediately. Wear fully protective PVC clothing and breathing apparatus. Contain and absorb spill with sand, earth, inert material or vermiculite. Use soda ash or slaked lime to neutralize. Collect residues and place in labeled plastic containers with vented lids. Clear area of personnel and move upwind. Avoid breathing vapors and contact with skin and eyes. Do not exert excessive pressure on valve; do not attempt to operate damaged valve. Water spray or fog may be used to disperse vapor.

See DOT ERG

Large Spills: Contact fire department and tell them location and nature of hazard. Clear area of personnel and move upwind. Wear full body protective clothing with breathing apparatus. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation. Stop leak if safe to do so. Remove leaking cylinders to a safe place if possible. Release pressure under safe, controlled conditions by opening the valve. Do not exert excessive pressure on valve; do not attempt to operate damaged valve. Shut off all possible sources of ignition and increase ventilation. Water spray or fog may be used to disperse vapor. Use soda ash or slaked lime to neutralize.
Collect and seal in labeled drums for disposal. Wash spill area with large quantities of water. If contamination of

drains or waterways occurs, advise emergency services. After clean-up operations, decontaminate and launder all protective clothing and equipment before storing and reusing. DO NOT touch the spill material. Contain and absorb spill with sand, earth, inert material or vermiculite.
DO NOT USE WATER OR NEUTRALIZING AGENTS INDISCRIMINATELY ON LARGE SPILLS.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid generating and breathing mist and vapor, breathing vapors and contact with skin and eyes.
Avoid physical damage to containers. Use in a well-ventilated area. Wear protective clothing and gloves when handling containers. Handle and open container with care.
WARNING: To avoid violent reaction, ALWAYS add material to water and NEVER water to material. When handling, DO NOT eat, drink or smoke. Always wash hands with soap and water after handling. Work clothes should be laundered separately. Use good occupational work practices. Observe manufacturer's storing and handling recommendations.
Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.
Local exhaust ventilation may be required for safe working, i.e. to keep exposures below required standards; otherwise, PPE is required.
Keep dry. Reacts violently with water.
Transport containers on a trolley. Avoid sources of heat. DO NOT transfer gas from one cylinder to another.

Recommended Storage Methods: Packaging as recommended by manufacturer. Check that containers are clearly labeled.
Cylinder. Ensure the use of equipment rated for cylinder pressure. Ensure the use of compatible materials of construction. Valve protection cap to be in place until cylinder is secured, connected. Cylinder must be properly secured either in use or in storage. Cylinder valve must be closed when not in use or when empty. Segregate full from empty cylinders. WARNING: Suckback into cylinder may result in rupture. Use back-flow preventive device in piping.
Hydrochloric acid: Packs of 2.5 litres or less require a child-resistant closure. Glass container or Plastic carboy or Polylined drum.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: If risk of overexposure exists, wear air supplied breathing apparatus. Provide adequate ventilation in warehouse or closed storage areas. Use in a well-ventilated area. Local exhaust ventilation may be required for safe working, i. e. , to keep exposures below required standards; otherwise, PPE is required.
If risk of inhalation or overexposure exists, wear NIOSH-approved respirator or work in fume hood. Hydrogen chloride vapors will not be adequately absorbed by organic vapor respirators.

Personal Protective Clothing/Equipment:

Eyes: Chemical goggles. Full face shield.
DO NOT wear contact lenses. Contact lenses pose a special hazard; soft contact lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Neoprene gloves; rubber gloves. Nitrile gloves.
Safety footwear. Rubber boots.
Hydrochloric acid: Barrier cream and Neoprene gloves or Elbow length PVC gloves. Nitrile gloves.
PVC boots or PVC safety gumboots.

Respiratory Protection:
Exposure Range >5 to <50 ppm: Air Purifying, Negative Pressure, Half Mask
Exposure Range 50 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: white

Other: Ensure there is ready access to a safety shower; Eyewash unit.
Acid-resistant overalls. Full protective suit. Operators should be trained in procedures for safe use of this material.

Glove Selection Index:

BUTYL ..... Best selection
BUTYL/NEOPRENE ..... Best selection
HYPALON ..... Best selection
NEOPRENE..... Best selection
NEOPRENE/NATURAL..... Best selection
NITRILE+PVC ..... Best selection
PE/EVAL/PE ..... Best selection
SARANEX-23 ..... Best selection
VITON/NEOPRENE ..... Best selection
PVC..... Best selection

NITRILE ..... Best selection
NATURAL RUBBER..... Satisfactory; may degrade after 4 hours continuous immersion
NATURAL+NEOPRENE..... Satisfactory; may degrade after 4 hours continuous immersion
NAT+NEOPR+NITRILE ..... Poor to dangerous choice for other than short-term immersion

Section 9 - Physical and Chemical Properties

Appearance/General Info: Hydrogen chloride: Colorless, corrosive gas. Pungent suffocating odor. White fumes in moist air. Soluble in methanol, ethanol, ether and benzene.
Hydrochloric acid: Clear to light yellow (orange tint for inhibited grades) fuming corrosive liquid with sharp, suffocating odor.

Physical State: Hydrogen chloride: Compressed gas; Hydrochloric acid: Liquid
Odor Threshold: 0.26 to 0.3 ppm
Vapor Pressure (kPa): < 24.8 at 25 °C
Vapor Density (Air=1): 1.268 at 20 °C
Formula Weight: 36.461
Specific Gravity (H_2O=1, at 4 °C): < 1.19 at 20 °C
Evaporation Rate: Slow

pH: Hydrochloric acid: < 1
Boiling Point: -85 °C (-121 °F)
Freezing/Melting Point: -114.44 °C (-173.992 °F)
Volatile Component (% Vol): 100
Decomposition Temperature (°C): Not applicable
Water Solubility: 56.1 g/100 cc hot water at 60 °C

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Decomposes in the presence of moisture to produce corrosive acid. May generate sufficient heat to ignite combustible materials. Presence of heat source and direct sunlight (ultra-violet radiation). Product is considered stable under normal handling conditions. Hazardous polymerization will not occur.
Storage Incompatibilities: Hydrogen chloride: Segregate from most common metals and their alloys, alkalis, unsaturated organics, fluorine, metal carbides, metal acetylides, potassium permanganate and sulfuric acid. Compatibility with plastics should be confirmed prior to use.
Hydrochloric acid: Segregate from alkalies, oxidizing agents and chemicals readily decomposed by acids, i.e. cyanides, sulfides, carbonates. Avoid storage with metals, metal oxides, hydroxides, amines, carbonates, alkaline materials, acetic anhydride, cyanides, sulphides, sulphites, phosphides, acetylides, borides, carbides, silicides, vinyl acetate, formaldehyde and potassium permanganate. Reacts with zinc, brass, galvanized iron, aluminum, copper and copper alloys.

Section 11 - Toxicological Information

Toxicity
Inhalation (human) LC_{Lo}: 1300 ppm/30 m
Inhalation (human) LC_{Lo}: 3000 ppm/5 m
Inhalation (rat) LC_{50}: 3124 ppm/60 m
Inhalation (rat) LC_{50}: 4701 ppm/30 m
Oral (rat) LD_{50}: 900 mg/kg

Irritation
Eye (rabbit): 5 mg/30 s - mild

See *RTECS* MW 4025000, for additional data.

Section 12 - Ecological Information

Environmental Fate: No data found.
Ecotoxicity: TL_m Gambusia affinis (mosquito fish) 282 ppm/96 hr (fresh water) /Conditions of bioassay not specified; Lethal Lepomis macrochirus (bluegill sunfish) 3.6 mg/l/48 hr /Conditions of bioassay not specified; LC_{50} Cockle 330 to 1,000 mg/l/48 hr /Conditions of bioassay not specified; LC_{50} Carassius auratus (goldfish) 178 mg/l (1 to 2 hr survival time) /Conditions of bioassay not specified; LC_{50} Shore crab 240 mg/l/48 hr /Conditions of bioassay not specified; LC_{50} Shrimp 100 to 330 ppm/48 hr (salt water) /Conditions of bioassay not specified; LC_{100} Trout 10 mg/l 24 hr /Conditions of bioassay not specified
Biochemical Oxygen Demand (BOD): none

Section 13 - Disposal Considerations

Disposal: Recycle wherever possible. Consult manufacturer for recycling options. Treat and neutralize at an effluent treatment plant. Bury residue in an authorized landfill. Decontaminate empty containers with a lime slurry. Return empty containers to supplier or bury empty containers at an authorized landfill.
Return empty cylinders to supplier.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Note: This material has multiple possible HMT entries. Choose the appropriate one based on state and condition of specific material when shipped.

Shipping Name and Description: Hydrogen chloride, anhydrous
ID: UN1050
Hazard Class: 2.3 - Poisonous gas
Packing Group:
Symbols:
Label Codes: 2.3 - Poison Gas, 8 - Corrosive
Special Provisions: 3
Packaging: **Exceptions:** None **Non-bulk:** 304 **Bulk:** None
Quantity Limitations: **Passenger aircraft/rail:** Forbidden **Cargo aircraft only:** Forbidden
Vessel Stowage: **Location:** D **Other:** 40

Shipping Name and Description: Hydrochloric acid
ID: UN1789
Hazard Class: 8 - Corrosive material
Packing Group: II - Medium Danger
Symbols:
Label Codes: 8 - Corrosive
Special Provisions: A3, A6, B3, B15, IB2, N41, T8, TP2, TP12
Packaging: **Exceptions:** 154 **Non-bulk:** 202 **Bulk:** 242
Quantity Limitations: **Passenger aircraft/rail:** 1 L **Cargo aircraft only:** 30 L
Vessel Stowage: **Location:** C **Other:**

Shipping Name and Description: Hydrochloric acid
ID: UN1789
Hazard Class: 8 - Corrosive material
Packing Group: III - Minor Danger
Symbols:
Label Codes: 8 - Corrosive
Special Provisions: IB3, T4, TP1, TP12
Packaging: **Exceptions:** 154 **Non-bulk:** 203 **Bulk:** 241
Quantity Limitations: **Passenger aircraft/rail:** 5 L **Cargo aircraft only:** 60 L
Vessel Stowage: **Location:** C **Other:**

Section 15 - Regulatory Information

EPA Regulations:

RCRA 40 CFR: Not listed
CERCLA 40 CFR 302.4: Listed per CWA Section 311(b)(4) 5000 lb (2268 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Listed
RQ: 5000 lb
TPQ: 500 lb
TSCA: Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Material Safety Data Sheet Collection
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1171 RiverFront Center, Amsterdam, NY 12010
(518) 842-4111

Issue Date: 2006-06

Section 1 - Chemical Product and Company Identification 61

Material Name: Nitric Acid **CAS Number:** 7697-37-2
Chemical Formula: HNO_3
Structural Chemical Formula: HNO_3
EINECS Number: 231-714-2
ACX Number: X1002177-5
Synonyms: ACIDE NITRIQUE; ACIDO NITRICO; AQUA FORTIS; AZOTIC ACID; AZOTOWY KWAS; ENGRAVER'S ACID; ENGRAVERS ACID; HYDROGEN NITRATE; KYSELINA DUSICNE; NITAL; NITRIC ACID; NITRIC ACID OTHER THAN RED FUMING WITH >70% NITRIC ACID; NITRIC ACID OTHER THAN RED FUMING WITH NOT >70% NITRICACID; NITROUS FUMES; NITRYL HYDROXIDE; RED FUMING NITRIC ACID (RFNA); SALPETERSAURE; SALPETERZUUROPLOSSINGEN; WHITE FUMING NITRIC ACID (WFNA)
General Use: Manufacture of organic and inorganic nitrates and nitro compounds for fertilizers, dye intermediates and many organic chemicals.
Used for etching and cleaning metals.
Operators should be trained in procedures for safe use of this material.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
nitric acid	7697-37-2	>95

OSHA PEL
TWA: 2 ppm; 5 mg/m^3.

ACGIH TLV
TWA: 2 ppm; STEL: 4 ppm.

EU OEL
STEL: 2.6 mg/m^3 (1 ppm).

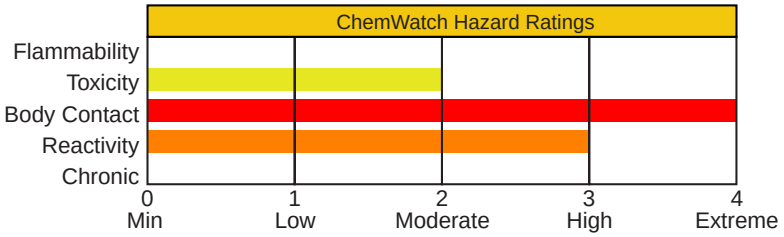
NIOSH REL
TWA: 2 ppm (5 mg/m^3); STEL: 4 ppm (10 mg/m^3).

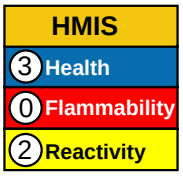
IDLH Level
25 ppm.

DFG (Germany) MAK
TWA: 2 ppm; PEAK: 2 ppm.

Section 3 - Hazards Identification

Fire Diamond





ANSI Signal Word

Danger!


Corrosive

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Clear to yellow fuming liquid; acrid, suffocating odor. Corrosive. Other Acute Effects: lung damage. Chronic Effects: tooth erosion, bronchitis. Strong oxidizer.

Potential Health Effects

Target Organs: eyes, skin, respiratory system, teeth
Primary Entry Routes: inhalation, ingestion, skin contact, eye contact
Acute Effects
Inhalation: The vapor is extremely discomforting and corrosive to the upper respiratory tract and lungs and the material presents a hazard from a single acute exposure or from repeated exposures over long periods.
Inhalation hazard is increased at higher temperatures.
Reactions may occur following a single acute exposure or may only appear after repeated exposures.

Reactions may not occur on exposure but response may be delayed with symptoms only appearing many hours later.
The material may produce respiratory tract irritation which produces an inflammatory response involving the recruitment and activation of many cell types, mainly derived from the vascular system. Unlike most organs the lung can respond to a chemical insult or agent by first trying to remove or neutralize the irritant and then repairing the damage. The repair process, which initially developed to protect mammalian lungs from foreign matter and antigens, may however, cause further damage the lungs when activated by hazardous chemicals. The result is often the impairment of gas exchange, the primary function of the lungs.
Inhalation of nitric acid mist or fumes at 2 to 25 ppm over an 8 hour period may cause pulmonary irritation and symptoms of lung damage.
Only several minutes of exposure to concentrated atmosphere i.e. 200 ppm may cause severe pulmonary damage and even fatality. Death may be delayed for several days.
Exposure to nitric acid fumes (with concurrent inhalation of nitrogen dioxide and nitric oxide) may elicit prompt irritation of the upper respiratory tract leading to coughing, gagging, chest pain, dyspnea, cyanosis if concentrations are sufficiently high and duration of exposure sufficiently long, pulmonary edema.

Eye: The liquid is extremely corrosive to the eyes and contact may cause rapid tissue destruction and is capable of causing severe damage with loss of sight.
The vapor is extremely discomforting to the eyes 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.
The material may produce moderate eye irritation leading to inflammation.
Repeated or prolonged exposure to irritants may produce conjunctivitis.
Eye contact with concentrated acid may give no pain, whilst diluted solution causes intense pain and both can cause permanent eye damage or blindness. Burns may result in shrinkage of the eyeball, symblepharon (adhesions between tarsal and bulbar conjunctivae), permanent corneal opacification, and visual impairment leading to blindness.

Skin: The liquid is extremely corrosive to the skin and contact may cause tissue destruction with severe burns.
Bare unprotected skin should not be exposed to this material.
The vapor is highly discomforting to the skin.
The material may cause skin irritation after prolonged or repeated exposure and may produce a contact dermatitis (nonallergic). This form of dermatitis is often characterized by skin redness (erythema) and swelling (edema) which may progress to vesiculation, scaling and thickening of the epidermis. Histologically there may be intercellular edema of the spongy layer (spongiosis) and intracellular edema of the epidermis.
Skin contact causes yellow discoloration of the skin, blisters and scars that may not heal. The skin may be stained bright-yellow or yellowish brown due to the formation of xanthoproteic acid. Dilute solutions may harden the epithelium without producing overt corrosion.

Ingestion: Considered an unlikely route of entry in commercial/industrial environments.
The material is extremely corrosive if swallowed and is capable of causing burns to mouth, throat, esophagus, with extreme discomfort, pain and may be fatal.
Even a small amount causes severe corrosion of the stomach, burning pain, vomiting and shock, possibly causing non-healing scarring of the gastrointestinal tract and stomach. Death may be delayed 12 hours to 14 days or to several months. Such late fatalities are attributed to a chemical lobular pneumonitis secondary to aspiration. Survivors show stricture of the gastric mucosa and subsequent pernicious anemia.

Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Not listed; MAK - Not listed.

Chronic Effects: Prolonged or repeated overexposure to low concentrations of vapor may cause chronic bronchitis, corrosion of teeth, even chemical pneumonitis.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.
Lay patient down. Keep warm and rested.
If available, administer medical oxygen by trained personnel.
If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor, without delay.

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water. Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.
Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.
Immediately transport to hospital or doctor. DO NOT delay.

Skin Contact: Immediately flush body and clothes with large amounts of water, using safety shower if available.
Quickly remove all contaminated clothing, including footwear.
Wash affected areas with water (and soap if available) for at least 15 minutes. Transport to hospital or doctor. DO NOT delay.

Ingestion: Contact a Poison Control Center.
Do NOT induce vomiting. Give a glass of water.
Immediately transport to hospital or doctor. DO NOT delay.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: For acute or short-term repeated exposures to strong acids:

1.Airway problems may arise from laryngeal edema and inhalation exposure.
Treat with 100% oxygen initially.
2.Respiratory distress may require cricothyroidotomy if endotracheal intubation is contraindicated by excessive swelling.
3. Intravenous lines should be established immediately in all cases where there is evidence of circulatory compromise.
4.Strong acids produce a coagulation necrosis characterized by formation of a coagulum (eschar) as a result of the desiccating action of the acid on proteins in specific tissues.

INGESTION:

1.Immediate dilution (milk or water) within 30 minutes post-ingestion is recommended.
2.Do not attempt to neutralize the acid since exothermic reaction may extend the corrosive injury.
3.Be careful to avoid further vomiting since re-exposure of the mucosa to the acid is harmful. Limit fluids to one or two glasses in an adult.
4.Charcoal has no place in acid management.
5.Some authors suggest the use of lavage within 1 hour of ingestion.

SKIN:

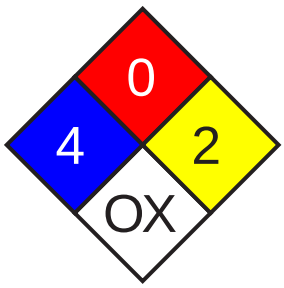
1.Skin lesions require copious saline irrigation. Treat chemical burns as thermal burns with non-adherent gauze and wrapping.
2.Deep second-degree burns may benefit from topical silver sulfadiazine.

EYE:

1.Eye injuries require retraction of the eyelids to ensure thorough irrigation of the conjunctival cul-de-sacs. Irrigation should last at least 20-30 minutes. Do not use neutralizing agents or any other additives. Several liters of saline are required.
2.Cycloplegic drops (1% cyclopentolate for short-term use or 5% homatropine for longer term use), antibiotic drops, vasoconstrictive agents, or artificial tears may be indicated dependent on the severity of the injury.
3.Steroid eye drops should only be administered with the approval of a consulting ophthalmologist.

Section 5 - Fire-Fighting Measures

Flash Point: Nonflammable
Autoignition Temperature: Not applicable
LEL: Not applicable
UEL: Not applicable
Extinguishing Media: Water spray or fog; foam, dry chemical powder, or BCF (where regulations permit).
Carbon dioxide.



Fire Diamond

General Fire Hazards/Hazardous Combustion Products: Will not burn but increases intensity of fire.
Heating may cause expansion or decomposition leading to violent rupture of containers.
Heat affected containers remain hazardous.
Contact with combustibles such as wood, paper, oil or finely divided metal may cause ignition, combustion or violent decomposition.
May emit irritating, poisonous or corrosive fumes.
Decomposes on heating and produces toxic fumes of nitrogen oxides (NO_x) and nitric acid.

Fire Incompatibility: Oxidizing agents as a class are not necessarily combustible themselves, but can increase the risk and intensity of fire in many other substances.
Reacts vigorously with water and alkali.
Avoid reaction with organic materials/compounds, powdered metals, reducing agents and hydrogen sulfide (H_2S) as ignition may result.
Reacts with metals producing flammable/explosive hydrogen gas.

Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear full body protective clothing with breathing apparatus. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
Fight fire from a safe distance, with adequate cover.
Extinguishers should be used only by trained personnel.
Use water delivered as a fine spray to control fire and cool adjacent area.
Avoid spraying water onto liquid pools.
Do not approach containers suspected to be hot.
Cool fire-exposed containers with water spray from a protected location.
If safe to do so, remove containers from path of fire.
If fire gets out of control withdraw personnel and warn against entry.
Equipment should be thoroughly decontaminated after use.

Section 6 - Accidental Release Measures

Small Spills: Dangerous levels of nitrogen oxides may form during spills of nitric acid.
Wear fully protective PVC clothing and breathing apparatus.
Clean up all spills immediately. No smoking, bare lights, ignition sources.
Avoid all contact with any organic matter including fuel, solvents, sawdust, paper or cloth and other incompatible materials, as ignition may result.
Avoid breathing dust or vapors and all contact with skin and eyes.
Control personal contact by using protective equipment.
Contain and absorb spill with dry sand, earth, inert material or vermiculite. DO NOT use sawdust as fire may result.
Scoop up solid residues and seal in labeled drums for disposal.
Neutralize/decontaminate area.
Use soda ash or slaked lime to neutralize.

Large Spills: DO NOT touch the spill material. Restrict access to area.
Clear area of personnel and move upwind. Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear full body protective clothing with breathing apparatus. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
No smoking, flames or ignition sources. Increase ventilation.
Contain spill with sand, earth or other clean, inert materials.
NEVER use organic absorbents such as sawdust, paper, cloth; as fire may result. Avoid any contamination by organic matter.
Use spark-free and explosion-proof equipment.
Collect any recoverable product into labeled containers for possible recycling. DO NOT mix fresh with recovered material.
Collect residues and seal in labeled drums for disposal.
Wash area and prevent runoff into drains. Decontaminate equipment and launder all protective clothing before storage and reuse.
If contamination of drains or waterways occurs advise emergency services.
DO NOT USE WATER OR NEUTRALIZING AGENTS INDISCRIMINATELY ON LARGE SPILLS.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid generating and breathing mist. Do not allow clothing wet with material to stay in contact with skin.
Avoid all personal contact, including inhalation.
Wear protective clothing when risk of exposure occurs.
Use in a well-ventilated area.
WARNING: To avoid violent reaction, ALWAYS add material to water and NEVER water to material.
Avoid smoking, bare lights or ignition sources.
Avoid contact with incompatible materials.
When handling, DO NOT eat, drink or smoke.
Keep containers securely sealed when not in use. Avoid physical damage to containers. Always wash hands with soap and water after handling. Work clothes should be laundered separately.
Launder contaminated clothing before reuse.
Use good occupational work practices. Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.

Recommended Storage Methods: Stainless steel drum. Check that containers are clearly labeled.
Packaging as recommended by manufacturer.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Use in a well-ventilated area.
Local exhaust ventilation may be required for safe working, i. e. , to keep exposures below required standards; otherwise, PPE is required.
If risk of overexposure exists, wear NIOSH-approved respirator.
Correct fit is essential to obtain adequate protection.
In confined spaces where there is inadequate ventilation, wear full-face air supplied breathing apparatus.

Personal Protective Clothing/Equipment:

Eyes: Chemical goggles. Full face shield.
DO NOT wear contact lenses. Contact lenses pose a special hazard; soft contact lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Bare unprotected skin should not be exposed to this material. Impervious, gauntlet length gloves i.e., butyl rubber gloves or Neoprene rubber gloves or wear chemical protective gloves, e.g. PVC.

Wear safety footwear or safety gumboots, e.g. Rubber.

Respiratory Protection:

Exposure Range >2 to <25 ppm: Supplied Air, Constant Flow/Pressure Demand, Half Mask

Exposure Range 25 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face

Other: Operators should be trained in procedures for safe use of this material.

Acid-resistant overalls or Rubber apron or PVC apron.

Ensure there is ready access to an emergency shower.

Ensure that there is ready access to eye wash unit.

Ensure that there is ready access to breathing apparatus.

Glove Selection Index:

BUTYL ..... Best selection
HYPALON ..... Best selection
NEOPRENE..... Best selection
NEOPRENE/NATURAL..... Best selection
PE/EVAL/PE ..... Best selection
SARANEX-23 ..... Best selection
NATURAL RUBBER..... Satisfactory; may degrade after 4 hours continuous immersion
NATURAL+NEOPRENE..... Satisfactory; may degrade after 4 hours continuous immersion
PVC..... Poor to dangerous choice for other than short-term immersion
NITRILE+PVC..... Poor to dangerous choice for other than short-term immersion

Section 9 - Physical and Chemical Properties

Appearance/General Info: Clear, colorless to slightly yellow liquid. Sharp strong odor.
CAUTION: exothermic dilution hazard.
HIGHLY CORROSIVE. Corrosive to most metals. Powerful oxidizing agent.
Darkens to brownish color on aging and exposure to light.

Physical State: Liquid
Odor Threshold: 0.75 to 2.50 mg/m^3
Vapor Pressure (kPa): 8.26
Vapor Density (Air=1): 1.5
Formula Weight: 63.02
Specific Gravity (H_2O=1, at 4 °C): 1.3-1.42
pH: < 1

pH (1% Solution): 1
Boiling Point: 83 °C (181 °F) at 760 mm Hg
Freezing/Melting Point: -42 °C (-43.6 °F)
Volatile Component (% Vol): 100 (nominal)
Decomposition Temperature (°C): Not applicable
Water Solubility: Soluble in all proportions

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Presence of heat source and direct sunlight. Storage in unsealed containers. Hazardous polymerization will not occur.

Storage Incompatibilities: Segregate from reducing agents, finely divided combustible materials, combustible materials, sawdust, metals and powdered metals.

Avoid contamination of water, foodstuffs, feed or seed.

Segregate from alkalies, oxidizing agents and chemicals readily decomposed by acids, i.e. cyanides, sulfides, carbonates.

Section 11 - Toxicological Information

Toxicity

Oral (human) LD_{Lo}: 430 mg/kg
Inhalation (rat) LC_{50}: 2500 ppm/1 hr
Unreported (man) LD_{Lo}: 110 mg/kg

Irritation

Nil reported

See *RTECS* QU 5775000, for additional data.

Section 12 - Ecological Information

Environmental Fate: No data found.

Ecotoxicity: LC_{50} Starfish 100-300 mg/l/48 hr /Aerated water conditions; LC_{50} Shore crab 180 mg/l/48 hr /Static, aerated water conditions; LC_{50} Cockle 330-1000 mg/l/48 hr /Aerated water conditions

BCF: no food chain concentration potential

Biochemical Oxygen Demand (BOD): none

Section 13 - Disposal Considerations

Disposal: Recycle wherever possible. Special hazards may exist - specialist advice may be required.
Consult manufacturer for recycling options.
Follow applicable federal, state, and local regulations.
Treat and neutralize at an approved treatment plant.
Decontaminate empty containers. Observe all label safeguards until containers are cleaned and destroyed.
Puncture containers to prevent reuse and bury at an authorized landfill.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Note: This material has multiple possible HMT entries. Choose the appropriate one based on state and condition of specific material when shipped.

Shipping Name and Description: Nitric acid *other than red fuming, with more than 70 percent nitric acid*

ID: UN2031
Hazard Class: 8 - Corrosive material
Packing Group: I - Great Danger
Symbols:
Label Codes: 8 - Corrosive, 5.1 - Oxidizer
Special Provisions: B47, B53, T10, TP2, TP12, TP13
Packaging: **Exceptions:** None **Non-bulk:** 158 **Bulk:** 243
Quantity Limitations: **Passenger aircraft/rail:** Forbidden **Cargo aircraft only:** 2.5 L
Vessel Stowage: **Location:** D **Other:** 44, 66, 89, 90, 110, 111

Shipping Name and Description: Nitric acid *other than red fuming, with not more than 70 percent nitric acid*

ID: UN2031
Hazard Class: 8 - Corrosive material
Packing Group: II - Medium Danger
Symbols:
Label Codes: 8 - Corrosive
Special Provisions: B2, B47, B53, IB2, T8, TP2, TP12
Packaging: **Exceptions:** None **Non-bulk:** 158 **Bulk:** 242
Quantity Limitations: **Passenger aircraft/rail:** Forbidden **Cargo aircraft only:** 30 L
Vessel Stowage: **Location:** D **Other:**

Shipping Name and Description: Nitric acid, red fuming

ID: UN2032
Hazard Class: 8 - Corrosive material
Packing Group: I - Great Danger
Symbols: + - Override definitions
Label Codes: 8 - Corrosive, 5.1 - Oxidizer, 6.1 - Poison *or* Poison Inhalation Hazard *if inhalation hazard, Zone A or B*
Special Provisions: 2, B9, B32, B74, T20, TP2, TP12, TP13, TP38, TP45
Packaging: **Exceptions:** None **Non-bulk:** 227 **Bulk:** 244
Quantity Limitations: **Passenger aircraft/rail:** Forbidden **Cargo aircraft only:** Forbidden
Vessel Stowage: **Location:** D **Other:**

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Not listed
CERCLA 40 CFR 302.4: Listed per CWA Section 311(b)(4) 1000 lb (453.5 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Listed
RQ: 1000 lb
TPQ: 1000 lb
TSCA: Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Material Safety Data Sheet Collection
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(518) 842-4111

Issue Date: 2006-06

Section 1 - Chemical Product and Company Identification 61

Material Name: Isobutene **CAS Number:** 115-11-7
Chemical Formula: C_4H_8
Structural Chemical Formula: $(CH_3)_2C=CH_2$
EINECS Number: 204-066-3
ACX Number: X1003822-9
Synonyms: Isobutene; ISOBUTYLENE; ASYM-DIMETHYLETHYLENE; GAMMA-BUTYLENE; 1,1-DIMETHYLETHYLENE; ISO-BUTENE; ISOBUTENE; ISOPROPYLIDENEMETHYLENE; LIQUEFIED PETROLEUM GAS; 2-METHYL-1-PROPENE; 2-METHYLPROPENE; 2-METHYLPROPYLENE; 1-PROPENE,2-METHYL-; PROPENE,2-METHYL-; UNSYM. DIMETHYLETHYLENE
General Use: Production of butene polymers used as adhesives, tackifiers, oil additives.
Butyl rubbers, copolymer resins with butadiene, acrylates and methacrylates.
Also to produce anti-oxidants for foods, food supplements, plastics and in production of isooctane and high-octane aviation gasoline.
Used in closed pressurized systems, fitted with safety relief valve.
Vented gas is flammable, denser than air and will spread. Vent path must not contain ignition sources, pilot lights, bare flames.

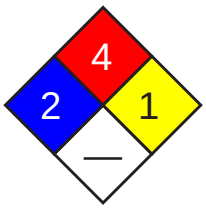
Section 2 - Composition / Information on Ingredients

Name	CAS	%
isobutene	115-11-7	>99

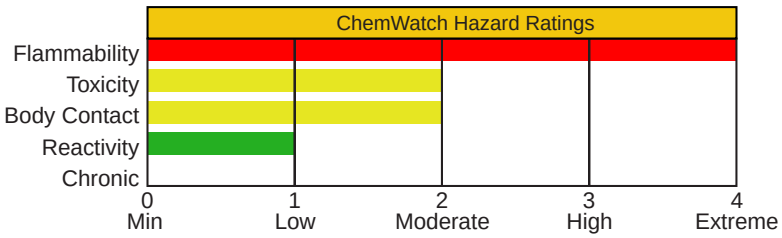
OSHA PEL **NIOSH REL**

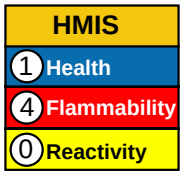
ACGIH TLV

Section 3 - Hazards Identification



Fire Diamond





ANSI Signal Word

Danger!


Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless gas. Acute Effects: Simple asphyxiant which can displace available oxygen; initial symptoms: rapid respiration, air hunger, diminished mental alertness, impaired muscular coordination. Can form explosive mixtures in air. Flammable.

Potential Health Effects

Target Organs: None reported
Primary Entry Routes: inhalation
Acute Effects
Inhalation: The gas is a simple asphyxiant (precludes access to oxygen) and is harmful if exposure is prolonged and inhalation may cause loss of consciousness.

Acute effects from inhalation of high concentrations of gas / vapor are pulmonary irritation, including coughing, with nausea; central nervous system depression - characterized by headache and dizziness, increased reaction time, fatigue and loss of coordination.
If exposure to highly concentrated atmosphere of gas is prolonged this may lead to narcosis, unconsciousness, even coma, and unless resuscitated, death.
Iso-butene is a simple asphyxiant and may have a narcotic action.
Material is highly volatile and may quickly form concentrated atmosphere in confined or unventilated area. Vapor is heavier than air and may displace and replace air in breathing zone, acting as a simple asphyxiant. This may happen with little warning of overexposure.
Hydrocarbons may sensitize the heart to adrenalin and other circulatory catecholamines; as a result cardiac arrhythmias and ventricular fibrillation may occur. Abrupt collapse may produce traumatic injury.
Central nervous system (CNS) depression may be evident early. Symptoms of moderate poisoning may include giddiness, headache, dizziness and nausea.
Serious poisonings may result in respiratory depression and may be fatal.
The paraffin gases C1-4 are practically non-toxic below their lower flammability limits (18000-50000 ppm). Above this level, incidental effects include CNS depression and irritation but these are reversible upon cessation of the exposure. The C3 and iso-C5 hydrocarbons show increasing narcotic properties; branching of the chain also enhances the effect.
The C4 hydrocarbons appear to be more highly neurotoxic than the C3 and C5 members. Several fatalities due to voluntary inhalation of butane have been reported, possibly due to central, respiratory and circulatory effects resulting from anesthesia, laryngeal edema, chemical pneumonia or the combined effects of cardiac toxicity and increased sympathomimetic effects.
Inhalation of petroleum gases may produce narcosis, due in part to olefinic impurities. Displacement of oxygen in the air may cyanosis.
If present in sufficient quantity these gases may reduce the oxygen level to below 18% producing asphyxiation.
Symptoms include rapid respiration, mental dullness, lack of coordination, poor judgement, nausea and vomiting.
The onset of cyanosis may lead to unconsciousness and death.

Eye: The liquid is highly discomforting and may cause severe cold burns 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.
The gas is regarded as non-irritating to the eyes.

Skin: Vaporizing liquid causes rapid cooling and contact may cause cold burns, frostbite.The liquid is discomforting to the skin and may rapidly cause severe cold burns.
Bare unprotected skin should not be exposed to this material.
There is no evidence of skin absorption but contact may cause frostbite,

Ingestion: Overexposure is unlikely in this form.
Considered an unlikely route of entry in commercial/industrial environments.
The liquid is highly discomforting if swallowed and may cause severe cold burns.

Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Not listed; MAK - Not listed.

Chronic Effects: Chronic overexposure may produce dermatitis.

Section 4 - First Aid Measures

Inhalation: Avoid becoming a casualty and remove to fresh air.
Lay patient down. If breathing is shallow or has stopped, ensure clear airway and apply resuscitation.
If available, medical oxygen should be administered by trained personnel.
Transport to hospital or doctor, without delay.

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water. Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.
Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: In case of cold burns (frost-bite): Bathe the affected area immediately in cold water for 10 to 15 minutes, immersing if possible and without rubbing.
Do not apply hot water or radiant heat. Apply a clean, dry dressing.
Transport to hospital or doctor.

Ingestion: Contact a Poison Control Center. DO NOT induce vomiting. Observe the patient carefully. Never give liquid to a person showing signs of being sleepy or with reduced awareness; i.e. becoming unconscious. Give water (or milk) to rinse out mouth. Then provide liquid slowly and as much as casualty can comfortably drink. Transport to hospital or doctor without delay.

After first aid, get appropriate in-plant, paramedic, or community medical support.

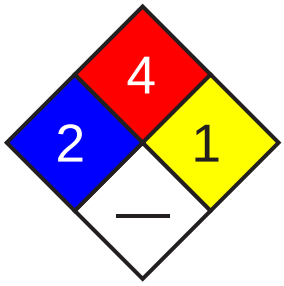
Note to Physicians: For acute or short-term repeated exposures to petroleum distillates or related hydrocarbons:
1.Primary threat to life from pure petroleum distillate ingestion and/or inhalation is respiratory failure.

2.Patients should be quickly evaluated for signs of respiratory distress (e.g. cyanosis, tachypnea, intercostal retraction, obtundation) and given oxygen. Patients with inadequate tidal volumes or poor arterial blood gases (pO_2 <50 mm Hg or pCO_2 >50 mm Hg) should be intubated.
3.Arrhythmias complicate some hydrocarbon ingestion and/or inhalation and electrocardiographic evidence of myocardial injury has been reported; intravenous lines and cardiac monitors should be established in obviously symptomatic patients. The lungs excrete inhaled solvents, so that hyperventilation improves clearance.
4.A chest x-ray should be taken immediately after stabilization of breathing and circulation to document aspiration and detect the presence of pneumothorax.
5.Epinephrine (adrenalin) is not recommended for treatment of bronchospasm because of potential myocardial sensitization to catecholamines.
Inhaled cardioselective bronchodilators (e.g. Alupent, Salbutamol) are the preferred agents, with aminophylline a second choice.
6.Lavage is indicated in patients who require decontamination; ensure use of cuffed endotracheal tube in adult patients.

Section 5 - Fire-Fighting Measures

Flash Point: -76.111 °C
Autoignition Temperature: 465 °C
LEL: 1.8% v/v
UEL: 9.6% v/v
Extinguishing Media: Water spray or fog; dry chemical powder.
Carbon dioxide.
Foam.

See DOT ERG



Fire Diamond

General Fire Hazards/Hazardous Combustion Products: Flammable gas. Liquid and vapor are highly flammable.
Dangerous hazard when exposed to heat, flame and oxidizers.
Gas may form explosive mixtures with air over a wide area.
Decomposes on heating and produces toxic fumes of carbon monoxide (CO) and carbon dioxide (CO_2).
Fire Incompatibility: Avoid contamination with oxidizing agents i.e. nitrates, oxidizing acids, chlorine bleaches, pool chlorine etc. as ignition may result.
Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear full body protective clothing with breathing apparatus. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
Do not extinguish burning gas. If safe to do so, stop flow of gas.
If flow of gas cannot be stopped, leave gas to burn.
Cool fire-exposed containers with water spray from a protected location.
Do not approach cylinders suspected to be hot.
If safe to do so, remove containers from path of fire.
Fight fire from a safe distance, with adequate cover.

Section 6 - Accidental Release Measures

Small Spills: Avoid breathing vapor and any contact with liquid or gas. Protective equipment including respirator should be used. Do NOT enter confined spaces where gas may have accumulated. Shut of all sources of possible ignition and increase ventilation. Clear area of personnel. Stop leak only if safe to so do. Remove leaking cylinders to safe place. Release pressure under safe controlled conditions by opening valve. Keep area clear of personnel until gas has dispersed.

See DOT ERG

Large Spills: DO NOT touch the spill material. Shut off all possible sources of ignition and increase ventilation. Restrict access to area. Clear area of personnel and move upwind.
May be violently or explosively reactive. Wear full body protective clothing with breathing apparatus. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
Avoid spraying water onto liquid pools.
Use extreme caution to avoid a violent reaction.
Stop leak if safe to do so.
DO NOT enter confined places where gas may have collected. Remove leaking cylinders to a safe place. Fit vent pipes. Release pressure under safe, controlled conditions by opening valve. Burn issuing gas at vent pipes.
Do not exert excessive pressure on valve; do not attempt to operate damaged valve.
Keep area clear of personnel until gas has dispersed
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Use good occupational work practices. Use in a well-ventilated area.

Obtain a work permit before attempting any repairs.
Do not attempt repair work on lines, vessels under pressure.
Atmospheres must be tested and O.K. before work resumes after leakage.
Wear protective clothing and gloves when handling containers.
No smoking, bare lights, heat or ignition sources.
Use spark-free tools when handling. Ground all lines and equipment.
Prevent concentration in hollows and sumps. DO NOT enter confined spaces until atmosphere has been checked.
Gas may travel a considerable distance to source of ignition.
Vapor may ignite on pumping or pouring due to static electricity.
Avoid physical damage to containers.
DO NOT transfer gas from one cylinder to another.
Natural gases contain a contaminant, radon-222, a naturally occurring radioactive gas. During subsequent processing, radon tends to concentrate in liquified petroleum streams and in product streams having similar boiling points.
Industry experience indicates that the commercial product may contain small amounts of radon-222 and its radioactive decay products (radon daughters). The actual concentration of radon-222 and radioactive daughters in process equipment (IE lines, filters, pumps and reactor units) may reach significant levels and produce potentially damaging levels of gamma radiation. A potential external radiation hazard exists at or near any pipe, valve or vessel containing a radon enriched stream or containing internal deposits of radioactive material. Field studies, however, have not shown that conditions exist that expose the worker to cumulative exposures in excess of general population limits. Equipment containing gamma-emitting decay products should be presumed to be internally contaminated with alpha- emitting decay products which may be hazardous if inhaled or ingested.
During maintenance operations that require the opening of contaminated process equipment, the flow of gas should be stopped and a four hour delay enforced to allow gamma-radiation to drop to background levels. Protective equipment (including high efficiency particulate respirators (P3) suitable for radionucleotides or supplied air) should be worn by personnel entering a vessel or working on contaminated process equipment to prevent skin contamination or inhalation of any residue containing alpha-radiation.
Airborne contamination may be minimized by handling scale and/or contaminated materials in a wet state.

Recommended Storage Methods: Packaging as recommended by manufacturer.
Check that containers are clearly labeled.
Cylinder fitted with valve protector cap.
Ensure the use of equipment rated for cylinder pressure.
Ensure the use of compatible materials of construction.
Cylinder valve must be closed when not in use or when empty.
Cylinder must be properly secured either in use or in storage.
WARNING: Suckback into cylinder may result in rupture.
Use back-flow preventive device in piping.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Use in a well-ventilated areaIf gas concentrations are high: or If risk of overexposure exists, wear NIOSH-approved respirator.
Correct fit is essential to obtain adequate protection.
Used in closed pressurized systems; fitted with temperature and pressure safety relief valves which are vented to allow safe dispersal.
Provide adequate ventilation in warehouse or closed storage areas.

Personal Protective Clothing/Equipment:

Eyes: Safety glasses with side shields; or as required, chemical goggles.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Protective gloves eg. leather gloves or gloves with leather facing. Neoprene rubber gloves.
Safety footwear.

Other: Operators should be trained in correct use & maintenance of respirators Ensure that there is ready access to breathing apparatus.
Protective overalls, closely fitted at neck and wrist. Eye-wash unit.
IN CONFINED SPACES:
1. Non-sparking protective boots.
2. Static-free clothing.
3. Ensure availability of lifeline.
Staff should be trained in all aspects of rescue work.
Ensure there is ready access to an emergency shower.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Easily liquified flammable gas or colorless highly volatile liquid. Packed as liquid under pressure and remains liquid only under pressure. Sudden release of pressure or leakage may result in rapid vaporization with generation of large volume of highly flammable / explosive gas. Strong gasoline odor. Floats and boils on water giving a flammable / explosive, visible cloud. Soluble in alcohol, ether, benzene and sulphuric acid.

Physical State: Liquefied gas
Odor Threshold: 1.3 to 3.0 mg/m^3
Vapor Pressure (kPa): 182 kPa at 10 °C
Vapor Density (Air=1): 2.01
Formula Weight: 56.11
Specific Gravity (H_2O=1, at 4 °C): 0.59
Evaporation Rate: Very rapid
pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point: -6.9 °C (20 °F)
Freezing/Melting Point: -140.35 °C (-220.63 °F)
Volatile Component (% Vol): 100
Water Solubility: Practically insoluble in water

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Product is considered stable. Hazardous polymerization will not occur.
Storage Incompatibilities: Avoid contact with oxidizing agents.

The interaction of alkenes and alkynes with nitrogen oxides and oxygen may produce explosive addition products; these may form at very low temperatures and explode on heating to higher temperatures (the addition products from 1,3-butadiene and cyclopentadiene form rapidly at -150 °C and ignite or explode on warming to -35 to -15 C). These derivatives ("pseudo- nitrosites") were formerly used to characterize terpene hydrocarbons.

Exposure to air must be kept to a minimum so as to limit the build-up of peroxides which will concentrate in bottoms if the product is distilled.

The product must not be distilled to dryness if the peroxide concentration is substantially above 10 ppm (as active oxygen) since explosive decomposition may occur. Distillate must be immediately inhibited to prevent peroxide formation. The effectiveness of the antioxidant is limited once the peroxide levels exceed 10 ppm as active oxygen. Addition of more inhibitor at this point is generally ineffective.

Prior to distillation it is recommended that the product should be washed with aqueous ferrous ammonium sulfate to destroy peroxides; the washed product should be immediately re-inhibited.

A range of exothermic decomposition energies for double bonds is given as 40-90 kJ/mol. The relationship between energy of decomposition and processing hazards has been the subject of discussion; it is suggested that values of energy released per unit of mass, rather than on a molar basis (J/g) be used in the assessment. For example, in "open vessel processes" (with man-hole size openings, in an industrial setting), substances with exothermic decomposition energies below 500 J/g are unlikely to present a danger, whilst those in "closed vessel processes" (opening is a safety valve or bursting disk) present some danger where the decomposition energy exceeds 150 J/g.

Avoid reactions with oxidizing agents, organic acids, inorganic acids halogenated compounds, polymerizable esters, oxygen, cyanohydrins and molten sulphur.

Section 11 - Toxicological Information

Toxicity
Inhalation (rat) LC_{50}: 620000 mg/m^3/4h

Irritation
Nil reported

See *RTECS* UD 0890000, for additional data.

Section 12 - Ecological Information

Environmental Fate: No data found.
Ecotoxicity: No data found.
BCF: no food chain concentration potential
Biochemical Oxygen Demand (BOD): none

Section 13 - Disposal Considerations

Disposal: Consult manufacturer for recycling options.
Discharge to burning flare. Return empty cylinders to supplier.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Note: This material has multiple possible HMT entries. Choose the appropriate one based on state and condition of specific material when shipped.

Shipping Name and Description: Isobutylene *see also* Petroleum gases, liquefied
ID: UN1055
Hazard Class: 2.1 - Flammable gas
Packing Group:
Symbols:
Label Codes: 2.1 - Flammable Gas
Special Provisions: 19, T50
Packaging: **Exceptions:** 306 **Non-bulk:** 304 **Bulk:** 314, 315
Quantity Limitations: **Passenger aircraft/rail:** Forbidden **Cargo aircraft only:** 150 kg
Vessel Stowage: **Location:** E **Other:** 40

Shipping Name and Description: Petroleum gases, liquefied *or* Liquefied petroleum gas
ID: UN1075
Hazard Class: 2.1 - Flammable gas
Packing Group:
Symbols:
Label Codes: 2.1 - Flammable Gas
Special Provisions: T50
Packaging: **Exceptions:** 306 **Non-bulk:** 304 **Bulk:** 314, 315
Quantity Limitations: **Passenger aircraft/rail:** Forbidden **Cargo aircraft only:** 150 kg
Vessel Stowage: **Location:** E **Other:**

Section 15 - Regulatory Information

EPA Regulations:

RCRA 40 CFR: Not listed
CERCLA 40 CFR 302.4: Not listed
SARA 40 CFR 372.65: Not listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Material Safety Data Sheet Collection
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Isopropyl Alcohol
ISO5300

Issue Date: 2006-06

Section 1 - Chemical Product and Company Identification 61

Material Name: Isopropyl Alcohol **CAS Number:** 67-63-0
Chemical Formula: C_3H_8O
Structural Chemical Formula: $(CH_3)_2CHOH$
EINECS Number: 200-661-7
ACX Number: X1001458-1
Synonyms: ALCOJEL; ALCOOL ISOPROPILICO; ALCOOL ISOPROPYLIQUE; ALCOSOLVE; ALCOSOLVE 2; AVANTIN; AVANTINE; CHROMAR; COMBI-SCHUTZ; (COMPONENT OF) HIBISTAT; DIMETHYL CARBINOL; DIMETHYLCARBINOL; EPA PESTICIDE CHEMICAL CODE 047501; HARTOSOL; 2-HYDROXYPROPANE; IMSOL A; IPA; ISOHOL; ISOPROPANOL; ISOPROPYL ALCOHOL; ISO-PROPYLALKOHOL; LUTOSOL; 1-METHYLETHANOL; 1-METHYLETHYL ALCOHOL; PETROHOL; PRO; 2-PROPANOL; I-PROPANOL; N-PROPAN-2-OL; PROPAN-2-OL; PROPOL; 2-PROPYL ALCOHOL; I-PROPYL ALCOHOL; SEC-PROPYL ALCOHOL; I-PROPYLALKOHOL; SECONDARY PROPYL ALCOHOL; SPECTRAR; STERISOL HAND DISINFECTANT; TAKINEOCOL; VISCO 1152
Derivation: Treating propylene with sulfuric acid and then hydrolyzing or direct hydration of propylene using superheated steam. Most commonly available as rubbing alcohol (70% IPA).
General Use: As a solvent for gums, shellac, and essential oils, chemical intermediate, dehydrating agent, vehicle for germicidal compounds, de-icing agent for liquid fuels; for denaturing ethyl alcohol, preserving pathological specimens; in extraction of alkaloids, quick-drying inks and oils, and an ingredient of skin lotions, cosmetics, window cleaner, liquid soaps, and pharmaceuticals.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
Isopropyl alcohol	67-63-0	100% vol.

Most commonly sold as 70% isopropyl alcohol (rubbing alcohol).

OSHA PEL
TWA: 400 ppm; 980 mg/m^3.

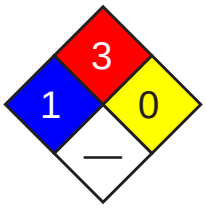
NIOSH REL
TWA: 400 ppm (980 mg/m^3); STEL: 500 ppm (1225 mg/m^3).

DFG (Germany) MAK
TWA: 200 ppm; PEAK: 400 ppm.

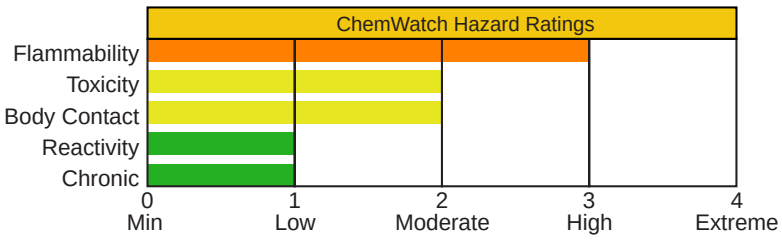
ACGIH TLV
TWA: 200 ppm; STEL: 400 ppm.

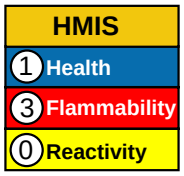
IDLH Level
2000 ppm (10% LEL).

Section 3 - Hazards Identification



Fire Diamond





ANSI Signal Word

Warning!


Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Volatile liquid. Irritating to eyes/respiratory tract. Other Acute Effects: CNS depression, possible dermatitis, systemic toxicity. Flammable

Potential Health Effects

Target Organs: Eyes, skin, respiratory system.
Primary Entry Routes: Inhalation, ingestion, skin contact/absorption.

Acute Effects

Inhalation: Vapor inhalation is irritating to the respiratory tract and can cause central nervous system depression at high concentrations. Volunteers exposed to 400 ppm for 3 to 5 min experienced mild eye and respiratory irritation. At 800 ppm, irritation was not severe, but most people found the air uncomfortable to breathe.

Eye: Exposure to the vapor or direct contact with the liquid causes irritation and possible corneal burns.

Skin: Some irritation may occur after prolonged exposure.

Ingestion: Accidental ingestions have provided the most information on isopropyl alcohol toxicity. Symptoms include nausea and vomiting, headache, facial flushing, dizziness, lowered blood pressure, mental depression, hallucinations and distorted perceptions, difficulty breathing, respiratory depression, stupor, unconsciousness, and coma. Kidney insufficiency including oliguria (reduced urine excretion), anuria (absent urine excretion), nitrogen retention, and edema (fluid build-up in tissues) may occur. One post-mortem examination in a case of heavy ingestion showed extensive hemorrhagic tracheobronchitis, broncho pneumonia, and hemorrhagic pulmonary edema. Death can occur in 24 to 36 h post-ingestion due to respiratory paralysis.

Carcinogenicity: NTP - Not listed; IARC - Group 3, Not classifiable as to carcinogenicity to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Not listed; MAK - Not listed.

Medical Conditions Aggravated by Long-Term Exposure: Dermatitis or respiratory or kidney disorders.

Chronic Effects: Repeated skin contact can cause drying of skin and delayed hypersensitivity reactions in some individuals.

Section 4 - First Aid Measures

See DOT ERG

Inhalation: Remove exposed person to fresh air and support breathing as needed.

Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.

Skin Contact: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have the *conscious and alert* person drink 1 to 2 glasses of water to dilute. Vomiting may be contraindicated because of the rapid onset of central nervous system depression. Gastric lavage is preferred.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Diagnostic test: acetone in urine. Isopropyl alcohol is oxidized in the body to acetone where it is excreted by the lungs or kidneys. Some acetone may be further metabolized to acetate, formate, and finally carbon dioxide. Probable oral lethal dose is 240 mL.

Section 5 - Fire-Fighting Measures

See DOT ERG

Flash Point: 53 °F (12 °C), Closed Cup

Burning Rate: 2.3 mm/min.

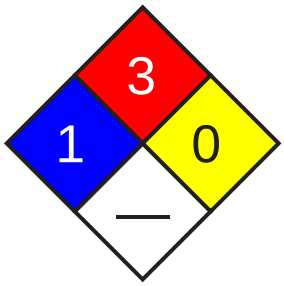
Autoignition Temperature: 750°F (399°C)

LEL: 2 % v/v

UEL: 12.7 % v/v at 200 °F

Flammability Classification: Class 1B Flammable Liquid

Extinguishing Media: Carbon dioxide, dry chemical, water *spray* (solid streams can spread fire), alcohol- resistant foam, or fog.



Fire Diamond

General Fire Hazards/Hazardous Combustion Products: Carbon oxides and acrid smoke. Container may explode in heat of fire. Vapors may travel to an ignition source and flash back. Isopropyl alcohol poses an explosion hazard indoors, outdoors, and in sewers.

Fire-Fighting Instructions: If possible without risk, move container from fire area. Apply cooling water to container side until well after fire is out. Stay away from ends of tanks. For massive fire in cargo area, use monitor nozzles or unmanned hose holders; if impossible, withdraw and let fire burn. Withdraw immediately if you hear a rising sound from venting safety device or notice any tank discoloration due to fire. *Do not* release runoff from fire control methods to sewers or waterways. Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighters' protective clothing provides only limited protection.

Section 6 - Accidental Release Measures

See DOT ERG

Spill/Leak Procedures: Notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. Shut off ignition sources. Cleanup personnel should protect against vapor inhalation and skin/eye contact. Water spray may reduce vapor, but may not prevent ignition in closed spaces.

Small Spills: Take up with earth, sand, vermiculite, or other absorbent, noncombustible material and place in suitable containers.

Large Spills: For large spills, dike far ahead of liquid spill for later disposal. Do not release into sewers or waterways.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Use non-sparking tools to open containers.
Never eat, drink, or smoke in work areas. Practice good personal hygiene after using isopropyl alcohol, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Recommended Storage Methods: Store in a cool, dry, well-ventilated area away from heat, ignition sources, and incompatibles (Sec 10). Install electrical equipment of Class 1, Group D.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: To prevent static sparks, electrically ground and bond all equipment used with and around IPA. Provide general or local exhaust ventilation systems to maintain airborne levels below OSHA PELs (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.

Administrative Controls: Consider preplacement and periodic medical exams of exposed workers with emphasis on the skin, kidneys, and respiratory system. Be extra cautious when using IPA concurrently with carbon tetrachloride because animal studies have shown it enhances carbon tetrachloride's toxicity.

Personal Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact. Nitrile rubber (breakthrough time > 8 hr), Neoprene and Teflon (breakthrough time > 4 hr) are suitable materials for PPE. Do not use PVA, PVC or natural rubber (breakthrough time < 1 hr). Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. For < 1000 ppm, use any powered, air purifying respirator with organic vapor cartridges or any chemical cartridge respirator with a full facepiece and organic vapor cartridge(s). For < 10,000 ppm, use any supplied-air respirator (SAR) operated in continuous-flow mode. For < 12,000 ppm, use any air- purifying, full facepiece respirator (gas mask) with a chin-style, front-or back-mounted organic vapor canister or any SCBA or SAR with a full facepiece. For emergency or entrance into unknown concentrations, use any SCBA or SAR (with auxiliary SCBA) with a full facepiece and operated in pressure-demand or other positive-pressure mode. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

Other: Separate contaminated work clothes from street clothes. Launder before reuse. Remove isopropyl alcohol from your shoes and clean personal protective equipment. Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Colorless with a slight odor and bitter taste.

Physical State: Liquid
Odor Threshold: 7.84 to 490 mg/m^3
Vapor Pressure (kPa): 44 mm Hg at 25 °F (77 °C)
Formula Weight: 60.09
Density: 0.78505 at 68°F (20 °C)
Refractive Index: 1.375 at 68 °F (20 °C)
Boiling Point: 180.5 °F (82.5 °C)
Freezing/Melting Point: -129.1 °F (-89.5 °C)
Viscosity: 2.1 cP at 77 °F (25 °C)
Surface Tension: 20.8 dyne/cm at 77 °F (25 °C)
Ionization Potential (eV): 10.10 eV
Critical Temperature: 455 °F (235 °C)
Critical Pressure: 47 atm
Water Solubility: > 10 %
Other Solubilities: Soluble in alcohol, ether, chloroform, and benzene. Insoluble in salt solutions.

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Isopropyl alcohol is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization does not occur. Exposure to heat, ignition sources, and incompatibles.

Storage Incompatibilities: Include acetaldehyde, chlorine, ethylene oxide, acids and isocyanates, hydrogen + palladium, nitroform, oleum, phosgene, potassium *t*-butoxide, oxygen (forms unstable peroxides), trinitromethane, barium perchlorate, tetrafluoroborate, chromium trioxide, sodium dichromate + sulfuric acid, aluminum, aluminum triisopropoxide, and oxidizers. Will attack some forms of plastic, rubber, and coatings.

Hazardous Decomposition Products: Thermal oxidative decomposition of isopropyl alcohol can produce carbon oxides and acrid smoke.

Section 11 - Toxicological Information

Acute Oral Effects:

Rat, oral, LD_{50}: 5045 mg/kg caused a change in righting reflex, and somnolence (general depressed activity).

Human, oral, TD_{Lo}: 223 mg/kg caused hallucinations, distorted perceptions, lowered blood pressure, and a change in pulse rate.

Human, oral, LD_{Lo}: 3570 mg/kg caused coma, respiratory depression, nausea, and vomiting.

Irritation Effects:

Rabbit, eye: 100 mg caused severe irritation.

Rabbit, skin: 500 mg caused mild irritation.

Other Effects:

Rat, inhalation: 3500 ppm/7 hr given from 1 to 19 days of pregnancy caused fetotoxicity.

See *RTECS* NT8050000, for additional data.

Section 12 - Ecological Information

Environmental Fate: On soil, IPA will volatilize or leach into groundwater. Biodegradation is possible but rates are not found in available literature. It will volatilize (est. half-life = 5.4 days) or biodegrade in water. It is not expected to bioconcentrate in fish. In the air, it reacts with photochemically produced hydroxyl radicals with a half-life of one to several days. Because it is soluble, removal by rain, snow or other precipitation is possible.

Ecotoxicity: Guppies (*Poecilia reticulata*) LC_{50} = 7,060 ppm/7 days; fathead minnow (*Pimephales promelas*) LC_{50} = 11,830 mg/L/1 hr. BOD = 133 %/5 days.

Octanol/Water Partition Coefficient: log K_{ow} = 0.05

Section 13 - Disposal Considerations

Disposal: Microbial degradation is possible by oxidizing isopropyl alcohol to acetone by members of the genus *Desulfovibrio*. Spray waste into incinerator (permit-approved facilities only) equipped with an afterburner and scrubber. Isopropyl alcohol can be settled out of water spills by salting with sodium chloride. Note: Salt may harm aquatic life, so weigh the benefits against possible harm before application. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations. Triple rinse containers.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Isopropanol *or* Isopropyl alcohol
ID: UN1219
Hazard Class: 3 - Flammable and combustible liquid
Packing Group: II - Medium Danger
Symbols:
Label Codes: 3 - Flammable Liquid
Special Provisions: IB2, T4, TP1
Packaging: **Exceptions:** 150 **Non-bulk:** 202 **Bulk:** 242
Quantity Limitations: **Passenger aircraft/rail:** 5 L **Cargo aircraft only:** 60 L
Vessel Stowage: **Location:** B **Other:**

Section 15 - Regulatory Information

EPA Regulations:

RCRA 40 CFR: Not listed
CERCLA 40 CFR 302.4: Not listed
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Material Safety Data Sheet Collection
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1171 RiverFront Center, Amsterdam, NY 12010
(518) 842-4111

Methanol
MET1440

Issue Date: 2006-06

Section 1 - Chemical Product and Company Identification 61

Material Name: Methanol **CAS Number:** 67-56-1
Chemical Formula: CH_4O
Structural Chemical Formula: CH_3OH
EINECS Number: 200-659-6
ACX Number: X1001287-2
Synonyms: ALCOHOL,METHYL; ALCOOL METHYLIQUE; ALCOOL METILICO; CARBINOL; X-CIDE 402 INDUSTRIAL BACTERICIDE; COAT-B1400; COLONIAL SPIRIT; COLONIAL SPIRITS; COLUMBIAN SPIRIT; COLUMBIAN SPIRITS; EPA PESTICIDE CHEMICAL CODE 053801; EUREKA PRODUCTS CRIOSINE DISINFECTANT; EUREKA PRODUCTS,CRIOSINE; FREERS ELM ARRESTER; IDEAL CONCENTRATED WOOD PRESERVATIVE; METANOL; METANOLO; METHANOL; METHYL ALCOHOL; METHYL HYDRATE; METHYL HYDROXIDE; METHYLALKOHOL; METHYLOL; METYLOWY ALKOHOL; MONOHYDROXYMETHANE; PMC REJEX-IT F-40ME; PYROLIGNEOUS SPIRIT; PYROXYLIC SPIRIT; PYROXYLIC SPIRITS; SURFLO-B17; WILBUR-ELLIS SMUT-GUARD; WOOD ALCOHOL; WOOD NAPHTHA; WOOD SPIRIT
Derivation: Prepared by wood pyrolysis; non-catalytic oxidation of hydrocarbons; as a by-product in the fisher-tropsch synthesis; or by reduction of carbon monoxide.
General Use: Used as an industrial solvent; starting material for organic synthesis; antifreeze for windshield washer fluid; in fuel antifreezes; gasoline octane booster; fuel for stoves; extractant for oils; denaturing ethanol; softening agent; food additive; in paint, varnish removers, and embalming fluids; in the manufacture of photographic film, celluloid, textile soap, wood stains, coated fabrics, shatterproof glass, paper coating, waterproofing formulations, artificial leather, dyes.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
Methanol	67-56-1	ca 100% vol

Trace Impurities: (Grade A): Acetone and aldehydes < 30 ppm, acetic acid < 30 ppm

OSHA PEL
TWA: 200 ppm; 260 mg/m^3.

ACGIH TLV
TWA: 200 ppm; STEL: 250 ppm; skin.

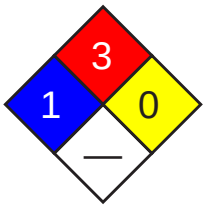
EU OEL
TWA: 260 mg/m^3 (200 ppm).

NIOSH REL
TWA: 200 ppm (260 mg/m^3); STEL: 250 ppm (325 mg/m^3); skin.

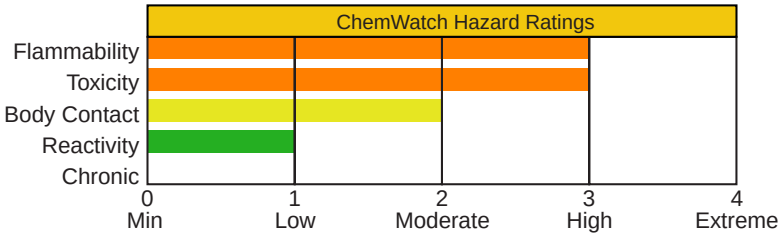
IDLH Level
6000 ppm.

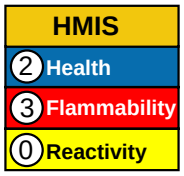
DFG (Germany) MAK
TWA: 200 ppm; PEAK: 800 ppm; skin.

Section 3 - Hazards Identification



Fire Diamond





ANSI Signal Word
Warning!


Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless liquid; slight alcohol odor when pure or disagreeably pungent odor. Irritating to eyes/skin/respiratory tract. Other Acute Effects: headache, visual disturbance, blindness, respiratory failure. Chronic Effects: reproductive effects reported in animal testing. Flammable; moderate explosion hazard.

Potential Health Effects

Target Organs: Eyes, skin, central nervous system (CNS), gastrointestinal (GI) tract, respiratory system
Primary Entry Routes: Inhalation, ingestion, skin and/or eye contact/absorption
Acute Effects
Inhalation: Irritation, breathing difficulty, headache, drowsiness, vertigo, light-headedness, nausea, vomiting, acidosis (decreased blood alkalinity), visual disturbance, and at high concentrations, CNS damage, convulsions, circulatory collapse, respiratory failure, coma and blindness can result from inhalation of methanol vapor. Concentration >= 200 ppm may cause headache; 50,000 ppm can cause death within 1-2 hrs.
Eye: Contact with liquid may result in irritation, inflamed lids, light sensitization, and superficial lesions.
Skin: Contact may cause irritation, dermatitis, swelling, scaling, and systemic effects.
Ingestion: GI irritation and systemic effects. Symptoms may be delayed 18-48 hours. Fatal dose - 2 to 8 ounces.
Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Not listed; MAK - Not listed.
Medical Conditions Aggravated by Long-Term Exposure: None reported.
Chronic Effects: Exposure to methanol vapors has caused conjunctivitis, headache, giddiness, insomnia, GI disturbance, impaired vision. CNS damage is also likely. Methanol is slowly eliminated from the body; exposure is considered cumulative over the short term.

Section 4 - First Aid Measures

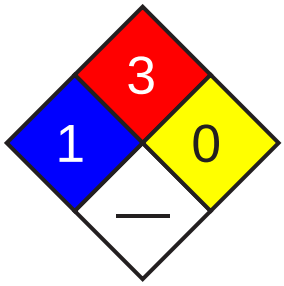
See DOT ERG

Inhalation: Remove exposed person to fresh air and support breathing as needed.
Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water for at least 15 minutes. Consult a physician or ophthalmologist if pain or irritation develops.
Skin Contact: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have the *conscious and alert* person drink 1 to 2 glasses of water, then induce vomiting.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Note to Physicians: Follow emesis with rehydration, correction of acidosis, and folate to enhance formate oxidation. Consider IV administration of ethanol (if blood methanol >20 mg/dL) to show metabolic oxidation of methanol. Assay formic acid in urine, blood pH and plasma bicarbonate.

Section 5 - Fire-Fighting Measures

See DOT ERG

Flash Point: 54 °F (12 °C), Closed Cup
Burning Rate: 1.7 mm/min
Autoignition Temperature: 867 °F (464 °C)
LEL: 6.0% v/v
UEL: 36% v/v
Flammability Classification: OSHA Class IB Flammable Liquid.
Extinguishing Media: Use dry chemical, carbon dioxide, water spray, fog or alcohol-resistant foam. A water spray may be used to cool fire-exposed containers, and flush spills away from ignition sources.
General Fire Hazards/Hazardous Combustion Products: Heating methanol to decomposition can produce carbon oxides (CO_x), formaldehyde, acrid smoke, and irritating fumes. Can form explosive mixtures in the air. The heavier-than-air vapors of methanol may travel along low-lying surfaces to distant sources of ignition and flash back to the material source. Containers may explode in heat of fire.



Fire Diamond

Fire-Fighting Instructions: *Do not* scatter material with any more water than needed to extinguish fire. *Do not* release runoff from fire control methods to sewers or waterways. Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode.

Section 6 - Accidental Release Measures

See DOT ERG

Spill/Leak Procedures: Isolate spill area for at least 330-660 feet (100-200 m) in all directions. Fully encapsulating, vapor protective clothing should be worn for spills and leaks with no fire. Eliminate all ignition sources (no smoking, flares, sparks or flames in immediate area). Ground all equipment used when handling this product. *Do not* touch or walk through spilled material. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. A vapor suppressing foam may be used to reduce vapors.
Small Spills: Absorb with earth, sand or other non-combustible material and transfer to containers for later disposal.

Use clean non-sparking tools to collect absorbed material.

Large Spills: Dike far ahead of liquid spill for later disposal. *Do not* release into sewers or waterways. Ground all equipment. Use non-sparking tools.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid vapor inhalation, and skin and eye contact. Use only with ventilation sufficient to reduce airborne concentrations to non-hazardous levels (see Sec. 2). Wear protective gloves, goggles, and clothing (see Sec. 8). Keep away from heat and ignition sources. Ground and bond all containers during transfers to prevent static sparks. Use non-sparking tools to open and close containers.

Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Recommended Storage Methods: Store in tightly closed container in cool, well-ventilated area, away from heat, ignition sources and incompatibles (see Sec. 10). Equip drums with self-closing valves, pressure vacuum bungs, and flame arrestors.

Regulatory Requirements: Follow applicable OSHA regulations. Also 29 CFR 1910.106 for Class 1B Flammable Liquids.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: To prevent static sparks, electrically ground and bond all containers and equipment used in shipping, receiving, or transferring operations. Provide general or local exhaust ventilation systems to maintain airborne concentrations as low as possible. Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.

Administrative Controls: Enclose operations and/or provide local explosion-proof exhaust ventilation at the site of chemical release. Where possible, transfer methanol from drums or other storage containers to process containers. Minimize sources of ignition in surrounding areas.

Personal Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets of butyl rubber, Teflon, Viton, Saranex, 4H, Responder, Trellchem HPS, or Tychem 10000 (Breakthrough Time (BT) >8 hr) to prevent skin contact. Natural rubber, neoprene, nitrile rubber, polyethylene, polyvinyl alcohol and CPF 3 may degrade after contact and are not recommended. Wear splash-proof chemical safety goggles, and face shield, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/ NIOSH-approved respirator. For concentrations <= 2000 ppm, use a supplied air respirator; <= 5000 ppm, supplied air (SA) respirator in continuous flow mode; <= 6000 ppm, SA respirator with tight-fitting face mask operated in continuous flow mode, or SCBA with full facepiece, or SA respirator with full facepiece; > IDLH/unknown/emergency, SCBA with full facepiece operated in pressure-demand or other positive-pressure mode, or SA respirator with full facepiece operated in pressure-demand or other positive-pressure mode in combination with auxiliary SCBA operated in pressure-demand or other positive-pressure mode. For escape, use an appropriate escape-type SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen- deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

Other: Separate contaminated work clothes from street clothes. Launder before reuse. Remove this material from your shoes and clean personal protective equipment. Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Colorless; slight alcohol odor when pure, disagreeably pungent odor when crude.

Physical State: Liquid

Odor Threshold: 13.1150 to 26840 mg/m^3

Vapor Pressure (kPa): 127 mm Hg at 77 °F (25 °C)

Vapor Density (Air=1): 1.11

Bulk Density: 6.59 lbs/gal at 68 F (20 °C)

Formula Weight: 32.04

Density: 0.796 g/mL at 59 °F (15 °C)

Specific Gravity (H_2O=1, at 4 °C): 0.81 at 0 °C/4 °C

Refractive Index: 1.3292 at 68 °F (20 °C)

pH: Slightly acidic

Boiling Point: 148 °F (64.7 °C) at 760 mm Hg

Freezing/Melting Point: -144.04 °F (-97.8 °C)

Viscosity: 0.614 mPa sec

Surface Tension: 22.61 dynes/cm

Ionization Potential (eV): 10.84 eV

Water Solubility: Miscible

Other Solubilities: Ethanol, acetone, benzene, chloroform, DMSO, ether, ketones, most organic solvents.

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Methanol is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur. Vapor inhalation, oxidizers.

Storage Incompatibilities: Include beryllium dihydride, metals (potassium, magnesium), oxidants (barium perchlorate, bromine, chlorine, hydrogen peroxide, sodium hypochlorite, phosphorus trioxide), potassium tertbutoxide, carbon tetrachloride and metals, chloroform and heat, diethyl zinc, alkyl aluminum salts, acetyl bromide, chloroform and sodium hydroxide, cyanuric chloride, nitric acid, chromic anhydride, lead perchlorate.

Hazardous Decomposition Products: Thermal oxidative decomposition of methanol can produce carbon oxides (CO_x), formaldehyde, acrid smoke, and irritating fumes.

Section 11 - Toxicological Information

Acute Oral Effects:

Rat, oral, LD_{50}: 5628 mg/kg.

Human, oral, LD_{Lo}: 428 mg/kg produced toxic effects: behavioral - headache; lungs, thorax, or respiration - other changes.

Human, oral, LD_{Lo}: 143 mg/kg produced optic nerve neuropathy, dyspnea, nausea or vomiting.

Acute Inhalation Effects:

Rat, inhalation, LC_{50}: 64000 ppm/4 hr.

Human, inhalation, TC_{Lo}: 300 ppm produced visual field changes, headache; lungs, thorax, or respiration - other changes.

Acute Skin Effects:

Rabbit, skin, LD_{50}: 15800 mg/kg.

Monkey, skin, LD_{Lo}: 393 mg/kg.

Irritation Effects:

Rabbit, standard Draize test: 100 mg/24 hr resulted in moderate irritation.

Rabbit, standard Draize test: 20 mg/24 hr resulted in moderate irritation.

Other Effects:

Rat, oral: 10 µmol/kg resulted in DNA damage.

Rat, inhalation: 50 mg/m^3/12 hr/13 weeks intermittently produced degenerative changes to brain and coverings; muscle contraction or spasticity.

Rat, inhalation: 2610 ppm/6 hr/4 weeks intermittently produced toxic effects: endocrine - changes in spleen weight.

Multiple Dose Toxicity Effects - Rat, oral: 12 g/kg/8 weeks intermittently produced toxic effects: behavioral - ataxia; behavioral - alteration of operant conditioning.

Human, lymphocyte: 300 mmol/L resulted in DNA inhibition.

Rat (female), oral: 7500 mg/kg, administered during gestational days 17-19 produced effects on newborn - behavioral.

Rat (female), oral: 35295 mg/kg administered during gestational days 1-15 produced effects on the fertility index; pre implantation mortality; and post-implantation mortality.

Rat (female), inhalation: 20000 ppm/7 hr, administered during gestational days 1-22 produced specific developmental abnormalities - musculoskeletal system; cardiovascular (circulatory) system; urogenital system.

Rat (male), oral: 200 ppm/20 hr, 78 weeks prior to mating produced paternal effects - testes, epididymis, sperm duct.

See *RTECS* PC1400000, for additional data.

Section 12 - Ecological Information

Environmental Fate: Bioconcentration (BCF, estimated at 0.2) is not expected to be significant. Physical removal from air can occur via rainfall. Relatively rapid evaporation from dry surfaces is likely to occur. If released to the atmosphere, it degrades via reaction with photochemically produced hydroxyl radicals with an approximate half-life of 17.8 days. If released to water or soil, biodegradation is expected to occur. A low K_{oc} indicates little sorption and high mobility in the soil column.

Ecotoxicity: Trout, LC_{50}: 8,000 mg/L/48 hr; *Pimephales promelas* (fathead minnow) LC_{50}: 29.4 g/L/96 hr.

Henry's Law Constant: 4.55 $x10^{-6}$ atm-m^3/mole at 77 °F (25 °C)

Octanol/Water Partition Coefficient: log K_{ow} = -0.77

Soil Sorption Partition Coefficient: K_{oc} = 0.44

Section 13 - Disposal Considerations

Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Note: This material has multiple possible HMT entries. Choose the appropriate one based on state and condition of specific material when shipped.

Shipping Name and Description: Methanol
ID: UN1230
Hazard Class: 3 - Flammable and combustible liquid
Packing Group: II - Medium Danger
Symbols: + I

Label Codes: 3 - Flammable Liquid, 6.1 - Poison *or* Poison Inhalation Hazard *if inhalation hazard, Zone A or B*
Special Provisions: IB2, T7, TP2
Packaging: **Exceptions:** 150 **Non-bulk:** 202 **Bulk:** 242
Quantity Limitations: **Passenger aircraft/rail:** 1 L **Cargo aircraft only:** 60 L
Vessel Stowage: **Location:** B **Other:** 40

Shipping Name and Description: Methanol
ID: UN1230
Hazard Class: 3 - Flammable and combustible liquid
Packing Group: II - Medium Danger
Symbols: D - Domestic transportation

Label Codes: 3 - Flammable Liquid
Special Provisions: IB2, T7, TP2
Packaging: **Exceptions:** 150 **Non-bulk:** 202 **Bulk:** 242
Quantity Limitations: **Passenger aircraft/rail:** 1 L **Cargo aircraft only:** 60 L
Vessel Stowage: **Location:** B **Other:**

Section 15 - Regulatory Information

EPA Regulations:

RCRA 40 CFR: Listed U154 Ignitable Waste
CERCLA 40 CFR 302.4: Listed per RCRA Section 3001 5000 lb (2268 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Material Safety Data Sheet Collection
Genium group inc.
1171 RiverFront Center, Amsterdam, NY 12010
(518) 842-4111

Issue Date: 2006-06

Sodium Hydroxide
SOD4950

Section 1 - Chemical Product and Company Identification 61

Material Name: Sodium Hydroxide
CAS Number: 1310-73-2
Chemical Formula: HNaO
Structural Chemical Formula: NaOH
EINECS Number: 215-185-5
ACX Number: X1000118-8
Synonyms: CAUSTIC SODA; CAUSTIC SODA,BEAD; CAUSTIC SODA,DRY; CAUSTIC SODA,FLAKE; CAUSTIC SODA,GRANULAR; CAUSTIC SODA,SOLID; HYDROXYDE DE SODIUM; LEWIS-RED DEVIL LYE; LYE; NATRIUMHYDROXID; NATRIUMHYDROXYDE; SODA LYE; SODA,CAUSTIC; SODA,HYDRATE; SODIO(IDROSSIDO DI); SODIUM HYDRATE; SODIUM HYDROXIDE; SODIUM HYDROXIDE,BEAD; SODIUM HYDROXIDE,DRY; SODIUM HYDROXIDE,FLAKE; SODIUM HYDROXIDE,GRANULAR; SODIUM HYDROXIDE,SOLID; SODIUM(HYDROXYDE DE); WHITE CAUSTIC
General Use: Component of alkali cleaners. Manufacture of soap, pulp and paper; rayon. Chemical manufacture. Neutralizing agent in petroleum refining; manufacture of aluminum, detergents, textile processing, refining of vegetable oils. Laboratory reagent, for organic fusion, etching of metal. Used for regenerating ion exchange resins, lye peeling of fruits and vegetables in the food industry.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
sodium hydroxide	1310-73-2	>98

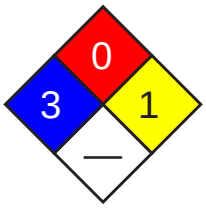
OSHA PEL
TWA: 2 mg/m^3.

NIOSH REL
Ceiling: 2 mg/m^3.

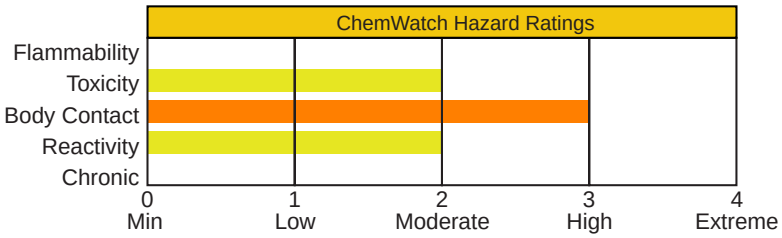
ACGIH TLV
Ceiling: 2 mg/m^3.

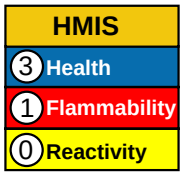
IDLH Level
10 mg/m^3.

Section 3 - Hazards Identification



Fire Diamond





ANSI Signal Word

Danger!


Corrosive

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

White, odorless, hydroscopic flakes, lumps, or pellets. Corrosive, causes severe burns to eyes/skin/respiratory tract. Chronic Effects: dermatitis. Reacts with water.

Potential Health Effects

Target Organs: eyes, digestive system, respiratory system, skin
Primary Entry Routes: ingestion, inhalation, skin contact, eye contact
Acute Effects
Inhalation: Generated dust may be highly discomforting and corrosive to the upper respiratory tract if inhaled and is capable of causing severe burns to the upper respiratory tract.

The material may produce respiratory tract irritation which produces an inflammatory response involving the recruitment and activation of many cell types, mainly derived from the vascular system. Unlike most organs the lung can respond to a chemical insult or agent by first trying to remove or neutralize the irritant and then repairing the damage. The repair process, which initially developed to protect mammalian lungs from foreign matter and antigens, may however, cause further damage the lungs when activated by hazardous chemicals. The result is often the impairment of gas exchange, the primary function of the lungs.

Severe acute dust inhalation exposure may be fatal due to spasm, inflammation and edema of the larynx and bronchi, chemical pneumonitis and severe pulmonary edema.

Symptoms of overexposure include burning sensation, coughing, wheezing, laryngitis, shortness of breath, headache, nausea and vomiting.

Eye: The solid/dust is extremely corrosive to the eyes and is capable of causing severe damage with loss of sight. The material may produce severe irritation to the eye causing pronounced inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.

Skin: The solid/dust is highly discomforting and extremely corrosive to the skin and is capable of causing severe burns and ulceration.

Bare unprotected skin should not be exposed to this material. The material may produce severe skin irritation after prolonged or repeated exposure, and may produce a contact dermatitis (nonallergic). This form of dermatitis is often characterized by skin redness (erythema) and swelling (edema) which may progress to vesiculation, scaling and thickening of the epidermis. Histologically there may be intercellular edema of the spongy layer (spongiosis) and intracellular edema of the epidermis.

Burns are not immediately painful; onset of pain may be delayed minutes or hours; thus care should be taken to avoid contamination of gloves and boots. A 5% aqueous solution applied to the skin of rabbits for 4 hours produced severe necrosis. Instillation of a 1% solution into the conjunctival sac failed to produce ocular or conjunctival injury in rabbits provided the eye was promptly irrigated with copious amounts of water.

Ingestion: Considered an unlikely route of entry in commercial/industrial environments.

The solid is extremely corrosive to the gastrointestinal tract and may be fatal if swallowed.

Ingestion may result in severe burns to the mouth, throat and stomach, pain, nausea and vomiting, swelling of the larynx and subsequent suffocation, perforation of the gastrointestinal tract.

A 1% aqueous solution (pH 13.4) failed to cause gastric, esophageal or other damage in rabbits.

Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Not listed; MAK - Not listed.

Chronic Effects: Prolonged contact is unlikely, given the severity of response, but repeated exposures may produce severe ulceration.

Section 4 - First Aid Measures

Inhalation: If dust is inhaled, remove to fresh air. Encourage patient to blow nose to ensure clear breathing passages. Ask patient to rinse mouth with water but to not drink water. Seek immediate medical attention.

Eye Contact: DO NOT delay. Immediately hold the eyes open and wash continuously for at least 15 minutes with fresh running water. Ensure irrigation under eyelids by occasionally lifting the upper and lower lids. Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: DO NOT delay. Immediately flush body and clothes with large amounts of water, using safety shower if available. Quickly remove all contaminated clothing, including footwear. Wash affected areas with water (and soap if available) for at least 15 minutes. Transport to hospital or doctor.

In case of burns: Quickly immerse affected area in cold running water for 10 to 15 minutes. Bandage lightly with a sterile dressing. Treat for shock if required. Lay patient down. Keep warm and rested. Transport to hospital or doctor.

Ingestion: DO NOT delay. Contact a Poison Control Center. If swallowed, do NOT induce vomiting. Give a glass of water.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: For acute or short-term repeated exposures to highly alkaline materials:

1. Respiratory stress is uncommon but presents occasionally because of soft tissue edema.
2. Unless endotracheal intubation can be accomplished under direct vision, cricothyroidotomy or tracheotomy may be necessary.
3. Oxygen is given as indicated.
4. The presence of shock suggests perforation and mandates an intravenous line and fluid administration.
5. Alkali corrosives damage occurs by liquefaction necrosis whereby the saponification of fats and solubilization of proteins allow deep penetration into the tissue. Alkalis continue to cause damage after exposure.

INGESTION:

1. Milk and water are the preferred diluents. No more than 2 glasses of water should be given to an adult.
2. Neutralizing agents should never be given since exothermic heat reaction may compound injury.

* Catharsis and emesis are absolutely contra-indicated.

* Activated charcoal does not absorb alkali.
* Gastric lavage should not be used.
Supportive care involves the following.
1. Withhold oral feedings initially.
2. If endoscopy confirms transmucosal injury start steroids only within the first 48 hours.
3. Carefully evaluate the amount of tissue necrosis before assessing the need for surgical intervention.
4. Patients should be instructed to seek medical attention whenever they develop difficulty in swallowing (dysphagia).
SKIN AND EYE: Injury should be irrigated for 20-30 minutes. Eye injuries require saline.

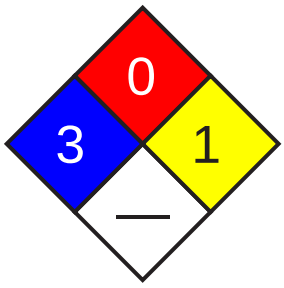
Section 5 - Fire-Fighting Measures

Extinguishing Media: Use extinguishing media suitable for surrounding area.

See DOT ERG

General Fire Hazards/Hazardous Combustion Products: Noncombustible. Not considered to be a significant fire risk, however containers may burn. Solid in contact with water or moisture reacts violently, and solutions are highly alkaline and may cause severe skin burns.

Fire Incompatibility: Avoid reaction with strong oxidizers, strong acids, organic materials/compounds.
In presence of moisture, the material is corrosive to aluminum, zinc and tin producing highly flammable hydrogen gas.



Fire Diamond

Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
Wear full body protective clothing with breathing apparatus. Prevent, by any means available, spillage from entering drains or waterways.
Use fire fighting procedures suitable for surrounding area.
Do not approach containers suspected to be hot.
Cool fire exposed containers with water spray from a protected location.
If safe to do so, remove containers from path of fire.
Avoid spraying water onto liquid pools.
Equipment should be thoroughly decontaminated after use.

Section 6 - Accidental Release Measures

Small Spills: DO NOT touch the spill material. Slippery when spilt.
Clean up all spills immediately.
Control personal contact by using protective equipment.
Use dry clean up procedures and avoid generating dust.
Place in suitable containers for disposal.

See DOT ERG

Large Spills: DO NOT touch the spill material. Slippery when spilt.
Keep dry. Reacts violently with water.
Clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
Wear full body protective clothing with breathing apparatus. Prevent, by any means available, spillage from entering drains or waterways.
Shut off all possible sources of ignition and increase ventilation.
Stop leak if safe to do so.
Use dry clean up procedures and avoid generating dust. Collect recoverable product into labeled containers for recycling. Collect residues and seal in labeled drums for disposal.
Wash area down with large quantity of water and prevent runoff into drains.
If contamination of drains or waterways occurs, advise emergency services.
After clean up operations, decontaminate and launder all protective clothing and equipment before storing and reusing.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid generating and breathing dust. Avoid contact with skin and eyes.
Wear protective clothing when risk of exposure occurs.
Use in a well-ventilated area.
Local exhaust ventilation may be required for safe working, i.e. to keep exposures below required standards, otherwise PPE is required.
Handle and open container with care.
Keep dry. Reacts violently with water.
WARNING: Contact with water generates heat.

Avoid contact with incompatible materials.
Avoid physical damage to containers.
Keep containers securely sealed when not in use.
Always wash hands with soap and water after handling. Work clothes should be laundered separately. Launder contaminated clothing before reuse. Use good occupational work practice. Observe manufacturer's storing and handling recommendations.
Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.

Recommended Storage Methods: Plastic bag or Packaging as recommended by manufacturer. Glass container. Polyethylene or polypropylene container or Polylined drum.
DO NOT use aluminum, galvanized or tin-plated containers.
Check that containers are clearly labeled.

Storage Requirements: Keep dry. Reacts violently with water.
Store in original containers. Keep containers securely sealed. Store in a cool, dry, well-ventilated area. Store away from incompatible materials and foodstuff containers. Protect containers against physical damage and check regularly for leaks.
Observe manufacturer's storing and handling recommendations.
DO NOT use aluminum, galvanized or tin-plated containers.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Use in a well-ventilated area DO NOT handle directly. Wear gloves and use scoop/tongs/tools. If risk of overexposure exists, wear NIOSH approved respirator.
If conditions are such that worker exposure potential is high, wear full-face air-supplied breathing apparatus and full protective suit.

Personal Protective Clothing/Equipment:

Eyes: Safety glasses with side shields Chemical goggles. Full face shield.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: DO NOT handle directly. Wear gloves and use scoop/tongs/tools.
Elbow length PVC gloves or Butyl rubber gloves or Neoprene rubber gloves.
Safety footwear.

Respiratory Protection:
Exposure Range >2 to <10 mg/m^3: Air Purifying, Negative Pressure, Half Mask
Exposure Range 10 to unlimited mg/m^3: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: dust/mist filter (use P100 or consult supervisor for appropriate dust/mist filter)

Other: Overalls. PVC apron. PVC protective suit may be required if exposure severe.
Eyewash unit. Ensure there is ready access to a safety shower.

Section 9 - Physical and Chemical Properties

Appearance/General Info: White hygroscopic, odorless, pellets, flakes, sticks or solid cast mass. Explosive boiling and spitting will occur if added to hot water. Reacts violently with acids. CAUSTIC alkali. Soluble in alcohol, ether, glycerol.

Physical State: Divided solid
Vapor Pressure (kPa): Negligible
Formula Weight: 40
Specific Gravity (H_2O=1, at 4 °C): 2.12 at 20 °C
pH: Not applicable
pH (1% Solution): 12.7
Boiling Point: 1390 °C (2534 °F)
Freezing/Melting Point: 318.4 °C (605.12 °F)
Water Solubility: 1 g dissolves in 0.9 ml water

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Vigorously exotherms when mixed with water. In the presence of moisture, highly corrosive to aluminum, zinc and tin.
HIGHLY reactive: with ammonium salts evolves ammonia gas. Rapidly picks up moisture from the air and with carbon dioxide in air forms sodium carbonate.
Presence of incompatible materials and storage in unsealed containers.
Product is considered stable under normal handling conditions.
Hazardous polymerization will not occur.

Storage Incompatibilities: Keep dry. Reacts violently with water.
Segregate from water, strong oxidizers, strong acids, organic materials, ammonium compounds, nitro compounds and trichlorethylene.

Section 11 - Toxicological Information

Toxicity
No data reported

Irritation
Skin (rabbit): 500 mg/24h SEVERE
Eye (rabbit): 0.05 mg/24h SEVERE
Eye(rabbit):1 mg/24h SEVERE
Eye(rabbit):1 mg/30s rinsed-SEVERE

See *RTECS* WB 4900000, for additional data.

Section 12 - Ecological Information

Environmental Fate: No data found.
Ecotoxicity: LC_{100} Cyprinus carpio 180 ppm/24 hr at 25 deg; TL_m mosquito fish 125 ppm/96 hr (freshwater) ; TL_m Bluegill 99 mg/L/48 hr (tap water)
Biochemical Oxygen Demand (BOD): none
Octanol/Water Partition Coefficient: log K_{ow} = too low to be measured

Section 13 - Disposal Considerations

Disposal: Recycle wherever possible or consult manufacturer for recycling options.
Follow applicable federal, state, and local regulations.
Treat and neutralize with dilute acid at an effluent treatment plant.
Recycle containers, otherwise dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Sodium hydroxide, solid
ID: UN1823
Hazard Class: 8 - Corrosive material
Packing Group: II - Medium Danger
Symbols:
Label Codes: 8 - Corrosive
Special Provisions: IB8, IP2, IP4
Packaging: **Exceptions:** 154 **Non-bulk:** 212 **Bulk:** 240
Quantity Limitations: **Passenger aircraft/rail:** 15 kg **Cargo aircraft only:** 50 kg
Vessel Stowage: **Location:** A **Other:**

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Not listed
CERCLA 40 CFR 302.4: Listed per CWA Section 311(b)(4) 1000 lb (453.5 kg)
SARA 40 CFR 372.65: Not listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Material Safety Data Sheet

Section 1 – Chemical Product and Company Identification

Catalog Numbers: BU5004-A, BU5004-B, BU5004-C, BU5004-D, BU5004-P, BU5004-Q, BU5004-G, BU5004-T

Product Identity: Buffer Solution, pH 4.00

Chemical Family: Not Applicable
Synonyms: Not Applicable
Recommended Use: Laboratory chemicals

Manufacturer's Name: AquaPhoenix Scientific, Inc., 9 Barnhart Dr., Hanover, PA 17331, (866) 632-1291
Emergency Contact Number (24hr): Chemtel (800) 255-3924

Issue Date: 12/28/06
Revision Date: 6/5/08, 02/25/10, 09/14/10, 02/19/12

Section 2 – Hazard Identification

Emergency Overview: Non-flammable, non-corrosive, non-toxic. Does not present significant health hazards. Wash areas of contact with water.
Appearance: Clear, reddish liquid **Odor:** Odorless
Target Organs: Eyes, skin
Potential Health Effects/ Routes of Exposure:
Eyes: May cause slight irritation.
Skin: May cause slight irritation.
Ingestion: May cause diarrhea, nausea, vomiting, and cramps.
Inhalation: Not likely to be a hazard.
Chronic Effect / Carcinogenicity: None (IARC, NTP, OSHA)
Aggravated Medical Conditions No information available
These chemicals are not considered hazardous by OSHA.
See section 11 for toxicological information. See section 12 for potential environmental effects.

Section 3 – Composition, Information on Ingredients

Potassium Acid Phthalate, CAS# 877-24-7, <1% w/v
Water, purified, CAS# 7732-18-5, >98% w/v

Section 4 – First Aid

Eyes: Immediately flush eyes with water for at least 15 minutes. Immediately get medical assistance.
Skin: Flush with water for 15 minutes. Get medical assistance if irritation develops.
Ingestion: DO NOT induce vomiting. Dilute with water or milk. Get medical assistance.
Inhalation: Remove to fresh air. Give artificial respiration if necessary. If breathing is difficult, give oxygen.
Notes to Physician Treat symptomatically.

Section 5 – Fire Fighting Measures

Flash Point: Not Applicable **Autoignition Temperature** No information available.
Explosion Limits Upper No data available **Lower** No data available
Extinguishing Media: Use means suitable to extinguishing surrounding fire.
Unsuitable Extinguishing Media: No information available
Fire & Explosion Hazards: Not considered to be a fire or explosion hazard.

Fire Fighting Instructions / Equipment: Use normal procedures. Use protective clothing. Use NIOSH-approved breathing equipment.
Hazardous Combustion Products: No information Available
Sensitivity to mechanical impact No information available.
Sensitivity to static discharge No information available.
Specific Hazards Arising from the Chemical: No information available
NFPA Rating: (estimated) Health: 1; Flammable: 0; Reactivity: 0

Section 6 – Accidental Release Measures

Personal Precautions Use personal protective equipment. Ensure adequate ventilation. Avoid contact with skin, eyes and clothing.
Environmental Precautions No information available.
Methods for Containment and Clean Up Absorb with suitable material. Always obey local regulations.

Section 7 – Handling and Storage

Handling: Wash hands after handling. Avoid contact with skin and eyes.
Storage: Protect from freezing and physical damage.

Section 8 – Exposure Controls, Personal Protection

Potassium Acid Phthalate, CAS# 877-24-7, ACGIH TLV: NA, OSHA PEL: NA
Water, purified, CAS# 7732-18-5, ACGIH TLV: NA, OSHA PEL: NA

Engineering Measures/ General Hygiene: Normal ventilation is adequate. Ensure eyewash and safety showers are available.
Personal Protection Equipment: Skin Protection: Chemical resistant gloves.
Eye/Face Protection: Safety Glasses or goggles. **Respiratory Protection:** Normal ventilation is adequate

Section 9 – Physical and Chemical Properties

Appearance/Physical State: Clear, reddish liquid

Odor: Odorless	**% Volatility:** No Information Available
Boiling Point: Approx 100C	**Specific Gravity:** Approx 1
Melting Point: Approx 0 C	**Vapor Pressure:** No Information Available
Vapor Density: No Information Available	**Flash Point:** Not Applicable
Evaporation Rate: No Information Available	**Coefficient of water/oil distribution:** Not Available
pH: 4.0	**Odor Threshold:** Not Available
Flammability: No Information Available	**Decomposition Temperature:** No Information Available
Solubility: Infinite	**Partition Coefficient n-octanol/water:** No data available
Relative Density: No Information Available	**Molecular Weight:** Not available

Section 10 – Stability and Reactivity

Chemical Stability: Stable under normal conditions of use and storage.
Incompatible Materials Nitric Acid.
Conditions to Avoid: No Information Available.
Hazardous Decomposition Products: Oxides of potassium and carbon.
Hazardous Polymerization: Does not occur
Hazardous Reactions: None under normal processing.

Section 11 – Toxicological Information

Routes of Exposure/Symptoms/Corrosiveness – See Section 2
LD50 orl-rat: 3200 mg/kg (Potassium Acid Phthalate) LC50 inhalation-rat: NA
Irritation: No Information Available
Toxicologically Synergistic: No Information Available

Chronic Exposure
Carcinogenicity No Information Available
Sensitization No information available.
Mutagenic Effects No information available.
Reproductive Effects No information available.
Developmental Effects (Immediate/Delayed) No information available.
Teratogenicity No information available.
Other Adverse Effects No Information Available.
Endocrine Disruptor Information No information available

Section 12 – Ecological Information

Ecotoxicity: Not Available.
Persistence and Degradability: No Information Available **Mobility:** No Information Available
Bioaccumulation/ Accumulation: No Information Available

Section 13 – Disposal Considerations

Waste Disposal/Waste Disposal of Packaging: Dilute with water.
All chemical waster generators must determine whether a discarded chemical is classified as hazardous waste. Comply with all local, state, and federal regulations.

Section 14 – Transport Information

DOT - Not Regulated

Section 15 – Regulatory Information (not meant to be all inclusive)

OSHA Status: These chemicals are not considered hazardous by OSHA.
Canada DSL: These chemicals are listed on Canada's DSL list.
TSCA: The components of this solution are listed on the TSCA Inventory
SARA Title III Section 313: Not Applicable
RCRA Status: Not Applicable
CERCLA Reportable Quantity: Not Applicable
WHMIS: Not Applicable.
This product has been classified in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR

Section 16 – Additional Information

Disclaimer: The information on this MSDS applies to this specific material as supplied. It may not be valid for this material if it is used in combination with any other materials. It is the user's responsibility to determine the suitability and completeness of this information for his own particular use. No warranty is implied regarding the accuracy of the data or the results to be obtained from the products use.

Material Safety Data Sheet

Section 1 – Chemical Product and Company Identification

Catalog Numbers: BU5007-A, BU5007-B, BU5007-C, BU5007-D, BU5007-P, BU5007-Q, BU5007-G, BU5007-T

Product Identity: Buffer Solution, pH 7.00

Chemical Family: Not Applicable
Synonyms: Not Applicable
Recommended Use: Laboratory chemicals

Manufacturer's Name: AquaPhoenix Scientific, Inc., 9 Barnhart Dr., Hanover, PA 17331, (866) 632-1291
Emergency Contact Number (24hr): Chemtel (800) 255-3924

Issue Date: 12/28/06
Revision Date: 06/24/09, 08/26/10, 02/19/12, 08/02/12

Section 2 – Hazard Identification

Emergency Overview: Non-flammable, non-corrosive, non-toxic. Does not present significant health hazards. Wash areas of contact with water.
Appearance: Clear, yellowish liquid **Odor:** Odorless
Target Organs: Eyes, skin
Potential Health Effects/ Routes of Exposure:
Eyes: May cause slight irritation.
Skin: May cause slight irritation.
Ingestion: May cause diarrhea, nausea, vomiting, and cramps.
Inhalation: Not likely to be a hazard.
Chronic Effect / Carcinogenicity: None (IARC, NTP, OSHA)
Aggravated Medical Conditions No information available
These chemicals are not considered hazardous by OSHA.
See section 11 for toxicological information. See section 12 for potential environmental effects.

Section 3 – Composition, Information on Ingredients

Sodium Hydroxide, CAS# 1310-73-2, <1% v/v
Potassium Phosphate, Monobasic, CAS# 7778-77-0, <1% w/v
Sorbic Acid, CAS# 110-44-1, <1% w/v
Water, purified, CAS# 7732-18-5, >99% w/v

Section 4 – First Aid

Eyes: Immediately flush eyes with water for at least 15 minutes. Get medical assistance immediately.
Skin: Flush with water for 15 minutes. Get medical assistance if irritation develops.
Ingestion: DO NOT induce vomiting. Dilute with water or milk. Get medical assistance.
Inhalation: Remove to fresh air. Give artificial respiration if necessary. If breathing is difficult, give oxygen.
Notes to Physician Treat symptomatically.

Section 5 – Fire Fighting Measures

Flash Point: Not Applicable **Autoignition Temperature:** No information available.
Explosion Limits Upper No data available **Lower** No data available
Extinguishing Media: Use means suitable to extinguishing surrounding fire.
Unsuitable Extinguishing Media: No information available

Fire & Explosion Hazards: Not considered to be a fire or explosion hazard.
Fire Fighting Instructions / Equipment: Use normal procedures. Use protective clothing. Use NIOSH-approved breathing equipment.
Hazardous Combustion Products: No information Available
Sensitivity to mechanical impact No information available.
Sensitivity to static discharge No information available.
Specific Hazards Arising from the Chemical: No information available
NFPA Rating: (estimated) Health: 1; Flammable: 0; Reactivity: 0

Section 6 – Accidental Release Measures

Personal Precautions Use personal protective equipment. Ensure adequate ventilation. Avoid contact with skin, eyes and clothing.
Environmental Precautions No information available.
Methods for Containment and Clean Up Absorb with suitable material. Always obey local regulations.

Section 7 – Handling and Storage

Handling: Wash hands after handling. Avoid contact with skin and eyes.
Storage: Protect from freezing and physical damage.

Section 8 – Exposure Controls, Personal Protection

Sodium Hydroxide, CAS# 1310-73-2, ACGIH TLV: 2 mg/m3, OSHA PEL: 2mg/m3
Potassium Phosphate, Monobasic, CAS# 7778-77-0, ACGIH TLV: NA, OSHA PEL: NA
Sorbic Acid, CAS# 110-44-1, ACGIH TLV: NA, OSHA PEL: NA
Water, purified, CAS# 7732-18-5, ACGIH TLV: NA, OSHA PEL: NA

Engineering Measures/ General Hygiene: Normal ventilation is adequate. Ensure eyewash and safety showers are available.
Personal Protection Equipment: Skin Protection: Chemical resistant gloves.
Eye/Face Protection: Safety Glasses or goggles. **Respiratory Protection:** Normal ventilation is adequate

Section 9 – Physical and Chemical Properties

Appearance/Physical State: Clear, yellow liquid
Odor: Odorless
Boiling Point: Approx 100C
Melting Point: Approx 0 C
Vapor Density: No Information Available
Evaporation Rate: No Information Available
pH: 7.0
Flammability: No Information Available
Solubility: Infinite
Relative Density: No Information Available
% Volatility: No Information Available
Specific Gravity: Approx 1
Vapor Pressure: No Information Available
Flash Point: Not Applicable
Coefficient of water/oil distribution: Not Available
Odor Threshold: Not Available
Decomposition Temperature: No Information Available
Partition Coefficient n-octanol/water: Not Available
Molecular Weight: Not available

Section 10 – Stability and Reactivity

Chemical Stability: Stable under normal conditions of use and storage.
Incompatible Materials None identified.
Conditions to Avoid: No Information Available.
Hazardous Decomposition Products: Oxides of phosphorus.
Hazardous Polymerization: Does not occur.
Hazardous Reactions: None under normal processing.

Section 11 – Toxicological Information

Routes of Exposure/Symptoms/Corrosiveness – See Section 2

LD50 orl-rat: 1350mg/kg (Sodium Hydroxide) 1700mg/kg (Potassium Phosphate, Monobasic)
LC50 inhalation-rat: NA
Irritation: No Information Available.
Toxicologically Synergistic: No information available.
Chronic Exposure
Carcinogenicity No information available
Sensitization No information available.
Mutagenic Effects No information available.
Reproductive Effects No information available.
Developmental Effects (Immediate/Delayed) No information available.
Teratogenicity No information available.
Other Adverse Effects No information available.
Endocrine Disruptor Information No information available

Section 12 – Ecological Information

Ecotoxicity: Not Available.
Persistence and Degradability: No Information Available **Mobility:** No Information Available
Bioaccumulation/ Accumulation: No Information Available

Section 13 – Disposal Considerations

Waste Disposal/Waste Disposal of Packaging: Dilute with water.
All chemical waste generators must determine whether a discarded chemical is classified as hazardous waste. Comply with all local, state, and federal regulations.

Section 14 – Transport Information

DOT - Not Regulated

Section 15 – Regulatory Information (not meant to be all inclusive)

OSHA Status: These chemicals are not considered hazardous by OSHA.
Canada DSL: These chemicals are listed on Canada's DSL list.
TSCA: These chemicals are listed on the TSCA Inventory.
SARA Title III Section 313: Not Applicable
RCRA Status: Not Applicable
CERCLA Reportable Quantity: Sodium Hydroxide – 1000lb
WHMIS: Not Applicable.
This product has been classified in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR

Section 16 – Additional Information

Disclaimer: The information on this MSDS applies to this specific material as supplied. It may not be valid for this material if it is used in combination with any other materials. It is the user's responsibility to determine the suitability and completeness of this information for his own particular use. No warranty is implied regarding the accuracy of the data or the results to be obtained from the products use.

Material Safety Data Sheet

Section 1 – Chemical Product and Company Identification

Catalog Numbers: BU5010-A, BU5010-B, BU5010-C, BU5010-D, BU5010-P, BU5010-Q, BU5010-G, BU5010-T

Product Identity: Buffer Solution, pH 10.00

Chemical Family: Not Applicable
Synonyms: Not Applicable
Recommended Use: Laboratory chemicals

Manufacturer's Name: AquaPhoenix Scientific, Inc., 9 Barnhart Dr., Hanover, PA 17331, (866) 632-1291
Emergency Contact Number (24hr): Chemtel (800) 255-3924

Issue Date: 12/28/06
Revision Date: 6/5/08, 06/03/10, 02/19/12

Section 2 – Hazard Identification

Emergency Overview: Non-flammable, non-corrosive, non-toxic. Does not present significant health hazards. Wash areas of contact with water.
Appearance: Clear, blue liquid **Odor:** Odorless
Target Organs: Eyes, skin
Potential Health Effects/ Routes of Exposure:
Eyes: May cause slight irritation.
Skin: May cause slight irritation.
Ingestion: May cause diarrhea, nausea, vomiting, and cramps.
Inhalation: Not likely to be a hazard.
Chronic Effect / Carcinogenicity: None (IARC, NTP, OSHA)
Aggravated Medical Conditions No information available
These chemicals are not considered hazardous by OSHA.
See section 11 for toxicological information. See section 12 for potential environmental effects.

Section 3 – Composition, Information on Ingredients

Sodium Bicarbonate, CAS# 144-55-8, <0.5% w/v
Sodium Carbonate, CAS# 497-19-8, <0.5% w/v
Water, purified, CAS# 7732-18-5, >99% w/v

Section 4 – First Aid

Eyes: Immediately flush eyes with water for at least 15 minutes. Immediately get medical assistance.
Skin: Flush with water for 15 minutes. Get medical assistance if irritation develops.
Ingestion: DO NOT induce vomiting. Dilute with water or milk. Get medical assistance.
Inhalation: Remove to fresh air. Give artificial respiration if necessary. If breathing is difficult, give oxygen.
Notes to Physician Treat symptomatically.

Section 5 – Fire Fighting Measures

Flash Point: Not Applicable **Autoignition Temperature** No information available.
Explosion Limits Upper No data available **Lower** No data available
Extinguishing Media: Use means suitable to extinguishing surrounding fire.
Unsuitable Extinguishing Media: No information available
Fire & Explosion Hazards: Not considered to be a fire or explosion hazard.

Fire Fighting Instructions / Equipment: Use normal procedures. Use protective clothing. Use NIOSH-approved breathing equipment.
Hazardous Combustion Products: No information Available
Sensitivity to mechanical impact No information available.
Sensitivity to static discharge No information available.
Specific Hazards Arising from the Chemical: No information available
NFPA Rating: (estimated) Health: 1; Flammable: 0; Reactivity: 0

Section 6 – Accidental Release Measures

Personal Precautions Use personal protective equipment. Ensure adequate ventilation. Avoid contact with skin, eyes and clothing.
Environmental Precautions No information available.
Methods for Containment and Clean Up Absorb with suitable material. Always obey local regulations.

Section 7 – Handling and Storage

Handling: Wash hands after handling. Avoid contact with skin and eyes.
Storage: Protect from freezing and physical damage.

Section 8 – Exposure Controls, Personal Protection

Sodium Bicarbonate, CAS# 144-55-8, ACGIH TLV: NA, OSHA PEL: NA
Sodium Carbonate, CAS# 497-19-8, ACGIH TLV: NA, OSHA PEL: NA
Water, purified, CAS# 7732-18-5, ACGIH TLV: NA, OSHA PEL: NA

Engineering Measures/ General Hygiene: Normal ventilation is adequate. Ensure eyewash and safety showers are available.
Personal Protection Equipment: **Skin Protection:** Chemical resistant gloves.
Eye/Face Protection: Safety Glasses or goggles. **Respiratory Protection:** Normal ventilation is adequate

Section 9 – Physical and Chemical Properties

Appearance/Physical State: Clear, blue liquid
Odor: Odorless
Boiling Point: Approx 100C
Melting Point: Approx 0 C
Vapor Density: No Information Available
Evaporation Rate: No Information Available
pH: 10.0
Flammability: No Information Available
Solubility: Infinite
available
Relative Density: No Information Available
% Volatility: No Information Available
Specific Gravity: Approx 1
Vapor Pressure: No Information Available
Flash Point: Not Applicable
Coefficient of water/oil distribution: Not Available
Odor Threshold: Not Available
Decomposition Temperature: No Information Available
Partition Coefficient n-octanol/water: No data
Molecular Weight: Not available

Section 10 – Stability and Reactivity

Chemical Stability: Stable under normal conditions of use and storage.
Incompatible Materials None identified.
Conditions to Avoid: No Information Available.
Hazardous Decomposition Products: Oxides of sodium.
Hazardous Polymerization: Does not occur
Hazardous Reactions: None under normal processing.

Section 11 – Toxicological Information

Routes of Exposure/Symptoms/Corrosiveness – See Section 2
LD50 orl-rat: 4090 mg/kg (Sodium Carbonate), 4220 mg/kg (Sodium Bicarbonate) LC50 inhalation-rat: NA
Irritation: No Information Available

Toxicologically Synergistic: No Information Available
Chronic Exposure
Carcinogenicity No Information Available
Sensitization No information available.
Mutagenic Effects No information available.
Reproductive Effects No information available.
Developmental Effects (Immediate/Delayed) No information available.
Teratogenicity No information available.
Other Adverse Effects No Information Available.
Endocrine Disruptor Information No information available

Section 12 – Ecological Information

Ecotoxicity: Not Available.
Persistence and Degradability: No Information Available **Mobility:** No Information Available
Bioaccumulation/ Accumulation: No Information Available

Section 13 – Disposal Considerations

Waste Disposal/Waste Disposal of Packaging: Dilute with water.
All chemical waster generators must determine whether a discarded chemical is classified as hazardous waste. Comply with all local, state, and federal regulations.

Section 14 – Transport Information

DOT - Not Regulated

Section 15 – Regulatory Information (not meant to be all inclusive)

OSHA Status: These chemicals are not considered hazardous by OSHA.
Canada DSL: These chemicals are listed on Canada's DSL list.
TSCA: The components of this solution are listed on the TSCA Inventory
SARA Title III Section 313: Not Applicable
RCRA Status: Not Applicable
CERCLA Reportable Quantity: None Reported
WHMIS: Not Applicable.
This product has been classified in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR

Section 16 – Additional Information

Disclaimer: The information on this MSDS applies to this specific material as supplied. It may not be valid for this material if it is used in combination with any other materials. It is the user's responsibility to determine the suitability and completeness of this information for his own particular use. No warranty is implied regarding the accuracy of the data or the results to be obtained from the products use.

RUST-OLEUM CORP -- LABOR SAVER MARKING PAINTS, 2533 -- 8010-00N021794

========== Product Identification ==========

Product ID:LABOR SAVER MARKING PAINTS, 2533
MSDS Date:09/29/1987
FSC:8010
NIIN:00N021794
MSDS Number: BLRYV
=== Responsible Party ===
Company Name:RUST-OLEUM CORP
Address:11 HAWTHORN PARKWAY
City:VERNON HILLS
State:IL
ZIP:60061
Country:US
Info Phone Num:312-367-7700
Emergency Phone Num:312-864-8200
Preparer's Name:MJS
CAGE:08882
=== Contractor Identification ===
Company Name:RUST-OLEUM CORP
Address:11 HAWTHORN PARKWAY
Box:City:VERNON HILLS
State:IL
ZIP:60061-1583
Country:US
Phone:847-367-7700
CAGE:08882

========== Composition/Information on Ingredients ==========

Ingred Name:PROPANE
CAS:74-98-6
RTECS #:TX2275000
Fraction by Wt: 16-18%
OSHA PEL:1000 PPM
ACGIH TLV:ASPHYXIANT; 9192

Ingred Name:PROPANE, 2-METHYL-; (ISOBUTANE). VP: 40 PSIA. LEL: 1.9%
CAS:75-28-5
RTECS #:TZ4300000
Fraction by Wt: 10-12%

Ingred Name:TITANIUM DIOXIDE
CAS:13463-67-7
RTECS #:XR2275000
Fraction by Wt: 0-8%
OSHA PEL:15 MG/M3 TDUST
ACGIH TLV:10 MG/M3 TDUST; 9293

Ingred Name:SUPP DATA:CAUSE BLINDNESS IF INGESTED.
RTECS #:9999999ZZ

Ingred Name:METHYL ALCOHOL (METHANOL) (SARA III)
CAS:67-56-1
RTECS #:PC1400000
Fraction by Wt: 0-4%
OSHA PEL:S,200PPM/250STEL
ACGIH TLV:S,200PPM/250STEL; 93
EPA Rpt Qty:5000 LBS
DOT Rpt Qty:5000 LBS

Ingred Name:TOLUENE (SARA III)
CAS:108-88-3
RTECS #:XS5250000
Fraction by Wt: 0-18%
OSHA PEL:200 PPM/150 STEL
ACGIH TLV:50 PPM; 9293
EPA Rpt Qty:1000 LBS
DOT Rpt Qty:1000 LBS

Ingred Name:HEXANE (N-HEXANE)
CAS:110-54-3
RTECS #:MN9275000
Fraction by Wt: 6-10%
OSHA PEL:500 PPM

ACGIH TLV:50 PPM; 9293
EPA Rpt Qty:1 LB
DOT Rpt Qty:1 LB

Ingred Name:XYLENES (O-,M-,P- ISOMERS) (SARA III)
CAS:1330-20-7
RTECS #:ZE2100000
Fraction by Wt: 5-20%
OSHA PEL:100 PPM/150 STEL
ACGIH TLV:100 PPM/150STEL;9192
EPA Rpt Qty:1000 LBS
DOT Rpt Qty:1000 LBS

Ingred Name:ETHYLENE GLYCOL (SARA III)
CAS:107-21-1
RTECS #:KW2975000
Fraction by Wt: 0-4%
OSHA PEL:C 50 PPM
ACGIH TLV:C 50 PPM,VAPOR; 9192
EPA Rpt Qty:1 LB
DOT Rpt Qty:1 LB

Ingred Name:VM&P NAPHTHA. VP: 2 @ 20C. LEL: 0.9%
CAS:64742-89-8
Fraction by Wt: 1-3%
OSHA PEL:300 PPM;400 PPM STEL
ACGIH TLV:300 PPM

========== Hazards Identification ==========

LD50 LC50 Mixture:NONE SPECIFIED BY MANUFACTURER.
Routes of Entry: Inhalation:YES Skin:NO Ingestion:YES
Reports of Carcinogenicity:NTP:NO IARC:NO OSHA:NO
Health Hazards Acute and Chronic:(ACUTE) INHAL: ANESTHETIC, IRRIT OF RESP TRACT/ACUTE NERV SYS DEPRESS CHARACT BY HDCH, DIZZ, STAG, CONFUSN, UNCON/ COMA. SKIN/EYE: PRIMARY IRRITANT WHICH DEFATS SKIN & CAN LEAD TO DERMAT W/ RPTD OVERE XP. INGEST: GI IRRIT, NAUS, VOMIT & DIARR. (CHRONIC) RPTS HAVE SHOWN RPTD & PRLNGD OCCUP OVEREXP TO (SEE EFTS OF OVEREXP
Explanation of Carcinogenicity:NOT RELEVANT
Effects of Overexposure:HLTH HAZ: SOLV W/PERM BRAIN & NERV SYS DMG. OVEREXP TO XYLOL & TOLUENE IN LAB ANIMALS HAS SHOWN LIVER, KIDNEY, SPLEEN & EYE DMG AS WELL AS ANEMIA. IN HUMANS, OVEREXP HAS BEEN FOUND TO CAUSE LIVER & CA RDIAC ABNORMALITIES. OVEREXP TO HEXANE IN HIGH VAP CONC (1000-1500 PPM) OVER A PERIOD OF SEV MONTHS HAS BEEN (SUPP DATA)
Medical Cond Aggravated by Exposure:NONE SPECIFIED BY MANUFACTURER.

========== First Aid Measures ==========

First Aid:INHAL: REMOVE FROM EXPOS, RESTORE BRTHG & NOTIFY MD. EYE: FLUSH IMMED W/LRG AMTS OF WATER FOR AT LEAST 15 MIN. NOTIFY MD. SKIN: WASH AFFECTED AREA W/SOAP & WATER, REMOVE CONTAM CLTHG & WASH BEFORE REU SE. WASH HANDS BEFORE EATING/SMOKING. INGEST: DO NOT INDUCE VOMIT. KEEP PERSON WARM, QUIET & GET MD. ASPIR OF MATL IN LUNGS CAN CAUSE CHEM PNEUM WHICH CAN BE FATAL.

========== Fire Fighting Measures ==========

Flash Point Method:TCC
Flash Point:<0F,<-18C
Lower Limits:SEE INGRED
Extinguishing Media:NFPA CLASS B EXTINGUISHERS (CO2, DRY CHEMICAL OR FOAM).
Fire Fighting Procedures:WEAR NIOSH/MSHA APPRVD SCBA & FULL PROT EQUIP . WATER SPRAY MAY BE INEFFECTIVE. WATER MAY BE USED TO COOL CLSD CNTNRS TO PVNT PRESS BUILDUP (SUPP DATA)
Unusual Fire/Explosion Hazard:KEEP CNTNRS TIGHTLY CLSD. ISOLATE FROM HEAT, ELEC EQUIP, SPARKS & OPEN FLAME. CLSD CNTNRS MAY EXPLODE WHEN EXPSD TO EXTREME HEAT. DO NOT APPLY TO HOT SURFACES.

========== Accidental Release Measures ==========

Spill Release Procedures:REMOVE ALL SOURCES OF IGNITION, VENTILATE AREA AND REMOVE WITH INERT ABSORBENT AND NONSPARKING TOOLS.
Neutralizing Agent:NONE SPECIFIED BY MANUFACTURER.

========== Handling and Storage ==========

Handling and Storage Precautions:DO NOT STORE ABOVE 120F. DO NOT PUNCTURE.
Other Precautions:INTENTIONAL MISUSE BY DELIBERATELY CONCENTRATING AND INHALING CONTENTS CAN BE HARMFUL OR FATAL.

========== Exposure Controls/Personal Protection ==========

Respiratory Protection:USE NIOSH/MSHA APPROVED CHEMICAL CARTRIDGE RESPIRATOR (TC23C) TO REMOVE SOLID AIRBORNE PARTICLES OF OVERSPRAY AND ORGANIC VAPORS DURING SPRAY APPLICATION. IN CONFINED AREAS: USE NIOSH/MSHA APPROVED SU PPLIED-AIR RESPIRATOR OR HOODS (TC19C).
Ventilation:PROVIDE GENERAL OR LOCAL EXHAUST VENT IN VOLUME & PATTERN TO KEEP TLV OF MOST HAZ INGREDS BELOW ACCEPTABLE LIMIT.
Protective Gloves:IMPERVIOUS GLOVES .
Eye Protection:CHEMICAL WORKERS GOGGLES .
Other Protective Equipment:NONE SPECIFIED BY MANUFACTURER.
Work Hygienic Practices:WASH HANDS BEFORE EATING OR SMOKING.
Supplemental Safety and Health
FIRE FIGHT PROC: AND POSSIBLE AUTOIGNITION OR EXPLOSION. IF WATER IS USED, FOG NOZZLES ARE PREFERRED. EFTS OF OVEREXP: SHOWN TO CAUSE PERIPHERAL POLYNEUROPATHY WHICH HAS THE POTENTIAL OF BECOMING IRRE VERSIBLE. OVEREXP TO METHYL ALCOHOL HASBEEN SHOWN TO AFFECT CNS, ESPECIALLY OPTIC NERVE. MAY BE FATAL OR (SEE ING 10)

========== Physical/Chemical Properties ==========

HCC:F2
Boiling Pt:B.P. Text:<0F,<-18C
Vapor Pres:SEE INGRED
Vapor Density:HVR/AIR
Evaporation Rate & Reference:SLOWER THAN ETHER
Appearance and Odor:NONE SPECIFIED BY MANUFACTURER.

========== Stability and Reactivity Data ==========

Stability Indicator/Materials to Avoid:YES
STRONG OXIDIZING AGENTS.
Stability Condition to Avoid:NONE SPECIFIED BY MANUFACTURER.
Hazardous Decomposition Products:BY OPEN FLAME - CO AND CO2.

========== Disposal Considerations ==========

Waste Disposal Methods:DISPOSE OF ACCORDING TO LOCAL, STATE AND FEDERAL REGULATIONS. DO NOT INCINERATE CLOSED CONTAINERS.

Material Safety Data Sheet Collection
Genium group inc.
1171 RiverFront Center, Amsterdam, NY 12010
(518) 842-4111

Issue Date: 2006-06

Zinc Acetate
ZIN1180

Section 1 - Chemical Product and Company Identification 61

Material Name: Zinc Acetate **CAS Number:** 557-34-6
Chemical Formula: $C_4H_8O_4Zn$
Structural Chemical Formula: $Zn(C_2H_3O_2)_2$
EINECS Number: 209-170-2
ACX Number: X1013450-6
Synonyms: ACETIC ACID,ZINC SALT; ACETIC ACID,ZINC SALT (8CI,9CI); ACETIC ACID,ZINC(II) SALT; DICARBOMETHOXYZINC; ZINC ACETATE; ZINC DIACETATE
General Use: Preserving wood; as mordant in textile dyeing; manufacture of glazes for painting on porcelain; as a laboratory reagent in testing for albumin, tannin, urobilin, phosphate, blood; as an astringent.
Also as a cross-linking agent for polymers; and fuel additive.

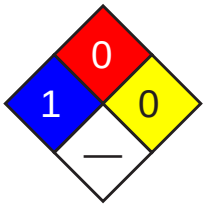
Section 2 - Composition / Information on Ingredients

Name	CAS	%
zinc acetate	557-34-6	98 min.

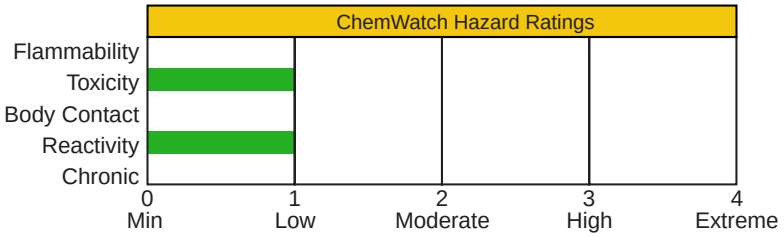
OSHA PEL **NIOSH REL**

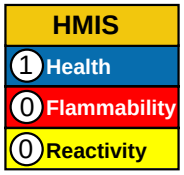
ACGIH TLV

Section 3 - Hazards Identification



Fire Diamond





ANSI Signal Word

Caution

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

White crystals; faint acetous (vinegar) odor. Irritating to eyes/skin/respiratory tract. Also causes: upon ingestion: nausea, vomiting, headache, abdominal pain.

Potential Health Effects

Target Organs: eyes, skin, respiratory system, digestive system
Primary Entry Routes: ingestion, inhalation, skin contact, eye contact
Acute Effects

Inhalation: Not normally a hazard due to nonvolatile nature of product. The dust may be highly discomforting to the upper respiratory tract.
The heat decomposition products of zinc acetate cause irritation to mucous membranes, coughing. Severe and chronic exposure to zinc oxide fumes may result in "metal fume fever"; a disabling but transient disease.

Eye: The dust may be highly discomforting to the eyes and is capable of causing a mild, temporary redness of the conjunctiva (similar to wind-burn), temporary impairment of vision and/or other transient eye damage/ulceration.
Very dilute preparations of zinc acetate have been used as eye drops

Skin: The material is moderately discomforting to the skin if exposure is prolonged.
Open cuts, abraded or irritated skin should not be exposed to this material.

Ingestion: Considered an unlikely route of entry in commercial/industrial environments.
The material is highly discomforting to the gastrointestinal tract and may be harmful if swallowed.

Soluble zinc salts produces irritation and corrosion of the alimentary tract (in a manner similar to copper salts) with pain, vomiting, etc.
Delayed deaths have been ascribed to inanition (weakness and extreme weight loss resulting from prolonged and severe food insufficiency) following severe strictures of the esophagus, and pylorus.
Ingestion may cause irritation or burning of the digestive tract, nausea and vomiting, and watery or bloody diarrhea.

Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Not listed; MAK - Not listed.

Chronic Effects: No human exposure data available. For this reason, health effects described are based on experience with chemically-related materials.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.
Lay patient down. Keep warm and rested.
If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor.

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water. Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.
Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water).
Wash affected areas thoroughly with water (and soap if available).
Seek medical attention in event of irritation.

Ingestion: Rinse mouth out with plenty of water.
Contact a Poison Control Center.
Do NOT induce vomiting. Give a glass of water.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians:

1.Absorption of zinc compounds occurs in the small intestine.
2.The metal is heavily protein bound.
3.Elimination results primarily from fecal excretion.
4.The usual measures for decontamination (Ipecac Syrup, lavage, charcoal or cathartics) may be administered, although patients usually have sufficient vomiting not to require them.
5.$CaNa_2EDTA$ has been used successfully to normalise zinc levels and is the agent of choice.

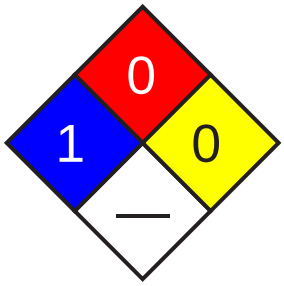
Section 5 - Fire-Fighting Measures

Flash Point: Nonflammable
LEL: Not applicable
UEL: Not applicable

Extinguishing Media: There is no restriction on the type of extinguisher which may be used.

General Fire Hazards/Hazardous Combustion Products: Noncombustible. Slight explosion hazard when exposed to strong oxidizers.
Decomposes on heating and produces acrid smoke and toxic fumes of carbon monoxide (CO), carbon dioxide (CO_2) and zinc oxide.

Fire Incompatibility: Avoid contamination with oxidizing agents i.e. nitrates, oxidizing acids, chlorine bleaches, pool chlorine etc. as ignition may result.
An exothermic reaction may occur in contact with sulfuric oleum.



Fire Diamond

Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
Wear breathing apparatus plus protective gloves. Prevent spillage from entering drains or waterways.
Do not approach containers suspected to be hot.
Cool fire-exposed containers with water spray from a protected location.
If safe to do so, remove containers from path of fire.

Section 6 - Accidental Release Measures

Small Spills: Clean up all spills immediately. Avoid contact with skin and eyes.
Wear impervious gloves and safety glasses.
Use dry clean-up procedures and avoid generating dust.
Vacuum up or sweep up.
Place spilled material in clean, dry, sealable, labeled container.

Large Spills: Clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
Wear breathing apparatus plus protective gloves. Prevent spillage from entering drains or waterways.
Stop leak if safe to do so. Avoid generating dust.

Collect recoverable product into labeled containers for recycling.
Collect residues and seal in labeled drums for disposal.
Wash area down with large quantity of water and prevent runoff into drains.
After clean-up operations, decontaminate and launder all protective clothing and equipment before storing and reusing.
If contamination of drains or waterways occurs, advise emergency services.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid generating and breathing dust.
Use good occupational work practices. Observe manufacturer's storing and handling recommendations.
Avoid all personal contact, including inhalation.
Wear protective clothing when risk of exposure occurs.
Use in a well-ventilated area.
Avoid contact with incompatible materials.
Avoid contact with moisture.
Handle and open container with care.
When handling, DO NOT eat, drink or smoke.
Keep containers securely sealed when not in use.
Avoid physical damage to containers.
Always wash hands with soap and water after handling. Work clothes should be laundered separately.

Recommended Storage Methods: Multi-ply paper bag with sealed plastic liner or heavy gauge plastic bag. Check that all containers are clearly labeled and free from leaks. Packing as recommended by manufacturer.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: None required when handling small quantities. OTHERWISE: Use in a well-ventilated area.
General exhaust is adequate under normal operating conditions.
If risk of overexposure exists, wear NIOSH-approved dust respirator.
Correct fit is essential to obtain adequate protection.

Personal Protective Clothing/Equipment:

Eyes: Safety glasses with side shields; or as required, chemical goggles.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Barrier cream and PVC gloves.
Safety footwear.

Other: Overalls. Ensure there is ready access to a safety shower.
Eyewash unit.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Available in both the anhydrous and more commonly the dihydrate form. Both forms are available as monoclinic crystals with an acetic acid odor. Both forms are very soluble in water and slightly soluble in alcohol.

Physical State: Divided solid
Vapor Pressure (kPa): Not applicable
Vapor Density (Air=1): Not applicable
Formula Weight: 183.5
Specific Gravity (H_2O=1, at 4 °C): 1.84
Evaporation Rate: Not applicable
pH: Not applicable
pH (1% Solution): 5 - 6
Boiling Point: Decomposes at 200 °C (392 °F)
Freezing/Melting Point: 237 °C (458.6 °F)
Volatile Component (% Vol): Not applicable
Decomposition Temperature (°C): 250-400
Water Solubility: 1 g soluble in 23 ml water

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Product is considered stable. Hazardous polymerization will not occur.
Storage Incompatibilities: Avoid storage with oxidizers.

Section 11 - Toxicological Information

Toxicity
Oral (rat) LD_{50}: 2510 mg/kg
Oral (rat) LD_{50}: 2170 mg/kg

Irritation
Skin (rabbit): 500 mg/24h - mild
Eye (rabbit): 20 mg/24h - moderate

See *RTECS* AK 1500000, for additional data.

Section 12 - Ecological Information

Environmental Fate: No data found.
Ecotoxicity: TL_m Pimephales promelas (fathead minnow) 0.88 ppm/96 hr (soft water) /Conditions of bioassay not specified
BCF: zinc accumulates in some organisms

Section 13 - Disposal Considerations

Disposal: Recycle wherever possible or consult manufacturer for recycling options.
Follow applicable federal, state, and local regulations.
Bury residue in an authorized landfill.
Recycle containers where possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: None

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Not listed
CERCLA 40 CFR 302.4: Listed per CWA Section 311(b)(4) 1000 lb (453.5 kg)
SARA 40 CFR 372.65: Listed as Compound
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Attachment B - Tailgate H&S Form

Document Control Number:TGM - _____
TGM + project number plus date as follows: xxxxxxxx.xxxx.xxxxx - dd/mm/year

TAILGATE HEALTH & SAFETY MEETING FORM

This form documents the tailgate meeting conducted in accordance with the Project HASP. Personnel who perform work operations on-site during the day are required to attend this meeting and to acknowledge their attendance, at least daily.

Project Name:			**Project Location:**
Date:	**Time:**	**Conducted by:**	**Signature/Title:**
Client:		**Client Contact:**	**Subcontractor companies:**

TRACKing the Tailgate Meeting

Think through the Tasks (list the tasks for the day):

1 _____ 3 _____ 5 _____

2 _____ 4 _____ 6 _____

Other Hazardous Activities - Check the box if there are any other Arcadis, Client or other party activities that may pose hazards to Arcadis operations ☐ If there are none, write "None" here: _____

If yes, describe them here: _____

How will they be controlled? _____

Prework Authorization - check activities to be conducted that require permit issuance or completion of a checklist or similar before work begins:

	Doc #		Doc #		Doc #
☐ Not applicable		☐ Working at Height		☐ Confined Space	
☐ Energy Isolation (LOTO)		☐ Excavation/Trenching		☐ Hot Work	
☐ Mechanical Lifting Ops		☐ Overhead & Buried Utilities		☐ Other permit	

Discuss following questions (for some review previous day's post activities). **Check if yes :**

☐ Incidents from day before to review?	☐ Lessons learned from the day before?	☐ Any Stop Work Interventions yesterday?
☐ Any corrective actions from yesterday?	☐ Will any work deviate from plan?	☐ If deviations, notify PM & client
☐ JSAs or procedures are available?	☐ Field teams to "dirty" JSAs, as needed?	☐ All equipment checked & OK?
☐ Staff has appropriate PPE?	☐ Staff knows Emergency Plan (EAP)?	☐ Staff knows gathering points?

☐ Topics from Corp H&S to cover?

Comments: _____

Recognize the hazards (check all those that are discussed) (Examples are provided) and **A**ssess the Risks (Low, Medium, High - circle risk level) - Provide an overall assessment of hazards to be encountered today and briefly list them under the hazard category.

☐ Gravity (i.e., ladder, scaffold, trips) (L M H)	☐ Motion (i.e., traffic, moving water) (L M H)	☐ Mechanical (i.e., augers, motors) (L M H)
☐ Electrical (i.e., utilities, lightning) (L M H)	☐ Pressure (i.e. gas cylinders, wells) (L M H)	☐ Environment (i.e., heat, cold, ice) (L M H)
☐ Chemical (i.e., fuel, acid, paint) (L M H)	☐ Biological (i.e., ticks, poison ivy) (L M H)	☐ Radiation (i.e., alpha, sun, laser) (L M H)
☐ Sound (i.e., machinery, generators) (L M H)	☐ Personal (i.e. alone, night, not fit) (L M H)	☐ Driving (i.e. car, ATV, boat, dozer) (L M H)

TAILGATE HEALTH & SAFETY MEETING FORM - Pg. 2

Control the hazards (Check all and discuss those methods to control the hazards that will be implemented for the day): Review the HASP, applicable JSAs, and other control processes. Discuss and document any additional control processes.

☒	**STOP WORK AUTHORITY** (Must be addressed in every Tailgate meeting - (*See statements below*)				
☐	Elimination	☐	Substitution	☐	Isolation
☐	Engineering controls	☐	Administrative controls	☐	Monitoring
☐	General PPE Usage	☐	Hearing Conservation	☐	Respiratory Protection
☐	Personal Hygiene	☐	Exposure Guidelines	☐	Decon Procedures
☐	Emergency Action Plan (EAP)	☐	Fall Protection	☐	Work Zones/Site Control
☐	JSA to be developed/used ***(specify)***	☐	TIP conducted ***(specify job/JSA)***	☐	Traffic Control
☐		☐		☐	Other ***(specify)***
☐		☐		☐	

Signature and Certification Section - Site Staff and Visitors

Name/Company/Signature	Initial & Sign in Time	Initial & Sign out Time	I have read and understand the HASP

Important Information and Numbers

All site staff should arrive fit for work. If not, they should report to the supervisor any restrictions or concerns.

In the event of an injury, employees will call WorkCare at **1.888-449-7787** and then notify the field supervisor who will then notify the Project or Task Manager.

In the event of a motor vehicle accident, employees will notify the field supervisor who will then notify the Project or Task Manager.

In the event of a utility strike or other damage to property of a client or 3rd party, employees will immediately notify the field supervisor, who will then immediately notify the Project or Task Manager.

Visitor Name/Co - not involved in work

	In	Out
	In	Out
	In	Out
	In	Out

I will STOP the job any time anyone is concerned or uncertain about health & safety or if anyone identifies a hazard or additional mitigation not recorded in the site, project, job or task hazard assessment.

I will be alert to any changes in personnel, conditions at the work site or hazards not covered by the original hazard assessments.

If it is necessary to **STOP THE JOB,** I will perform **TRACK**; and then amend the hazard assessments or the HASP as needed.

I will not assist a subcontractor or other party with their work unless it is absolutely necessary and then only after I have done TRACK and I have thoroughly controlled the hazard.

Post Daily Activities Review - Review at end of day or before next day's work (Check those applicable and explain:)

- ☐ Lessons learned and best practices learned today: _____
- ☐ Incidents that occurred today: _____
- ☐ Any Stop Work interventions today? _____
- ☐ Corrective/Preventive Actions needed for future work: _____
- ☐ Any other H&S issues: _____

Attachment C - Forms

Real Time Exposure Monitoring Data Collection Form

Document all air monitoring conducted on the Site below. Keep this form with the project file.

Site Name: _____ Date: _____

Instrument: _____ Model: _____ Serial #: _____

Calibration Method: (Material used settings, etc.)	
Calibration Results:	
Calibrated By:	

Activity Being Monitored	Compounds/Hazards Monitored	Time	Reading	Action Required? Y/N

Describe Any Actions Taken as a Result of this Air Monitoring and Why (does it match Table 5-1):

_____

_____

Employee Signature Form

I certify that I have read, understand, and will abide by the safety requirements outlined in this HASP.

Printed Name	Signature	Date

Subcontractor Acknowledgement: Receipt of HASP Signature Form

ARCADIS claims no responsibility for the use of this HASP by others although subcontractors working at the site may use this HASP as a guidance document. In any event, ARCADIS does not guarantee the health and/or safety of any person entering this site. Strict adherence to the health and safety guidelines provided herein will reduce, but not eliminate, the potential for injury at this site. To this end, health and safety becomes the inherent responsibility of personnel working at the site.

Printed Name	Company	Signature	Date

Visitor Acknowledgement and Acceptance of HASP Signature Form

By signing below, I waive, release and discharge the owner of the site and ARCADIS and their employees from any future claims for bodily and personal injuries which may result from my presence at, entering, or leaving the site and in any way arising from or related to any and all known and unknown conditions on the site.

Name	Company	Reason for Visit	Date/Time On Site	Date/Time Off Site

Hazardous Materials Transportation Form

	Vehicle (place X in box)	Type (pick-up, car, box truck, etc.)
Personal		
Rental		
ARCADIS owned/leased		
Government owned		
Trailer		

Materials Transported	Quantity	Storage/Transport Container

List Trained Drivers:

_____

_____

Hazardous Materials Shipment Form

Material Description and Proper Shipping Name (per DOT or IATA)	Shipment Quantity	DOT Hazard Classification	Shipment Method (air/ground)

List Shipper (i.e., who we are offering the shipment to):

_____

_____

List Trained Employee(s):

_____

_____

Exhibit 3 – Competent Person Evaluation Form for Excavation / Trenching

Exhibit 3 – Competent Person Evaluation Form for Excavation / Trenching

Name of Employee:_____Job Title:_____

Department: _____Office Location: _____

Experience with Excavations/Trenching:

_____

_____

_____

_____

_____

_____

Relevant Training:

_____

_____

_____

_____

_____

_____

_____

Other Relevant Qualifications:

_____

_____

_____

_____

_____

_____

_____

*Include documentation from employee's Supervisor that acknowledges their capacity to work as a designated competent person.

Based on the information listed above and an evaluation of this employee's knowledge and experience, I consider them to be a Competent Person for Excavation and Trenching.

Evaluation By: _____ Job Title: _____

Signature: _____ Date: _____

ARCADIS
Infrastructure · Water · Environment · Buildings

Daily / Periodic Excavation Inspection Checklist

Project Name:	**Date / Time:**
Project Number:	**Location:**
Prepared By:	**Project Manager:**

This checklist or similar must be completed for all excavations. It documents that daily and post-event / periodic inspections are conducted.

Soil Classified As:	☐ Stable Rock	☐ Type A	☐ Type B	☐ Type C
Soil Classified On:		By:		
Type of Protective System in Use	☐ Sloping	☐ Shoring	☐ Shielding	☐ Benching	☐ Other
Description:				

Inspection Item	YES	NO	N/A	Comments
Has the ARCADIS Utility Clearance Procedure been completed?	☐	☐	☐	
Are underground installations protected from damage?	☐	☐	☐	
Has a Competent Person been identified?	☐	☐	☐	
Are adequate means of entry / exit available in the excavation – at least every 25 feet?	☐	☐	☐	
If exposed to traffic, are personnel wearing reflective vests and adequate barriers/traffic controls installed?	☐	☐	☐	
Do barriers exist to prevent equipment from rolling into the excavation?	☐	☐	☐	
Was air monitoring conducted prior to and during excavation entry?	☐	☐	☐	
Was the stability of adjacent structures reviewed by a registered P.E.?	☐	☐	☐	
Are spoil piles at least 2 feet from the excavation edge?	☐	☐	☐	
Are employees protected from falling into excavation by guardrail systems, fences, or barricades *if the excavation is not readily seen because of plant growth or other visual barrier*? Best Management Practice Note: Even if employees are not entering into an excavation, competent person should be consulted to establish a safe zone distance away from the edge of any open excavation. General guidance would be for employees to remain 6 feet or more away from the edge of any excavation	☐	☐	☐	
If the well, pit, shaft, or similar excavation is 6 feet (1.8m) or more in depth are employees protected from falling by guardrail systems, fences or barricades?	☐	☐	☐	
Are work tasks completed remotely if feasible?	☐	☐	☐	
Is a protective system in place and in good repair?	☐	☐	☐	
Is excavation isolated from the effects of vibration?	☐	☐	☐	
Are employees protected from falling / elevated material?	☐	☐	☐	
Is soil classification adequate for current environmental / weather conditions?	☐	☐	☐	
Do portable ladders extend at least 3feet above the excavation?	☐	☐	☐	
Are portable ladders or ramps secured in place?	☐	☐	☐	
Have all personnel attended safety meeting on excavation hazards?	☐	☐	☐	
Are support systems for adjacent structures in place?	☐	☐	☐	
Is the excavation free from standing water?	☐	☐	☐	
Is water control and diversion of surface runoff adequate?	☐	☐	☐	
Are employees wearing required protective equipment?	☐	☐	☐	
Excavation Competent Person:				**Date/Time:**

ARCADIS

ARCADIS	Incident / Near-Miss Investigation Report

☐ OSHA Recordable ☐ First Aid Injury ☐ Fire Date of Incident:
☐ Lost Workday Injury ☐ Vehicle Accident ☐ Spill / Leak
☐ Restricted Duty Injury ☐ Equipment Damage ☐ Near Miss Incident Number:

Every employee injury, accident, and near miss must be reported within 24 hours of the injury. If the incident results in hospitalization, an immediate report must be made by telephone to the Project Manager and the Health and Safety Officer.

Project Information

Project Name: | Project #

Location of Incident:

Employee

Name: | Employee Number:

Employment Status: ☐ Regular ☐ Part Time | How long in present job?

Injury or Illness Information

Where did the incident / near miss occur? (number, street, city, state, zip):

Employee's specific activity at the time of the incident / near miss:

Equipment, materials, or chemicals the employee was using when the incident / near miss occurred (e.g., the equipment employee struck against or that struck the employee; the vapor inhaled or material swallowed; what the employee was lifting, pulling, etc.):

Describe the specific injury or illness (e.g., cut, strain, fracture, etc.):

Body part(s) affected (e.g., back, left wrist, right eye, etc.):

Name and address of treatment provider (e.g., physician or clinic): | Phone No.:

If hospitalized, name and address of hospital: | Phone No.:

Date of injury or onset of illness: / / | Time of event or exposure: ☐ AM ☐ PM

Did employee miss at least one full shift's work? ☐ No ☐ Yes, 1st date absent (MM/DD/YYYY) / /

Has employee returned to work? ☐ Regular work ☐ Restricted work ☐ No
☐ Yes, date returned (MM/DD/YYYY) / /

To whom reported: | Other workers injured / made ill in this event? ☐ Yes ☐ No

Description of Incident / Near Miss: (Describe what happened and how it happened.)

Motor Vehicle Accident (MVA)

Company Vehicle? ☐ Yes ☐ No

ARCADIS

ARCADIS	Incident / Near-Miss Investigation Report

Accident Location (street, city, state)							
Vehicle Towed?	☐ Yes ☐ No	Other Vehicle?	☐ Yes ☐ No	# Vehicles Towed:		# of Injuries:	

Spill

Material Spilled:	Quantity:	Source:
Agency Notifications:		
Cost of Incident $		

Third Party Incidents

Name of Owner:		Address:	Telephone:
Description of Damage:			
Witness Name:		Address:	Telephone:
Witness Name:		Address:	Telephone:

#	Root Cause and Contributing Factors: Conclusion (Describe in Detail Why Incident / Near Miss Occurred)
1	
2	
3	
4	
5	

Root Cause(s) Analysis (RCA):

1. Lack of skill or knowledge.
2. Lack of or inadequate operational procedures or work standards.
3. Inadequate communication of expectations regarding procedures or work standards.
4. Inadequate tools or equipment.
5. Correct way takes more time and / or requires more effort.
6. Short-cutting standard procedures is positively reinforced or tolerated.
7. Person thinks there is no personal benefit to always doing the job according to standards.
8. Uncontrollable.

#	RCA #	Solution(s): How to Prevent Incident / Near Miss From Reoccurring	Person Responsible	Due Date	Closure Date

Investigation Team Members

Name	Job Title	Date

Results of Solution Verification and Validation

ARCADIS

ARCADIS	Incident / Near-Miss Investigation Report

Reviewed By		
Name	Job Title	Date
	Project Manager	
	Health and Safety Reviewer	

Attachment D - Utility Checklist and Utility Strike Form

UTILITY LINE STRIKE INVESTIGATION FORM

This form is to be used for all utility-related investigations.

Notification of Corporate H&S is required for all utility strikes (Email or phone conversation) with an affirmative response from Corporate H&S.

No information is to be entered into the 4-Sight database or shared with outside sources until approved by the Legal Department.

REPORTED BY	
DATE/TIME OF INCIDENT	
INCIDENT DESCRIPTION (FACTS ONLY)	

	YES	NO
ARCADIS Employee Injured (includes first aid injuries and calls to WorkCare)		
Non-ARCADIS Employee Injured (subcontractors or Third-Parties)		
Public Utility		
Fire		
Spill/Leak		
Other Property / Equipment Damage (non-vehicle)		
Accident involves other motorized equipment (ATV, backhoe, etc.)		
Utility Damaged Requiring Repair		
ARCADIS onsite staff met required utility experience		
Client Business Disruption, Downtime, Financial Loss		
Project Profit Loss		

PROJECT NUMBER OR NAME	
CLIENT / COMPANY	
PM & PIC	
WORK TYPE	
INCIDENT ADDRESS (Street, City, State/Province, Country, Zip/Location Code)	

EMPLOYEES INVOLVED	
WITNESSES	
INVESTIGATION TEAM	
REVIEWERS	

UTILITY STRIKE INFORMATION				
ANA Managing office				
Utility struck by		ARCADIS		Subcontractor
		Other:		
Type of Utility Hit		Choose an item.		
		Other:		
Utility Material		Choose an item.		
		Other:		
Depth/Height of Utility		Choose an item.		
		Not applicable		
Lithology		Choose an item.		
		Other:		
		Not applicable		
Type of Device Striking Utility		Choose an item.		
		Other:		
Type of Work Being Conducted		Choose an item.		
		Other:		
Lines of Evidence Used (Check all used)		Public locate (One Call, 811, etc.)		ARCADIS locate—GPR
		Site map/drawing		ARCADIS locate—
		Site operator/owner interview		ARCADIS locate—
		ARCADIS site inspection		Air Knife
		3rd Party locate—GPR		Hydroknife
		3rd Party locate—Electromagnetic		Hand Augering
		3rd Party locate—Radiofrequency		Potholing/Day-lighting
		3rd Party locate—Other		Probing
		Other:		
Total lines of evidence		**(enter total number used to locate utilities)**		

CONTRIBUTING FACTORS (list reasons why incident occurred).

Root Cause(s) (Indicate Primary Root Cause)	**Root Cause Category(s)**	
	Choose an item.	Other:
	Choose an item.	Other:
	Choose an item.	Other:
	Choose an item.	Other:

ROOT CAUSE

Take your KEY Contributing Factors and ask "why" to determine what caused the incident (e.g. drill down to the Primary ROOT CAUSE).

Root Cause Category

Assign at least one Root Cause Category (you can select more than one for a root cause if needed). Indicate the Primary Root Cause Category for this incident.

- Training / Competency
  - Did not recognize the risk
  - Did not have skill, competence experience, or knowledge
  - Has not completed required training
  - Training inadequate or ineffective
- Adherence to standards, practices, expectations
  - Did not use TRACK, PM and quality tools
  - Did not use Stop Work Authority
  - Not familiar with or did not follow standards, procedures (HASP, QA plan, JSA, etc)
  - Inadequate project planning, including budgeting and scheduling and/or follow-up review
  - Behavior encouraged or tolerated with no consequence by supervisor, co-workers, or other parties
  - Employee or supervisor does not support H&S
  - Improper use of tools or equipment
- Availability of Standards, Practices, Procedures
  - No standard, procedure or practice (QA Plan, HASP, JSA, standard)
  - Inadequate standard, procedure or practice (QA Plan, HASP, JSA, standard)
- Communications
  - Inadequate management establishment and communication of expectations / culture
  - Inadequate team communication (i.e., tailgate, kickoff meeting, management of change)
  - Inadequate communication with client
- Tools/Equipment
  - Proper tools or equipment unavailable (including software)
  - Tools or equipment damaged
  - Tools improperly maintained/calibrated equipment
- Factors out of our Control
  - Natural Forces - Events outside of human control

- Third party out of our control

ANY POSITIVE OUTCOME	

ASSIGN SOLUTIONS

You can add more than one solution if needed.

Solution	**Responsible Party**	**Due Date**

Please attach supporting documents [e.g. Public utility location ticket/response, site map(s) and photo(s)] as appropriate.

Utilities and Structures Checklist

ARCADIS Design & Consultancy for natural and built assets

THIS FORM MUST BE COMPLETED IN ENTIRETY PRIOR TO BEGINNING ANY INTRUSIVE WORK

Project: _____

Project Number: _____

Form Completion Date: _____ Form Expiration Date: _____
(15 business days post form completion date)

Pre-Field Work

Required: One Call or "811" notified 48-72 hours in advance of work? #: _____

Ticket Expiration Date _____ (Review State Requirements)

Utility companies notified during the One Call process ☐ See attached ticket

_____ _____ _____ _____

_____ _____ _____ _____

List any other utilities requiring notification: ☐ None

_____ _____ _____ _____

Private Locator Contacted ☐ Yes ☐ No

Plan private utility clearance subcontractor assignments, areas, required clearance equipment, depth of clearance needed, types of utilities. When possible re-clear 811 markings to confirm utility locations.

Client provided utility maps or "as built" drawings showing utilities? ☐ Yes ☐ No

Field Work - This must be completed on site, by staff who have a minimum of one year of field experience in identifying utilities. Review Check list with PM or designee prior to beginning intrusive work.

Mechanized intrusive work in utility Tolerance Zone (<30-in.) requires pre-approval by Corporate H&S

List Soil Boring / Well IDs or Excavation Locations applicable to this clearance checklist:

3 Reliable Lines of Evidence Required Prior to Starting any Subsurface Intrusive Work

☐ One Call/"811" (Reliable as a line of evidence when working in public right of way or easement)
Utility Markings Present: ☐ Paint ☐ Pin flags/stakes ☐ Other ☐ None

☐ Client Provided Maps/Drawings **OR** ☐ Maps/Drawings requested but not provided

☐ Client Clearance Name(s)/Affiliation(s) _____

☐ Interview(s): Name(s)/Affiliation(s) _____

_____

Did person(s) interviewed indicate depths of any utilities in the subsurface?
☐ Yes, depths provided: ☐ Did not know or refused to answer
Additional Comments:

☐ Site Inspection (**Complete Page 2 & Photo Document Marked Utilities & Utility Structures**)
☐ Public Records / Maps / As-Builts
☐ **Private Locator: (Name and Company)** _____
☐ Ground Penetrating Radar (GPR)
☐ Radiofrequency (RF Loc)
☐ Electromagnetic (EM)
☐ Metal Detector

Soft Dig Methods
☐ Termination Depth _____ft. bgs
☐ Potholing / Vacuum Extraction
☐ Air-Knife ☐ Hydroknife
☐ Probing
☐ Hand Auguring

☐ Other: _____
☐ Marine Locator: (Name and Company) _____

Tips for Successful Utility Location (H&S Standard Section 5.6):
1. Don't forget to look up (mark above grade utilities if warranted)
2. Be on-site with Private Utility Locators
3. Ask Private Locators to "confirm" other's markings
4. Select alternate/backup locations during clearance process
5. Mark out all known utilities. Leave nothing to question
6. No hammering - no pickaxes - no digging bars - no shortcutting
7. No excessive turning or downward force of hand augers/shovels
8. Utilities may run in or directly under asphalt/concrete
9. Clearing, grubbing, and heavy equipment may damage shallow utilities.
10. Is Spotter needed for Heavy Equipment near aboveground utilities?

Utilities and Structures Checklist

During the site inspection look for the following: **("YES" requires additional investigation and the utility must be marked properly prior to beginning subsurface intrusive work)**:

Site Inspection	Utility Color Codes	Present	
A) Natural gas line present (evidence of a gas meter)?	Yellow	☐ Yes	☐ No
i) Feeder Lines to buildings or homes?		☐ Yes	☐ No
B) Evidence of electric lines:	Red		
i) Conduits to ground from electric meter or along wall?		☐ Yes	☐ No
ii) Conduits from power poles running into ground?		☐ Yes	☐ No
iii) Light poles, electric devices with no overhead lines?		☐ Yes	☐ No
iv) Overhead electric lines present? Marked? (See Section L)		☐ Yes	☐ No
C) Evidence of sewer drains:	Green		
i) Restrooms or kitchen on site?		☐ Yes	☐ No
ii) Sewer cleanouts present?		☐ Yes	☐ No
iii) Combined sewer /storm lines or multiple sewer lines?		☐ Yes	☐ No
D) Evidence of water lines:	Blue		
i) Water meter on site or multiple water lines?		☐ Yes	☐ No
ii) Fire hydrants in vicinity of work?		☐ Yes	☐ No
iii) Irrigation systems? (Sprinkler heads, valve boxes, controls in building)		☐ Yes	☐ No
E) Evidence of storm drains:	Green		
i) Open curbside or slotted grate storm drains		☐ Yes	☐ No
ii) Gutter down spouts going into ground		☐ Yes	☐ No
F) Evidence of telecommunication lines:	Orange		
i) Fiber optic warning signs in areas?		☐ Yes	☐ No
ii) Aboveground cable boxes or housings or wires in work area? Marked?		☐ Yes	☐ No
G) Underground storage tanks:			
i) Tank pit present, tank vent present?		☐ Yes	☐ No
ii) Product lines running to dispensers/buildings?		☐ Yes	☐ No
H) Do utilities enter or exit existing structures/buildings?			
If Yes, confirm the utility markings outside of structure/building match up.		☐ Yes	☐ No
I) Proposed excavation marked in white?	White	☐ Yes	☐ No
J) Unclassed utilities / anomalies marked in pink?	Pink	☐ Yes	☐ No
K) **Overhead** Utilities/Communication Lines - **Look Up and MARK**:			
i) Overhead electrical conduit, pipe chases, cable trays, product lines?		☐ Yes	☐ No
ii) Overhead fire sprinkler system?		☐ Yes	☐ No
L) **Overhead** Power lines in or near the work area:			
i) < 50 kV within 10 ft. of work area?		☐ Yes	☐ No
ii) >50 - 200 kV within 15 ft. of work area?		☐ Yes	☐ No
iii) >200-350 kV within 20 ft. of work area?		☐ Yes	☐ No
iv) >350-500 kV within 25 ft. of work area?		☐ Yes	☐ No
v) >500-750 kV within 35 ft. or work area?		☐ Yes	☐ No
vi) >750-1000 kV within 45 ft. of work area?		☐ Yes	☐ No
M) Other:			
i) Evidence of linear asphalt or concrete repair?		☐ Yes	☐ No
ii) Evidence of linear ground subsidence or change in vegetation?		☐ Yes	☐ No
iii) Unmarked manholes or valve covers in work area?		☐ Yes	☐ No
iv) Warning signs (Call Before you Dig, Look Up, etc.) on or adjacent to site?		☐ Yes	☐ No
v) Utility color markings not illustrated in this checklist?	i.e. Purple	☐ Yes	☐ No
vii) Operating heavy equipment on unpaved/unimproved ground; review equipment route for shallow utilities crossing it and modify if necessary.		☐ Yes	☐ No
O) Utilities & Structures Checklist been reviewed by the PM or Designee		Yes	No*
PM or Designee Name: _____		* If no, STOP WORK, call PM	

Name and Signature of person completing the checklist: _____

Date: _____ _____

Do not perform mechanized intrusive work within 30 inches of a utility marking without receiving pre-approval by Corporate H&S.

ALL UTILITY STRIKES REQUIRE CORPORATE H&S NOTIFICATION (EMAIL OR CALL) WITH A CONFIMRED RESPONSE

Attachment E - JSAs

Job Safety Analysis

General

JSA ID	14769	**Status**	(3) Completed
Job Name	Environment-Air Monitoring	**Created Date**	2/20/2017
Task Description	Air Monitoring	**Completed Date**	02/28/2017
Template	False	**Auto Closed**	False

Client / Project

Client	IBERDROLA USA
Project Number	B00130940000
Project Name	NEWARK FORMER MGP SITE
PIC	WHITE, KEITH
Project Manager	POWLIN, SCOTT

User Roles

Role	Employee	Due Date	Completed Date	Supervisor	Active
Developer	Beyrle, Nicholas J	3/9/2017	2/27/2017	Girard, Benjamin	☑
HASP Reviewer	Green, Adam S	3/13/2017	2/27/2017	Price, Richard J	☑
Quality Reviewer	Yalcin, Bora			Cianfaglione, Rick G	☑
Reviewer	Golubski, Jason R	3/13/2017	2/28/2017	Brien, Jason D	☑

Job Steps

Job Step No.	Job Step Description		Potential Hazard	Critical Action	H&S Reference
1	Inspect and Calibrate PID and Dust meter.	1	Faulty/uncalibrated equipment leading to over exposure of VOCs and/or dust.	Calibrate and document calibration readings to confirm meter meets manufacturers recommendations. Charge meter(s) to use througout the monitoring task.	
		2	Potential asphyxiation hazard if used in small enclosed area. Use caution with pressurized cylinders.	Inspect canister and valve for damages, leaks, and pressure. Use canister in well ventilated area. Avoid situations where canister could fall and burst.	
2	Survey area where air monitoring will be conducted	1	Head and body injury by getting struck by vehicles and other heavy equipment that may be present in the area.	Delineate work area with cones and barricades. Communicate with hand signals with heavy equipment operators that may be present in the work area. Wear a high visibility vest during survey of the area to make yourself more visible to equipment/vehicle operators. Wear a hard hat to protect head from overhead hazards around heavy equipment.	
		2	Slips, trips or falls from uneven terrain resulting in broken bones, lacerations or sprains.	Remove all trip hazards from walking path. Choose a walking path with even surfaces. Wear steel toe safety boots with rubber soles to maintain a non-slip surface with the ground.	
		3	Hearing damage from high noise levels above 85 dBA from remedial construction activities.	Utilize a dosimeter to determine noise levels in the work zone. If a worker cannot hear a normal conversation at 3 feet then the work zone is considered to be a high noise area. Keep all unnecessary personnel outside of the work zone to distance themselves from high noise areas. Wear hearing protection when working in the work zone to protect ears from the noise levels.	
		4	Eye injury from flying debris in wind.	Position body with back facing the wind to avoid wind blowing debris into eyes. Wear goggles if visible dust or debris is in the air to protect eyes from debris entering the eye.	
		5	Over exposure to VOCs and or dust from site operations (excavation, drilling, etc).	Stay upwind of work area(s). Initiate Stop Work if action levels are exceeded. Refer to the Community Air Monitoring Plan (or appropriate plan in the job work plan) for action levels and mitigation steps.	

PPE — Personal Protective Equipment

Type	Personal Protective Equipment	Description	Required
Dermal Protection	long sleeve shirt/pants	Level D	Required
Eye Protection	safety glasses		Required
Foot Protection	steel-toe boots		Required
Hand Protection	chemical resistant gloves (specify type)	Nitrile	Required
	work gloves (specify type)	Leather when hand hazard exists	Required
Head Protection	hard hat		Required
Hearing Protection	ear plugs	Require when hearing hazard exists	Required
Miscellaneous PPE	traffic vest--Class II or III		Required

Supplies

Type	Supply	Description	Required
Communication Devices	mobile phone		Required
Miscellaneous	fire extinguisher		Required
	first aid kit		Required
	flashlight		Required
Personal	sunscreen		Recommended
	water/fluid replacement		Required

Review Comments

Reviewer		Comments
Employee: **Role** **Review Type** **Completed Date**	Green, Adam S HASP Reviewer Revise 2/23/2017	Overall - Good JSA. Job step 1, Hazard 2 - Potential Fire from Calibration Gas. The calibration gas for LEL and multimeters is typically 50% LEL, so there would not be a fire hazard. There could be an asphyxiation hazard if the whole cylinder leaked into the enclosed room and displaced the oxygen, but that scenario is unlikely too. Maybe a statement to use caution with the pressurized cylinders.
Employee: **Role** **Review Type** **Completed Date**	Green, Adam S HASP Reviewer Approve 2/27/2017	Looks good. Thank you for the revision.
Employee: **Role** **Review Type** **Completed Date**	Golubski, Jason R Reviewer Approve 2/28/2017	

Job Safety Analysis

General

JSA ID	14770	**Status**	(3) Completed
Job Name	Environment-Drilling, soil sampling, well installation	**Created Date**	2/20/2017
Task Description	Drilling, soil sampling, and well installation	**Completed Date**	02/23/2017
Template	False	**Auto Closed**	False

Client / Project

Client	IBERDROLA USA
Project Number	B00130940000
Project Name	NEWARK FORMER MGP SITE
PIC	WHITE, KEITH
Project Manager	POWLIN, SCOTT

User Roles

Role	Employee	Due Date	Completed Date	Supervisor	Active
Developer	Beyrle, Nicholas J	3/13/2017	2/20/2017	Girard, Benjamin	☑
HASP Reviewer	Green, Adam S	3/6/2017	2/23/2017	Price, Richard J	☑
Reviewer	Golubski, Jason R	3/6/2017	2/21/2017	Brien, Jason D	☑

Job Steps

Job Step No.	Job Step Description		Potential Hazard	Critical Action	H&S Reference
1	Set up necessary traffic and public access controls	1	Struck by vehicle due to improper traffic controls	Use a buddy system for placing site control cones and/or signage. Position vehicle so that you are protected from moving traffic. Wear Class II traffic vest	
2	Utility Clearance	1	Potential to encounter underground or above ground utilities while drilling.	Complete utility clearance in accordance with the ARCADIS Utility Clearance H&S Standard.	ARCADIS H&S Standard ARCHSFS019
3	General drill rig operation	1	Excessive noise is generated by rig operation.	When the engine is used at high RPMs or soil samples are being collected, use hearing protection.	
		2	During drill rig operation, surfaces will become hot and cause burns if touched, and COCs in the soils more readily vaporize generating airborne contaminates.	Due to friction and lack of a drilling fluid, heat will be produced during this method. Mainly drill augers. Be careful handling split spoons. Wear proper work gloves. When soils and parts become heated, the COC could volatilize. Air monitoring should always be performed in accordance with the HASP.	
		3	Moving parts of the drilling rig can pull you in causing injury. Pinch points on the rig and auger connections can cause pinching or crushing of body parts.	Stay at least 5 feet away from moving parts of the drill rig. Know where the kill switch is, and have the drillers test it to verify that it is working. Do not wear loose clothing, and tie long hair back. Avoid wearing jewelry while drilling. Cone off the work area to keep general public away from the drilling rig.	
		4	Dust and debris can cause eye injury and soil cuttings and/or water could contain COCs.	Wear safety glasses and stay as far away from actual drilling operation as practicable. Wear appropriate gloves to protect from COCs.	
		5	Drilling equipment laying on the ground (i.e. augers, split spoons, decon equipment, coolers, etc), create a tripping hazard. Water from decon buckets generate mud and cause a slipping hazard.	Keep equipment and trash picked up, and store away from the primary work area.	
		6	The raised derrick can strike overhead utilities, tree limbs or other elevated items	Never move the rig with the derrick up. Ensure there is proper clearance to raise the derrick, and that you are far enough away from overhead power lines. See the Utility Clearance H&S Standard for guidance.	

4	Mudd rotary drilling	1	The raised derrick can strike overhead utilities, tree limbs or other elevated items.	Never move the rig with the derrick up. Ensure there is proper clearance to raise the derrick, and that you are far enough away from overhead power lines. See the Utility Location H&S policy and procedure for guidance.	
		2	This technology uses fluid, which collects with sediments in large basin. Fluid can splash out and cause slipping/mud hazard. Liquid mixture can splash into your eyes.	Wear rubber boots if needed, and keep clear of muddy/wet area as much as practicable. If area becomes excessively muddy, consider mud spikes or covering the area with a material that improves traction. Wear safety glasses.	
5	Hollow stem auger drilling	1	All hazards in step 3 apply. Additionally,The raised derrick can strike overhead utilities, tree limbs or other elevated items	Never move the rig with the derrick up. Ensure there is proper clearance to raise the derrick, and that you are far enough away from overhead power lines. See the Utility Location H&S policy and procedure for guidance.	
		2	Hands or fingers can get caught and crushed if trying to clean by hand or with tools while the auger is still turning.	Auger should always be stopped and clutch disengaged prior to cleaning.	
6	Air Rotary Drilling	1	This drilling method works with high air pressure and can generate flying debris that can strike your body or get in your eyes.	When the drill rig is being driven into media, it will produce flying debris. The flaps behind the drill rig should stay closed whenever possible to reduce the risk of flying debris. Safety glasses and hard hat should always be worn when the drill rig is operating. When penetrating asphalt, protect surrounding cars that may be present to avoid damage to pain or windshields.	
		2	The raise derrick can strike overhead utilities, tree limbs or other elevated items.	Never move this rig with the derrick up. Ensure there is proper clearance to raise the derrick and that you are far enough away from overhead power lines. See the Utility clearance H&S Standard for guidance.	
		3	When drilling through bedrock prior to groundwater, dust can be produced from pulverization. Inhalation of dusts/powder can occur.	Supplemental water should be used to manage dust and/or dust masks should be used if necessary.	
7	Reverse rotary drilling	1	This method will use fresh water to pump out drill cuttings through the center of the casing. Water/sediment mixture is generated and could cause contact with impacted soils or groundwater.	Ensure the pit construction can hold the amount of cuttings that are anticipated. Air monitoring should also be used of pit area.	
		2	Fire hydrants are often used for water source. Hydrants deliver water at high pressure. Pressurized water can cause flying parts/debris and excessive slipping hazards.	Water usage from fire hydrants should be cleared with local municipalities prior to use. Only persons that know how to use the hydrant should be performing this task. Ensure all connections are tight, and hose line is not run over to cut by traffic. Any leaks from the hydrant should be reported immediately.	
		3	Settling pit construction can cause tripping hazard from excavated soils, and plastic sheeting can cause slipping.	Cone off the area to keep the general public/visitors away from the settling pit. Ensure proper sloping of excavation.	
		4	The raised derrick can strike overhead utilities, tree limbs or other elevated items.	Never move the rig with the derrick up. Ensure there is proper clearance to raise the derrick, and that you are far enough away from overhead power lines. See the Utility Location H&S policy and procedure for guidance.	

8	Rotosonic drilling	1	Fire hydrants are often used for water source. Hydrants deliver water at high pressure. Pressurized water can cause flying parts/debris and excessive slipping hazards.	Water usage from fire hydrants should be cleared with local muncipalities prior to use. Only persons that know how to use the hydrant should be performing this task. Ensure all connections are tight, and hose line is not run over to cut by traffic. Any leaks from the hydrant should be reported immediately.	
		2	This method requires a lot of clearance. The drill head can turn 90 degrees to attach to the next drill flight or casing. This usually requires a large support truck to park directly behind the rig. As the drill head raises the new casing flight is angled down at the same time until it can be turned completely vertical.	Ensure sufficient overhead clearance.	
		3	Heavy lifting of cores can cause muscle strain.	Always use 2 people to move core containers. Use caution moving core samples to layout area. Plan layout area to ensure adequate aisle space between core runs for logging. Keep back straight and use job rotation.	
		4	The rotosonic drill head can move very quickly up and down while working on a borehole. Moving parts can strike someone or catch body parts.	The operator and helper must communicate and stay clear of the path of the drill head. The drill utilizes two large hydraulic clamps to continuously hold casings while load/unloading previous casings. Do not wear loose clothing.	
9	Direct push drilling	1	The drill rods will be handled by workers most of the time rather than the rig doing it, therefore pinch points can cause lacerations and crushing of fingers/body parts.	Keep a minimum of 5 feet away from drill rig operation and moving parts.	
		2	The direct push rigs are usually meant to fit in spaces where larger rig can't. Tight spaces can pin workers.	Do not put yourself between the rig and a fixed object. Use Spotters or a tape measure to ensure clearances in tight areas. Pre-plan equipment movement from one location to the next.	
		3	Some direct push equipment is controlled by wireless devices. These controls can fail and equipment can strike workers or cause damage to property.	The drill rig should be used in a large open area to test wireless controls prior to moving to boring locations. The operator of the rig will test the kill switch with wireless remote prior to use. Operator will stay in range of rig while moving so that wireless signal will not be too weak and cause errors to the controls.	
		4	Sampling sleeves must be cut to obtain access to soil. Cutting can cause lacerations.	It's preferable to let the driller cut the sleeves open. Many drillers have holders for the sleeve to allow for stability when cutting. If you cut the sleeves, use a hook blade, change blade regularly, and cut away from the body.	
		5	Soil cores may contain contaminated media.	Wear nitrile gloves and saftey glasses for protection from contaminated media when logging soil borings.	
10	Rock coring	1	Flying debris can hit workers or cause debris to get in eyes.	Rock chips or overburden may become airborne from drilling method. Wear safety glasses and hard hat and remain at a safe distance from back of drill rig.	
		2	Heavy lifting of cores can cause muscle strain.	Always use 2 people to move core containers. Use caution moving core samples to layout area. Plan layout area to ensure adequate aisle space between core runs for logging. Keep back straight and use job rotation.	

11	Sample collection and processing	1	Injuries can result from pinch points on sampling equipment, and from breakage of sample containers.	Care should be taken when opening sampling equipment. Look at empty containers before picking them up, and do not over-tighten container caps. Use dividers to store containers in the cooler so they do not break.	Sample Cooler Handling JSA
		2	Lifting heavy coolers can cause back injuries.	Use two people to move heavy coolers. Use proper lifting techniques.	
12	Monitoring well installation	1	Same hazards as in Step 3 with general drill rig operation	See step 3	
		2	Monitoring well construction materials can clutter the work area causing tripping hazards.	Well construction materials should be picked up during the well installation process.	
		3	Heavy lifting can cause muscle strains, and cutting open bags can cause lacerations.	Well construction materials are usually 50 lbs or greater. Team lift or use drill rig to hoist bags. Always use work gloves while cutting open bags.	
		4	Well pack material (i.e. sand, grout, bentonite) can become airborne and get in your eyes.	Wear safety glasses for protection from airborne sand and dust.	
		5	Cutting the top of the well to size can cause jagged/sharp edges on the top of the well casing.	Wear gloves when working with the top of the well casing, and file any sharp jagged edges that resulted from cutting to size.	
13	Soil cutting and purge water management	1	Moving full drums can cause back injury, or pinching/crushing injury.	Preferably have the drilling contractor move full drums with their equipment. If this is not practicable, use lift assist devices such as drum dollies, lift gates, etc. Employ proper lifting techniques, and perfrom TRACK to identify pinch/crush points. Wear leather work gloves, and clear all walking and work areas of debris prior to moving a drum.	Drum Handling JSA

PPE — Personal Protective Equipment

Type	Personal Protective Equipment	Description	Required
Dermal Protection	long sleeve shirt/pants	Level D	Required
Eye Protection	safety glasses		Required
Foot Protection	steel-toe boots		Required
Hand Protection	chemical resistant gloves (specify type)	Nitrile	Required
	work gloves (specify type)	Leather when hand hazard exists	Required
Head Protection	hard hat		Required
Hearing Protection	ear plugs	Required when hearing hazard exists	Required
Miscellaneous PPE	traffic vest--Class II or III		Required
Respiratory Protection	dust mask		Recommended

Supplies

Type	Supply	Description	Required
Communication Devices	mobile phone		Required
Decontamination	Decon supplies (specify type)	Driller to provide and manage	Recommended
Miscellaneous	fire extinguisher		Required
	first aid kit		Required
	flashlight		Required
Personal	eye wash (specify type)	bottle	Required
	sunscreen		Recommended
	water/fluid replacement		Required

Review Comments

Reviewer		Comments
Employee: **Role** **Review Type** **Completed Date**	Green, Adam S HASP Reviewer Approve 2/23/2017	Very comprehensive JSA which makes it difficult to tailgate and review. I would suggest identifying the drilling method to be utilized on the individual site and removing the drilling methods that will not be used. In my experience, not many people are going to review and use a JSA that is greater than 2 pages. As a company, we have a lot of experience with drilling, sampling and well installation. Always ensure a good rig inspection and practice good housekeeping around the drilling area. Physical hazards seem to be the biggest issues.
Employee: **Role** **Review Type** **Completed Date**	Golubski, Jason R Reviewer Approve 2/21/2017	Glad to see the first step is to set up traffic controls

Job Safety Analysis

General

JSA ID	14780	**Status**	(3) Completed
Job Name	Environment-Drum sampling/handling	**Created Date**	2/20/2017
Task Description	Drum Handling, Sampling and Transfer of Drum Contents	**Completed Date**	03/06/2017
Template	False	**Auto Closed**	False

Client / Project

Client	IBERDROLA USA
Project Number	B00130940000
Project Name	NEWARK FORMER MGP SITE
PIC	WHITE, KEITH
Project Manager	POWLIN, SCOTT

User Roles

Role	Employee	Due Date	Completed Date	Supervisor	Active
Developer	Beyrle, Nicholas J	3/13/2017	2/20/2017	Girard, Benjamin	☑
HASP Reviewer	Green, Adam S	3/6/2017	2/27/2017	Price, Richard J	☑
Reviewer	Ahrens, Bruce W	3/6/2017	3/6/2017	VanDewalker, Heather M	☑

Job Steps

Job Step No.	Job Step Description		Potential Hazard	Critical Action	H&S Reference
1	Inspect Drums for signs of Bulging, Leaking, Crystals, Temperature, and Odor	1	Exposure to chemicals stored in drum or container.	Read drum labels for information about contents. Review all relevant MSDSs about chemical contents. If labels are not attached, call PM or Local H&S Representative.	None
		2	Contents of the drum can cause fire/explosion hazard.	Use air monitoring meters to screen drums. % LEL and VOCs (PPM). If either of the values are above the action levels described in the HASP or MSDS then Stop Work, move away from the area, and reassess the situation. Call PM and H&S staff for support.	
2	Remove lids or bungs from Drums	1	Hand Injuries can occur from sharp edges, pinch points, and from use of hand tools.	Wear appropriate work gloves. When removing ring from drum, fingers can get pinched between ring and drum. Keep fingers clear of this space. Select proper tool for task. If large amount of drums will be encountered, use a speed or drum wrench.	Employee H&S Field book, Section III Subpart II, page 104. Also Section III Subpart L, page 38.
		2	Rapid depressurization from empty or partially full drums can cause flying parts or volatile COCs releasing on staff.	Do not handle or open bulging drums (contact Corp H&S for assistance). Bleed any built up pressure by carefully loosening bung prior to removing ring. Keep face and arms away from bung opening when loosening. Slightly lift lid, insert end of air monitoring device to monitor air inside drum.	
		3	Use of mechanical tools to remove bolts from drum lids causes excessive noise.	Wear hearing protection.	
		4	Splashing can occur if filling drum, or collecting samples.	Wear eye and face protection. Pour liquids into drum slowly to minimize splashing.	
		5	When working with COCs that have fire/explosive properties, sparking or heat could cause fire/explosion.	Use brass or non Spark Hand Tools if such a hazard exists or is suspected.	
3	Sample Contents from Drums	1	Exposure to COCs can occur by contacting impacted contents.	Select proper dermal protection for task, at a minimum nitrile gloves should be worn. Wear appropriate eye face and body protection as outlined in the HASP.	
		2	Staff can be exposed to chemical vapors/fumes when sampling.	Conduct air monitoring as outlined in the HASP, and if required, select appropriate respiratory protection for the task.	
		3	Sharp edges and broken sample containers can cause lacerations.	Discard any broken sample ware or glass properly. Do not over tighten sample containers.	

3	Sample Contents from Drums	4	Chemical burns or skin irritation can occur from contact with sample preservatives.	Wear chemical protective gloves when collecting samples, or when handling damaged sample containers.	
4	Replace drum lids	1	Hand Injuries can occur from sharp edges, pinch points, and from use of hand tools.	see step 2 above	
5	Moving and Storing Drums	1	Drum storage areas can be accessed by the general public, or may not be secure.	Calculate how many drums will be stored in new location. Ensure that drums are not easily accessed by the general public. Do not store such that drums impede pedestrian or vehicular traffic.	
		2	Muscle strain can occur when lifting/pulling/pushing drums.	Drums that are full can weigh as much as 800 lbs. Use a lift assist device whenever possible, and use a team lift approach. When moving soil drum generated by drilling, have drillers use their equipment to move the drums. Using dolly, slightly lift drum away from dolly to install forks under drum. Slowly let drum come back down and rest on dolly. Using hook on top of dolly, ensure it latches on top of drum bung.	
		3	Body parts can be pinched between lift device, or drum and the ground.	Be aware of hand and foot placement during drum staging. Do not hurry through task.	
		4	When moving, the drum can tip or the dolly could become unstable from uneven ground surface.	Plan travel route with drum prior to moving. With drum secure on dolly, have one employee pull back on dolly, and other employee slowly push back on drum toward dolly. Have second worker act as spotter for traffic, pedestrians, and any trip hazards along the way.	

PPE — Personal Protective Equipment

Type	Personal Protective Equipment	Description	Required
Dermal Protection	long sleeve shirt/pants	Level D	Required
Eye Protection	safety glasses		Required
Hand Protection	chemical resistant gloves (specify type)	Nitrile	Required
	work gloves (specify type)	Leather	Required

Supplies

Type	Supply	Description	Required
Communication Devices	mobile phone		Required
Miscellaneous	fall protection (specify type)		Required
	fire extinguisher		Required
	first aid kit		Required
	flashlight		Required
	Other	dolly	Required

Review Comments

Reviewer		Comments
Employee: **Role** **Review Type** **Completed Date**	Green, Adam S HASP Reviewer Approve 2/27/2017	No comments.
Employee: **Role** **Review Type** **Completed Date**	Ahrens, Bruce W Reviewer Approve 3/6/2017	Good JSA- no comments!

Job Safety Analysis

General

JSA ID	14772	**Status**	(2) Review
Job Name	Construction-Excavation and trenching	**Created Date**	2/20/2017
Task Description	Excavation and Trenching	**Completed Date**	
Template	False	**Auto Closed**	False

Client / Project

Client	IBERDROLA USA
Project Number	B00130940006
Project Name	Newark Former MGP Site
PIC	WHITE, KEITH
Project Manager	GOLUBSKI, JASON

User Roles

Role	Employee	Due Date	Completed Date	Supervisor	Active
Developer	Beyrle, Nicholas J	3/17/2017	3/6/2017	Girard, Benjamin	☑
HASP Reviewer	Green, Adam S	3/20/2017		Price, Richard J	☑
Reviewer	Golubski, Jason R	3/20/2017	3/7/2017	Brien, Jason D	☑

Job Steps

Job Step No.	Job Step Description		Potential Hazard	Critical Action	H&S Reference
1	Site preparation	1	Improper utility clearance may result in utility/equipment damage or injury.	Perform utility clearance with a minimum of 3 lines of evidence. Document utility clearance for reference including any ticket numbers or phone numbers of utilities.	
		2	Clearing vegetation may result in impact hazards.	Stand at least 25 ft from clearing operations using manual or mechanized methods. Larger vegetation like trees may be under stress and may break and wood parts my fly in any direction.	
		3	Slip trip and fall hazards from walkover activities (vegetation, uneven surfaces, etc and applies to all job steps in this JSA)	Plan route and focus on the task at hand (walking). Do not walk while looking at utility maps/drawings or talking on cell phones.	
2	Excavation and backfilling	1	Struck by equipment during excavation.	Stay at least 10 feet beyond the reach of excavation equipment unless establishing communication with operator. Wear PPE required by this JSA for increased visibility. Keep unneccessary workers away from the excavation area. Use cones to delineate swing radius of equipment.	
		2	Struck by equipment during sampling.	Have excavator operator retrieve samples from excavation with bucket. Establish eye contract with the operator. Ensure bucket is resting on the ground, hydraulic controls are disengaged, and the operator has removed their hands from the controls. Wear proper PPE for sample collection.	
		3	Equipment/worker falls into excavations from edge collapse	Stand at least 6 ft from edge of excavation. Competent person to oversee sloping, benching, bracing excavation to ensure stability.	
		4	Chemical exposure to site contaminants.	Wear protective clothing specified in this JSA, avoid skin contact with soil materials or any liquids in the excavation. Use air monitoring to ensure TLVs are not exceeded. Wash hands and face prior to eating, drinking or consuming tobacco.	
		5	Noise from excavation equipment	Keep distance from equipment to reduce noise levels. If levels cannot be controlled wear hearing protection appropriate for the hazard.	

3	Excavation equipment decontamination	1	Slips and falls on wet surfaces.	Wear footwear appropriate for wet environments. Reduce amount of pressure washing required by removing soils using dry methods to extent practical	
		2	Flying particles from cleaning activities.	Wear eye and skin protection during decontamination activities. Use face shield if overspray or flying debris is a persistent problem. Avoid cleaning (pressure washing) in direction of other nearby workers, keep unneccessary workers clear of decontamination activity.	

PPE — Personal Protective Equipment

Type	Personal Protective Equipment	Description	Required
Dermal Protection	long sleeve shirt/pants	Level D	Required
Eye Protection	safety glasses		Required
Foot Protection	steel-toe boots		Required
Hand Protection	chemical resistant gloves (specify type)	Nitrile when handling impacted soils	Required
	work gloves (specify type)	Leather when hand hazard exists	Required
Head Protection	hard hat		Required
Hearing Protection	ear plugs	Required when hearing hazard exists	Required
Miscellaneous PPE	traffic vest--Class II or III	Class II	Required

Supplies

Type	Supply	Description	Required
Communication Devices	mobile phone		Required
	walkie talkie		Required
Miscellaneous	fire extinguisher		Required
	first aid kit		Required
	flashlight		Required
Personal	eye wash (specify type)	Bottle	Required
	insect repellant		Recommended
	sunscreen		Recommended

Review Comments

Reviewer		Comments
Employee: **Role** **Review Type** **Completed Date**	Green, Adam S HASP Reviewer Revise 2/27/2017	I echo what Jason said. If samples need to be taken from the bucket, please ensure that the bucket is grounded, hydraulic controls are disengaged and the operator has taken their hands off of the controls.
Employee: **Role** **Review Type** **Completed Date**	Golubski, Jason R Reviewer Revise 2/21/2017	I realize this is taken from the standard JSA, but we should not be entering any excavations for Newark. Just explanatory test pits that will be observed from the ground surface. Please add something about using cones to mark the excavators swing radius and staying outside those cones will the excavator is actively digging.
Employee: **Role** **Review Type** **Completed Date**	Golubski, Jason R Reviewer Revise 3/3/2017	project number should be B0013094.0006 Step 2, Part 1 - Add language from Adam - When collecting samples from bucket, make eye contract with operator, verify bucket is grounded, and operator is "hands-off" controls
Employee: **Role** **Review Type** **Completed Date**	Golubski, Jason R Reviewer Approve 3/7/2017	

Job Safety Analysis

General

JSA ID	14771	**Status**	(3) Completed
Job Name	Environment-Groundwater Sampling and free product recovery	**Created Date**	2/20/2017
Task Description	Groundwater sampling	**Completed Date**	03/03/2017
Template	False	**Auto Closed**	False

Client / Project

Client	IBERDROLA USA
Project Number	B00130940000
Project Name	NEWARK FORMER MGP SITE
PIC	WHITE, KEITH
Project Manager	POWLIN, SCOTT

User Roles

Role	Employee	Due Date	Completed Date	Supervisor	Active
Developer	Beyrle, Nicholas J	3/13/2017	3/2/2017	Girard, Benjamin	☑
HASP Reviewer	Green, Adam S	3/16/2017	3/3/2017	Price, Richard J	☑
Reviewer	Golubski, Jason R	3/16/2017	3/3/2017	Brien, Jason D	☑

Job Steps

Job Step No.	Job Step Description		Potential Hazard	Critical Action	H&S Reference
1	Stage at pre-determined sampling location and set up work zone and sampling equipment	1	Personnel could be hit by vehicular traffic	Set up cones and establish work area. Position vehicle so that field crew is protected from site traffic. Unload as close to work area as safely possible.	
		2	Sampling equipment, tools and monitoring well covers can cause tripping hazard	Keep equipment picked up and use TRACK to assess changes.	
2	Open wells to equilibrate and gauge wells	1	When squatting, personnel can be difficult to see by vehicular traffic.	Wear class II traffic vest if wells are located proximal to vehicular traffic. Use tall cones and the buddy system if practicable.	
		2	Pinchpoints on well vault can pinch or lacerate fingers	Use correct tools to open well vault/cap. Wear leather gloves when removing well vault lids, and chemical protective gloves while gauging. Wear proper PPE including safety boots, knee pads and safety glasses.	
		3	Lifting sampling equipment can cause muscle strain	Unload as close to work area as safely possible; use proper lifting and reaching techniques and body positioning; don't carry more than you can handle, and get help moving heavy or awkward objects.	
		4	Pressure can build up inside well causing cap to release under pressure	Keep head away from well cap when removing. If pressure relief valves are on well use prior to opening well	
3	Begin Purging Well and Collecting Parameter Measurements	1	Electrical shock can occur when connecting/disconnecting pump from the battery.	Make sure equipment is turned off when connecting/disconnecting. Wear leather gloves. Use GFCIs when using powered tools and pumps. Do not use in the rain or run electrical cords through wet areas.	
		2	Purge water can spill or leak from equipment	Stop purging activities immediately, stop leakage and block any drainage grate with absorbent pads. Call PM to notify them of any reportable spill.	
		3	Water spilling on the ground can cause muddy/slippery conditions	Be careful walking in work area when using plastic around well to protect from spillage	
		4	Lacerations can occur when cutting materials such as plastic tubing	When cutting tubing, use tubing cutter. No open fixed blades should ever be used. When possible wear work gloves, leather type.	
		5	Purge water can splash into eyes	Pour water slowly into buckets/drums to minimize splashing. Wear safety glasses.	

4	Collect GW or Free Product Sample	1	Working with bailer rope can cause rope burns on hands.	Slowly raise and lower the rope or string for the bailer. Wear appropriate gloves for the task.	
		2	Sample containers could break or leak preservative	Discard any broken sampleware or glass properly. Do not overtighten sample containers. Wear chemical protective gloves.	
5	Recovery of Free Product from well	1	Exposure to free product	Additional chemical protection may be necessary based on the type of product. Additionally, safety goggles, a faceshield, or respiratory protection may be required. Verify in the HASP. Use air monitoring to ensure TLVs are not exceeded, refer to HASP for TLV s and mitigation procedures.	
6	Staging of Well Purge water and/or Free Product	1	Muscle strains can occur when moving purge water or drums	If using buckets, do not fill buckets up to the top. Always keep lid on buckets when traveling or moving them to another location. Only half fill buckets so when dumping the buckets weigh less. See drum handling JSA for movement of drums.	Drum handling JSA

PPE — Personal Protective Equipment

Type	Personal Protective Equipment	Description	Required
Dermal Protection	long sleeve shirt/pants	Level D	Recommended
Eye Protection	safety glasses		Required
Foot Protection	steel-toe boots		Required
Hand Protection	chemical resistant gloves (specify type)	Nitrile	Required
	work gloves (specify type)	Leather when hand hazard exists.	Required
Head Protection	hard hat		Required
Hearing Protection	ear plugs	Required when hearing hazard exists.	Recommended
Miscellaneous PPE	other	Knee pads/board	Required
	traffic vest--Class II or III		Required

Supplies

Type	Supply	Description	Required
Communication Devices	mobile phone		Required
Decontamination	Decon supplies (specify type)	alconox, DI water, spray bottle	Required
Miscellaneous	fire extinguisher		Required
	first aid kit		Required
	flashlight		Required
Personal	eye wash (specify type)	bottle	Required
	insect repellant		Recommended
	sunscreen		Recommended
	water/fluid replacement		Required

Review Comments

Reviewer		Comments
Employee: **Role** **Review Type** **Completed Date**	Green, Adam S HASP Reviewer Revise 2/27/2017	Additional hazard of exposure to VOCs while bailing and product recovery. Please add to potential hazards and air monitoring as per the HASP for the mitigation.
Employee: **Role** **Review Type** **Completed Date**	Green, Adam S HASP Reviewer Approve 3/3/2017	
Employee: **Role** **Review Type** **Completed Date**	Golubski, Jason R Reviewer Approve 3/3/2017	project number should be B0013094.0006

Job Safety Analysis

General

JSA ID	14779	**Status**	(3) Completed
Job Name	Environment-Sample cooler handling	**Created Date**	2/20/2017
Task Description	Sample cooler handling	**Completed Date**	02/27/2017
Template	False	**Auto Closed**	False

Client / Project

Client	IBERDROLA USA
Project Number	B00130940000
Project Name	NEWARK FORMER MGP SITE
PIC	WHITE, KEITH
Project Manager	POWLIN, SCOTT

User Roles

Role	Employee	Due Date	Completed Date	Supervisor	Active
Developer	Beyrle, Nicholas J	3/13/2017	2/20/2017	Girard, Benjamin	☑
HASP Reviewer	Green, Adam S	3/6/2017	2/27/2017	Price, Richard J	☑
Reviewer	Golubski, Jason R	3/6/2017	2/21/2017	Brien, Jason D	☑

Job Steps

Job Step No.	Job Step Description		Potential Hazard	Critical Action	H&S Reference
1	Transfer field samples to sample packing area	1	Lifting heavy coolers may result in muscle strain especially to lower back.	Use proper lifting techniques and keep back straight. Use buddy system for large coolers, Use mechanical aids like hand trucks if readily available to move coolers. Do not over fill coolers with full sample containers for temporary movement to the sample prep area. Ensure an adequate supply of sample coolers are in field.	
		2	Hazards to hands from broken glass caused by over tightening lids or improper placement in cooler	Inspect all bottles and bottle caps for cracks/leaks before and after filling container. Do not over tighten sample lids. Clean up any broken bottles immediately, avoid contact with sample preservatives. Wear leather gloves when handling broken glass.	
		3	Exposure to chemicals (acid preservatives or site contaminants) on the exterior of sample bottles after filling.	Wear protective gloves for acid preservatives and safety glasses with side shields during all sample container handling activities (before and after filling), Once filled follow project specific HASP PPE requirements for skin and eye protection.	
		4	Samples containing hazardous materials may violate DOT/IATA HazMat shipping regulations	All persons filling a sample bottle or preparing a cooler for shipment must have complete ARCADIS DOT HazMat shipping training. Compare the samples collected to the materials described in the Shipping Determination for the Project and ensure consistent. Re-perform all Shipping determinations if free product is collected and not anticipated during planning.	
2	Sample cooler selection	1	Sample coolers with defective handles, lid hinges, lid hasps cracked or otherwise damaged may result in injury (cuts to hands, crushing of feet if handle breaks etc)	Only use coolers that are new or in like new condition, No rope handled coolers unless part of the manufacturer's handle design.	ARCADIS Shipping Guide US-001
		2	Selection of excessively large coolers introduces lifting hazards once the cooler is filled.	Select coolers and instruct lab to only provide coolers of a size appropriate for the material being shipped. For ordinary sample shipping sample coolers should be 48 quart capacity or smaller to reduce lifting hazards.	

3	Pack Samples	1	Pinch points and abrasions to hands from cooler lid closing unexpectedly	Beware that lid could slam shut; block/brace if needed; be wary of packing in strong winds. New coolers may be more prone to self closing, tilt cooler back slightly to facilitate keeping lid open.	
		2	Awkward body positions and contact stress to legs and knees when preparing coolers on irregular or hard ground surfaces.	Plan cooler prep activities. Situate cooler where neutral body positions can be maintained if practical, like truck tailgate. Avoid cooler prep on rough gravel surfaces unless knees and legs protected during kneeling.	
		3	Frostbite or potential for oxygen deficiency when packing with dry ice. Contact cold stress to fingers handling blue ice or wet ice	Dry ice temperature is -109.30F. Wear thermal protective gloves. DO NOT TOUCH with bare skin! Dry ice sublimates at room temp and could create oxygen deficiency in closed environment. Maintain adequate ventilation! Do not keep dry ice in cab of truck. Wear gloves when handling blue ice or gaging wet ice. Dry Ice is DOT regulated for air shipping, follow procedures in Shipping Determination.	
4	Sealing, labeling and Marking Cooler	1	Cuts to hands and forearms from strapping tape placement or removing old tape and labels	Do not use a fixed, open-blade knife to remove old tags/labels, USE SCISSORS or other safety style cutting device. Only use devices designed for cutting. Do not hurry through task.	
		2	Lifting and awkward body position hazards from taping heavy coolers, dropping coolers on feet during taping.	Do not hurry through the taping tasks, ensure samples in cooler are evenly distributed in cooler to reduce potential for overhanging cooler falling off edge of tailgate/table when taping.	
		3	Improper labeling and marking may result in violation of DOT/IATA HazMat shipping regulations delaying shipment or resulting in regulatory penalty	Do not deviate from ARCADIS Shipping Guide or Shipping Determination marking or labeling requirements.	
5	Offering sample cooler to a carrier or lab courier for shipment.	1	Lifting heavy coolers may result in muscle strain especially to lower back.	See lifting hazard controls above.	
		2	Carrier refusal to accept cooler may cause shipping delay and/or result in violation of DOT HazMat shipping regulations.	Promptly report all rejected and refused shipments to the ARCADIS DOT Program Manager. Do Not re-offer shipment if carrier requires additional labels markings or paperwork inconsistent with your training or Shipping Determination without contacting the ARCADIS DOT Compliance Manager.	

PPE — Personal Protective Equipment

Type	Personal Protective Equipment	Description	Required
Dermal Protection	long sleeve shirt/pants	Level D	Required
Eye Protection	safety glasses		Required
Foot Protection	steel-toe boots		Required
Hand Protection	chemical resistant gloves (specify type)	nitrile	Required
	work gloves (specify type)	leather	Required

Supplies

Type	Supply	Description	Required
Communication Devices	mobile phone		Required
Miscellaneous	fire extinguisher		Required
	first aid kit		Required
	flashlight		Required

Review Comments

Reviewer		Comments
Employee: **Role** **Review Type** **Completed Date**	Green, Adam S HASP Reviewer Approve 2/27/2017	Good JSA.
Employee: **Role** **Review Type** **Completed Date**	Golubski, Jason R Reviewer Approve 2/21/2017	

Attachment F - STAR and TCP

Traffic Control Plan/Site Traffic Awareness and Response Plan

Demonstration Template 9/20/2016. Forward comments to Sam Moyers.

1.0 General

Plan type	TCP and STAR
Project Name:	Newark Former MGP Site
Project Number:	B0013094
Developer Name:	Nicholas (Klaus) Beyrle
Duration of Project (in hours or days):	10 hours
Time Restrictions (Y/N, if Y descibe below):	No
Roadway Work Zone Start Point	See comments below
Roadway Work Zone End Point	See comments below
Posted Speed Limit (roadway in mph)	30
Number of Lanes (each direction)	1
Road Category Type (select)	Urban (≤40 mph)

☐ Working on multiple roads?

Comments:

Roadway Work Zone Starting Point: Approximately 500 feet west of the intersection of North Main Street (N.Y.S. Route 88) on West Shore Blvd - (speed limit – 30 mph, low traffic – average daily traffic (ADT) of 1500 vehicles).

Roadway Work Zone End Point: Approximately 150 feet west of the intersection of North Main Street (N.Y.S. Route 88)

2.0 Work Description

Provide a brief description of scope of work:
The work will consist of a GPR Survey and subsequent advancement of soil borings using a rubber-tire drill rig in the Village of Newark, New York. The work will require that traffic be reduced to one lane only on West Shore Blvd. Work will be conducted between the hours of 8:30 am and 4:30 and lane closure will cease at the end of each work day.

3.0 Type and Duration

Work locations on this project will be: Intermediate work (1-8 hours per location)

Roadway work will be performed: Travel lane

Non-roadway work will be performed in: Active parking lot

Special traffic conditions may include (select most prevalent): Not applicable

4.0 Traffic Control Layout, Number of Devices Required and Phasing

The following traffic control configuration in the Field Guide to RWZ Safety applies:
Section 6.7 Lane Closure on Two-Lane Road with Low Traffic Volumes (DOT Facts-301r)

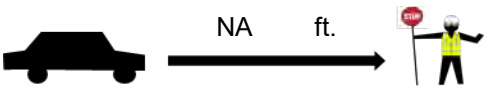
The following STAR requirements in the Field Guide to RWZ Safety applies:

Section 7.3 Intermediate Duration Work in Parking Areas (1 to 8 Hours) (DOT Facts-302b)

The menu below will be blank and is not applicable.

All Arcadis vehicles in a RWZ will, at a minimum, have a functioning high intensity strobe or rotating orange light. All Arcadis employees in the RWZ will wear, at a minimum, a retroreflective high visibility outer clothing meeting ANSI Class II or III requirements and other PPE required by JSA or HASP. Don't leave vehicle doors open. Park vehicles in RWZ with front wheels turned to the right. Avoid work configurations requiring standing to rear of vehicles. Stage equipment in vehicles where it can be accessed from the right side of the vehicle to the extent practical. An example STAR traffic control configuration for this project is illustrated below. The actual type and number of devices required are specified below.

Intermediate Term (1-8 Hours)
Channelizing Cones with Caution Tape

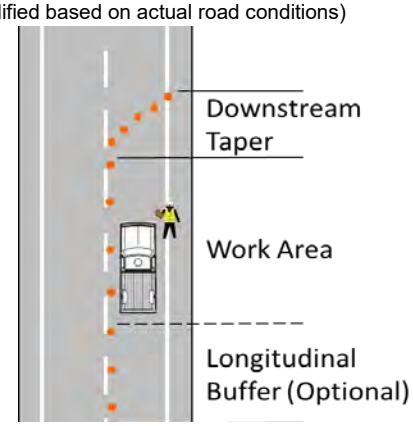
TCP sign spacing distances for "A", "B" and "C" (as applicable) in referenced DOT Facts.	TCP oncoming traffic site distance required to see Flagger and properly decelerate and stop.
A 100 ft. B 100 ft. C 100 ft.	NA ft. 

TCP Cone Calculation (Values are default. Yellow fields may be modified based on actual road conditions)

Active work area length (feet)	350
☐ Apply Optional Longitudinal Buffer (ft)?	0
Lane width of offset (feet)	12
Shoulder width of offset (feet)	8
Posted speed limit	30

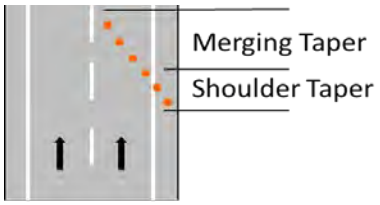
☑ **Shoulder Taper**

Taper Length (feet)	40
Cones Required	1
Cones Spacing (max., ft)	30



☑ **Merging Taper**

Taper Length (feet)	180
Cones Required	6
Cones Spacing (max., ft)	30



☑ **Work Area**

Cone Spacing (max., ft)	60
Cones Required	6

☑ **Downstream Taper**

Taper Length (feet)	100
Cones Required	5
Cone Spacing (max., ft)	20

Cones Required (minimum) 18

Note: Review taper configuration and cone spacing after TCP impllementation to ensure traffic is moving efficiently without motorist confusion in the RWZ.

Select the traffic control devices to be used and enter number each required:

Check all that apply:	*Wording or Pictogram*	*Number:*
☑ Warning signs	One Land Road Ahead	2
☑ Warning signs	Yield to oncoming traffic	2
☑ Warning signs	Road Work Ahead	2
☐ Stop/Slow paddle		
☐ Red flag		
☐ Drums		
☐ Channelizer cone (42 inch height, 10 lb base)		
☐ Channelizer cone (42 inch height, 30 lb base)		
☐ Traffic cones (≥ 18 inches tall)		18
☐ Barricade ☐ Type I ☐ Type II		
☐ Flags for cones		
☐ Lights (for night work)		
☐ Plastic fencing (rolls)		
☐ Caution tape (rolls)		
☐ Other (specify):		

TCP Phasing:

1) Deploy warning signs at first approach, if required
2) Deploy subsequent approach warning signs, if required
3) Deploy channeling devices, if required, starting with first approach
4) Deploy "End Road Work" signs, if required
5) Position vehicle as shield to the extent practical
6) Commence work, SSO or designated contractor to maintain devices
7) Remove devices in reverse order

STAR Phasing:

1) Position truck as shield, if practical
2) Deploy traffic control devices
3) Affix flags, caution tape or fencing
4) Unload project equipment
5) Commence work
6) SSO to maintain controls
7) Remove controls in reverse order

Reviewed By:

HASP Reviewer: _____

_____

ARCADIS Design & Consultancy for natural and built assets

FIELD GUIDE FOR ROADWAY WORK ZONE SAFETY

September, 2016

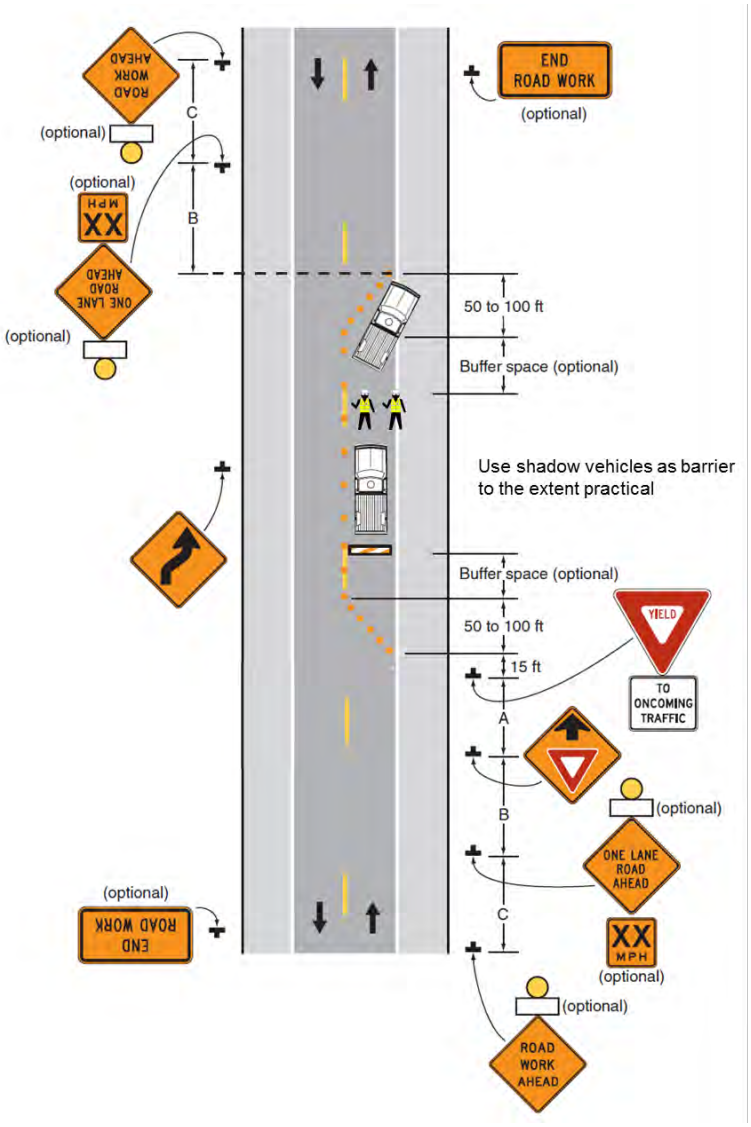
Section 6.7 and 7.3 only !!

DOT

6.7 Lane Closure on Two-Lane Road with Low Traffic Volumes (DOT Facts-301o)

Figure 22 may be used for lane closure on two-lane roads with low traffic volumes.

Figure 22. Example TTC for Lane Closure on Two-Lane Roads with Low Traffic Volumes



Note: The TCP/STAR Plan Template will automatically calculate sign spacing distances for “A”, “B” and “C”. See section 2.3 for sign distance if using an alternate TCP format.

6.7.1 Mandatory Requirements for Lane Closures on Two-Lane Roads with Low Traffic Volumes

M1. Lane closures on two lane roadways require EJE review and approval.

6.7.2 Guidance for Lane Closures on Two-Lane Roads with Low Traffic Volumes

G1. This RWZ application may be used as an alternate to the RWZ application shown in DOT Facts-301n (using flaggers) when the following conditions exist:

a. Vehicular traffic volume is such that sufficient gaps exist for vehicular traffic that must yield.

b. Road users from both directions are able to see approaching vehicular traffic through and beyond the work site and have sufficient visibility of approaching vehicles.

G2. The Type B flashing warning lights may be placed on the ROAD WORK AHEAD and the ONE LANE ROAD AHEAD signs whenever a night lane closure is necessary.

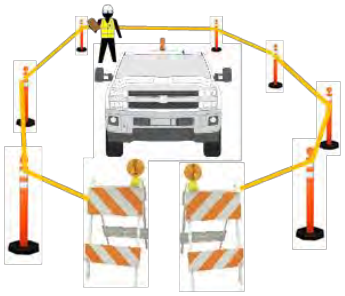
7.3 Intermediate Duration Work in Parking Areas (1 to 8 Hours) (DOT Facts-302b)

The configurations illustrated in Figure 35 should be considered for STAR Plan traffic protection in retail parking areas for work durations of 1 to 8 hours.

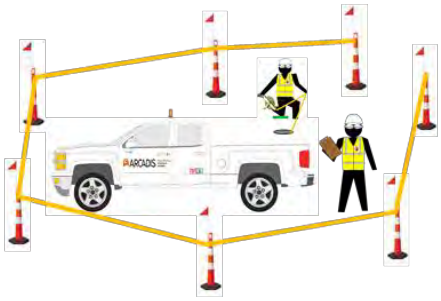
Figure 35. Example Intermediate Duration (1-8 Hours) Traffic Control Configurations for Use in STAR Plan Implementation

Scenario #1: Intermediate Term 1-8 Hours) Channelizing Cones with Flag and Caution Tape

Scenario #2: Intermediate Term (1-8 Hours) Channelizing Cones with Caution Tape and Lookout



Scenario #3: Intermediate Term (1-8 Hours) Channelizing Cones, Caution Tape and Type II Barricades



Scenario #4: Intermediate Term (1-8 Hours) Channelizing Cones with Flags and Caution Tape

7.3.1 General Guidelines for Safety

- Use the vehicle as a shield when possible. Orient the rear of the Arcadis vehicle away from site entrances and areas of increased backing or movement of other vehicles, when practical.
- Always work facing the area with greatest traffic movement and least protection
- Always assume vehicles will move in either direction (frontwards or backwards)
- Always use TRACK to predict traffic movement and stage vehicle and Control Zones in manner that offers protection without impairing site entrance or blocking access to fuel islands when possible. STAR Plan requirements should be reviewed against HASP exclusion zone requirements for consistency.
- If there is a perceived drivable space, you must assume that someone will attempt to access or drive to/through the location. Plan, deploy and work accordingly.
- Class II high visibility vest (minimum) to be worn at all times (refer to HASP or JSA for additional requirements, if any).
- Discuss with site operator or manager times of lower traffic volume and attempt to schedule work activity during traffic lulls. For retail gas station, always find out when the fuel deliveries arrive and avoid areas of the site during planned delivery times. For other facilities with dumpsters, inquire about dumpster emptying days and times.

7.3.2 Scenario Descriptions

1) Use a minimum of 4 channelizing cones with flags and caution tape when working near the edges of parking lots accessible to the public for intermediate work durations regardless of traffic volume. Flags will be particularly important if work is conducted near to the ground, a lookout is not available and/or a vehicle is not available to act as a barrier. This scenario may also be beneficial as part of HASP site control or if general pedestrian control is required for the work area in the parking lot.
2) Similar to Scenario #1, the flags in this scenario may be omitted if a lookout is used. Intricate work near the ground may warrant using a lookout if the parking lot has constant traffic flow.
3) Use of a combination of channelizing cones with barricades (Type II illustrated) should be considered if a parking lot entrance requires closure. The barricades should be placed at the entrance. The striping on the barricades should be presented as shown (see section 3.4.5 for more information on stripe orientation). This scenario may also be used if closing a parking lane of a

parking lot with high traffic flow (place barricades on each end of the work area in the parking lane).

4) Use channelizing cones with flags and caution tape for open areas of the parking lot regardless of traffic volume. The number of cones used should be sufficient to adequately encompass the work area while keeping the caution tape taught. If working alone near to the ground, use the truck as shield to extent possible or increase the number of cones and flags to promote visibility.

Attachment G - Heat Plan

Arcadis Heat Illness Prevention Plan
HASP Supplement

Date Completed 3/31/2017

Revision 3, 4/14/2015

The purpose of this document is to serve as a planning tool and implementation guide to help the Project Team Site, Site Health & Safety Officer (SHSO) or other designated responsible party to comply with the requirements set forth by Cal/OSHA Title 8 CCR 3395 Heat Illness Prevention Standard and the Washington State Outdoor Heat Exposure Regulations 296-62-09510 thru 09560.
This HASP Supplement is required to be used in California and Washington states.
Projects sites in other states and provinces can use this HASP Supplement as a Best Management Practice to prevent heat illness related injury.
The objective of this planning guide is to prevent or reduce the risk of work-related heat illness. This HASP Supplement provides site specific guidance for actions to be completed the project site. The Arcadis Health and Safety Standards ARC HSIH013 Heat Stress Prevention, and ARC HSGE008 Injury and Illness Prevention Program (IIPP) must accompany this HASP Supplement. To completely address the regulatory requirements for work in CA and WA states these standards are required to be used in association with the project-specific HASP and this supplement.

Project Name Newark Former MGP Site

Project Manager Jason Golubski

Authority and Implementation

The following designated individuals have authority and responsibility for implementing the provisions of this program at the work site indicated above.

Site Health &Safety Officer Ryan Clare **Designated Alternate** Jason Golubski

Procedures for Provision of Water

The Site Health & Safety Officer (SHSO) or designee will be responsible for implementing the following when conditions at the site are anticipated to exceed **80 degrees** Fahrenheit:

1. Maintaining an adequate supply of suitably cool, fresh and pure potable water (fresh and pure is defined as "odor free" and "suitably cool" is defined as water being cooler than the ambient temperature but not so cold as to cause discomfort or prevent drinking.) on site at all times to allow each employee to consume one quart of water per hour, ideally at a rate of four 8-oz cups per hour. Entering the requested information into the formula provided below calculates the number of quarts of water required per employee, per hours worked per day.
Electrolyte replacement drinks or “Sports Drinks” can be used to replace essential minerals lost during sweating. Generally, such drinks should supplement water intake such as one “sports drink” to every two bottles of water. Also, a teaspoon of salt added to every gallon of water could also be used.

2. Designate and communicate a water source such as an onsite potable plumbed system, chilled coolers containing bottled water, or drinking water coolers (of a sufficient capacity to support all field staff present) and disposable cups for potable water consumption. The water source must provide suitably cool, fresh and pure water in sufficient quantity for all employees at the site. Water shall be provided free of charge or expenses will be reimbursed for employees.

3. Document and communicate the decision to either provide all water for the day at the start of the shift (e.g., 2 gallons per employee for an 8-hour shift), or a replenishment plan. Note: a sufficient quantity of water must always be present and readily accessible to allow every employee to consume at least one quart of water per hour. It is suggested to have a minimum of three hours supply of water per employee on hand.

4. Water supplies must be positioned as close as possible to the work site. If site conditions prohibit such positioning then an alternative plan must be prepared to address making water readily available to site workers.

5. Inspect the coolers / water dispensers for cleanliness and replenishment of water and cooling ice on a documented routine interval based on temperatures and staff size. Cooling ice will be stored in clean coolers if added directly to water dispensers. If the site temperature exceeds 90 degrees F the frequency of the cooler inspection will increase to maintain cool water and water supply levels.

6. Oversee the daily inspection and maintenance of coolers to ensure they are kept clean and in good condition.

No. of Employees 2 **No. of Work Hours Per Day** 10 **Quarts of Water Required** 20

One cooler will be provided for every four workers and will contain 24 16-ounce bottles every 2 hours.
No. of Employees 2 **Number of Coolers** 1 **Bottles Required** 24

Form Color Key
Enter requested Information
Calculation Completed

Check which situation applies. Must check at least one box, or provide additional detail.

x	Ice will be purchased at the start of each day by the site Health & Safety Officer or designee.
	Ice will be distributed from on-site machine or service meeting applicable potable water standards.

Checklist of materials to order and keep on hand.

x	Anti-microbial hand cleaner.		Food Safe cleaning product for water cooler.
x	Paper towels.		Sufficient amount of drinking cups for each employee and water dispenser.
	Potable water to clean coolers.		Other Items -

Access to Shade

1. The Site Health & Safety Officer or designee is responsible for directing how shade will be coordinated and placed when temperatures exceed **80 degrees** Fahrenheit.

2. Before the start of work, the location of the shade areas, the importance of taking shade breaks, recognizing the signs and symptoms of heat illness, and the schedule of shade breaks (> 10 minutes every two hours), and the location will be addressed during each Tailgate Safety Meeting. Access to shade must be allowed at all times (As temperature increases cool down breaks should increase in frequency.)

3. The amount of shaded areas must be able to accommodate all employees taking a recovery or rest break including those employees who are on meal breaks. This doesn't mean that the shaded area(s) must provide shade to accommodate all employees on a site or working a shift at the same time. An example includes rotating routine breaks among employees. Also, additional portable shade structures can be erected on an "as-needed" basis. Employees must have enough shaded space so they can sit in a normal posture fully in the shade with enough space to allow for sitting without being in physical contact with each other. **Employees who desire access to shade must not be deprived of it due to lack of space.**

4. Employees who take a preventative cool-down rest; (1) shall be monitored and asked if they are experiencing symptoms of heat stress; (2) shall be encouraged to remain in the shade; (3) shall not be ordered back to work until any signs or symptoms of heat illness have abated, but in no event less than 5 minutes in addition to the time needed to access the shade.
If an employee exhibits signs or symptoms of heat illness while taking a preventative cool-down rest the SHSO will provide appropriate first aid or emergency response support.

5. Shade structures will be relocated to follow along with the crew for moving tasks. Shade structures will be placed within 50 feet of the work area, if practical. Shade structures must be no further than a short walk away (e.g. 2-3 minutes) from the work area. This consideration becomes critical as the temperature rises above 80 degrees F.

6. In situations where it is not safe or feasible to provide shade, the SHSO will document in the HASP Supplement the unsafe or unfeasible conditions, and include the steps taken to provide alternative cooling measures equivalent to shade.

Check Available Option

	Provide vehicle(s) with working air conditioner to all employees on recovery or rest breaks as well as employees taking onsite meal breaks on the shift at any time.)
	Provide temporary or mobile shade structure(s) that are either ventilated or open to air movement (Secure against wind.)
	Building or permanent structure(s) in close proximity to the work area that provide a cooling environment either through mechanical ventilation or are open to air movement will be used for shade. (Job trailer, pavilion, manufacturing building, etc.)

Monitoring of Weather

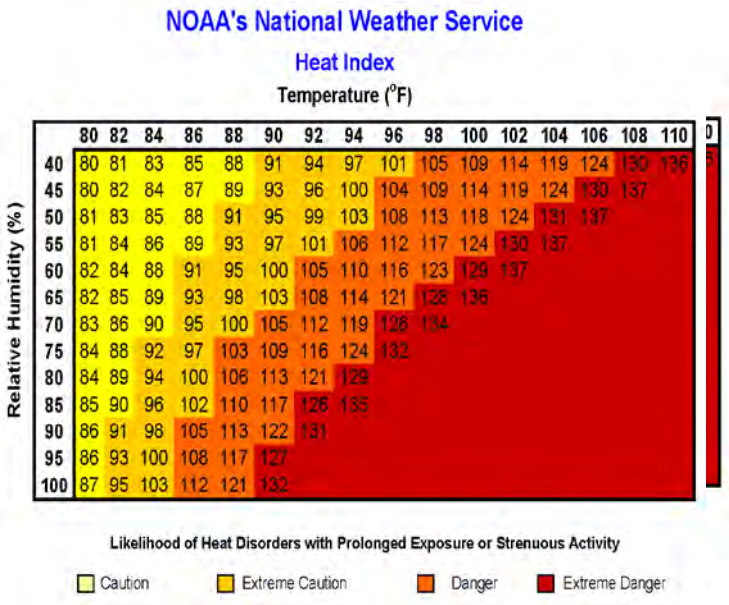
1. The SHSO or designee must check the extended weather forecast in advance of the upcoming work on a weekly basis. Work schedules will be adjusted in advance, taking into consideration whether high temperatures or a heat wave is expected.
Accepted weather forecasting resources include webpages such as: http://www.noaa.gov/ or http://www.weather.com/

2. Before work starts for the day or for the shift, the SHSO will review the forecasted temperature and humidity for the work site and compare conditions against the National Weather Service Heat Index (below) to evaluate the risk level for heat illness. Determination will be made of whether or not workers will be exposed to a combination of temperature and humidity characterized as "Extreme Caution", "Danger" or "Extreme Danger" for heat illnesses. It is important to note that the temperature at which these warnings occur must be lowered as much as 15 degrees if the workers under consideration are in direct sunlight.

3. A thermometer will be used at the job site to monitor for sudden increases in temperature. The SHSO will be responsible for obtaining a thermometer prior to the start of the project and making it readily accessible or mounting it in an area where it can easily be monitored throughout the course of the day.

3a. If the temperature exceeds **80 degrees** Fahrenheit, shade structures will be opened and made available to workers.

3b. If the temperature equals or exceeds **95 degrees** Fahrenheit, additional preventive measures (such as those outlined in the High Heat Procedures) will be implemented.



Procedures for High Heat and Heat Waves
High Heat
These procedures are additional preventative measures to be implemented when the temperature equals or exceeds **95 degrees Fahrenheit**.
The SHSO or designee is responsible for ensuring effective observation and monitoring of employees during periods of high heat by implementing one or more of the following procedures:
1. SHSO or designee will supervise 20 or fewer employees,
2. The “Buddy System” is mandatory;
3. Regular communication with SHSO or designee via mobile phone or radio of identifying another effective means of observation;
4. Designating one or more employees as authorized to contact emergency medical services and communicating that if no designate is identified and the SHSO is unavailable that any employee can call for emergency medical assistance.
5. During high heat conditions, employees will be provided with a minimum 10-minute cool-down period every two hours.

Tailgate Safety Meetings will include a review the high heat procedures, encourage employees to drink plenty of water, and remind employees of the importance to take a preventative or recovery cool-down rest when necessary.

The “Buddy System” must be implemented, especially for new employees and employees who have yet to acclimate to high heat conditions. Additionally, frequent communication will be maintained with employees working by themselves (via cell phone or two-way radio), to be on the lookout for possible symptoms of heat illness.

Employees will be observed for alertness and signs and symptoms of heat illness at regular intervals to be documented in the field book or field log.

When the SHSO is not available, an alternate responsible person must be assigned to look for signs and symptoms of heat illness. Such a designated observer will be trained and know what steps to take if heat illness occurs.

Heat Waves
A “heat wave” as defined by the National Oceanic and Atmospheric Administration (NOAA), is a period of abnormally and uncomfortably hot and unusually humid weather.” Typically, a heat wave lasts 2 or more days. A "Heat Wave" as defined for the purposes of this Standard is when temperatures are sustained above 80 degrees F.
During a heat wave or if site conditions indicate the potential for “Extreme Caution”, "Danger" or “Extreme Danger” per the NOAA Heat Index Table the following steps will be taken:

Work schedules will be modified to protect workers from heat illnesses. The SHSO or designee in coordination with the project team, will use their Stop Work Authority and evaluate the following actions and document the action in the daily field log

1 Modify work hours.
2 Reschedule or suspend work or specific tasks that are strenuous.
3 Cease work for the day.

If schedule modifications are not possible, the Heat Illness Prevention Plan will be reviewed before work resumes. At a minimum, procedures for heat illness prevention, the provisions of the high heat procedures, the weather forecast and emergency response protocols will be reviewed.

Employees will be provided with additional water and rest breaks and will be observed more frequently. During work activities and rest breaks, employees will be observed for signs and symptoms of heat illness.

All employees will maintain frequent communication with the SHSO or designee, who will be monitoring workers for possible symptoms of heat illness. In the event of large project sites where the SHSO may be unable to be near the workers (to directly observe or communicate with them), then communication via a cell phone or radio may be used for this purpose provided reception in the area is reliable.

Procedure for Emergency Response

Emergency procedures include recognizing the symptoms of heat related illness. A critical step also involves ensuring that effective communication is established either through voice, direct observation or electronic means such as via mobile phones or 2-way radios. In an emergency situation it is critical that employees understand the process and contact information for requesting emergency medical support. The reception coverage for the site must be evaluated and understood to ensure adequate communication is in place across the project site

1. The Site Health & Safety Officer or designee is responsible for implementing the following procedures for emergency response. These procedures include, but are not limited to, the following:

2. Prior to assigning staff to a particular work site, during the Tailgate H&S Tailgate Safety Meeting all site workers will review a map of the Site along with clear and precise directions (such as streets or road names, distinguishing features, and distances to major roads), to avoid a delay of emergency medical services.

3. Prior to assigning staff to a particular work site, efforts will be made to ensure that a qualified and appropriately trained and equipped person is available at the site to render first aid, if necessary.

4. Prior to the start of the morning Tailgate Safety Meeting, a determination will be made of whether or not a language barrier is present at the site, and steps will be taken (such as assigning the responsibility to call emergency medical services to the Health & safety Officer or an English speaking worker) to ensure that emergency medical services can be immediately called in the event of an emergency in accordance with the HASP.

5. All Health & Safety Officers and supervisors will carry cell phones or other means of communication to ensure that emergency medical services can be called. Checks will be made to ensure that these electronic devices are allowed on site, have adequate reception across the site, and are functional prior to each shift.

6. When an employee reports symptoms, or is observed displaying symptoms of possible heat illness, steps will be taken immediately to keep the affected employee cool and comfortable until emergency service responders have been called and treatment guidance is provided, or until they arrive at the Site (to reduce the progression to more serious illness).

7. During a heat wave or hot temperatures, workers will be reminded and encouraged to immediately report to the Site Health & Safety Officer any signs or symptoms they are experiencing.

Procedure for Handling a Sick Employee

1. The Site Health & Safety Officer or designee is responsible for implementing the following procedures for handling a sick employee.
These procedures include the following:

2. When an employee displays possible signs or symptoms of heat illness, the Site Health & Safety Officer or designee will check the sick employee and determine whether resting in the shade and drinking cool water will suffice or if emergency service providers will need to be called. In the event of a non-emergency incident the SHSO will contact the employees supervisor or the project manager as well as calling WorkCare **1-800-455-6155 (US) and 1-888-449-7787 (Canada)** for non-emergency medical assistance.
A sick worker will not be left alone, and will be monitored closely for the remainder of the day or until emergency support arrives.

3. Signs of the onset of Heat Illness are: excessive fatigue, heavy sweating, headaches, cramps, dizziness, elevated pulse.
Signs of Heat Exhaustion are: Cool, moist, pale or flushed skin, nausea or vomiting, disorientation or confusion.
Signs of Heat Stroke are: hot, red skin which can feel dry to the touch, or moist from overexertion, changes in consciousness, rapid or weak pulse, shallow rapid breathing.

4. When an employee displays possible signs or symptoms of heat illness and no trained first aid worker or supervisor is available at the site, emergency service providers will be called.

5. Emergency service providers will be called immediately if an employee displays signs or symptoms of heat illness (loss of consciousness, incoherent speech, convulsions, red and hot face) or does not get better after drinking cool water in intervals of 8 ounces every 15 minutes and resting in the shade. While the ambulance is in route, first aid will be administered (**cool the worker: place the worker in the shade, remove excess layers of clothing, place ice pack in the armpits and groin area and fan the victim**).
A worker determined to be suffering heat illness will not be allowed to leave the site except under medical care.

6. If an employee displays signs or symptoms of severe heat illness (loss of consciousness, incoherent speech, convulsions, red and hot face), and the work site is located more than 20 minutes away from a hospital, call emergency service providers, communicate the signs and symptoms of the victim, and request an Air Ambulance if necessary.

Revisions, notes, amendments, and clarifications specific to this plan will be detailed in the space below:

Attachment H - Vehicle Inspection Plan

Arcadis Weekly Vehicle Inspection Form

Vehicle # / License Plate # | **Lease Plan # / Last 6 of Vin #**

Inspection Date												
Odometer reading												
Driver / Inspector Name												
Check the appropriate box and enter repair date for identified repairs:	OK	Needs Repair	Repair Date	OK	Needs Repair	Repair Date	OK	Needs Repair	Repair Date	OK	Needs Repair	Repair Date
Interior — Horn operational												
Door Locks operational												
Seat Belts in good repair												
Seats and Seating Controls												
Steering Wheel - No Excessive Play												
Interior Lights and Light Controls												
Instrument Panel/Gauges												
Wiper Controls operational												
Heat/Defrost/Air Conditioning working												
Rear View Mirror present												
Backup Camera/Sensors working												
Jack and Lug Wrench present												
Exterior[1] — Lights and Signals operational												
Tires properly inflated/good tread depth												
Spare Tire properly inflated												
Doors operational												
Windows Not Cracked/Damaged												
Side View Mirrors												
Body Panels and Bumpers												
Engine & Brakes — Engine Start & Running Smoothly												
Fluid Levels, No Noticeable Leaks												
Belts tight, no cracks												
Brakes operational, no squeaking												
Emergency Equipment[2] — First Aid Kit, inspected weekly												
Fire Extinguisher properly secured												
Fire Extinguisher inspected weekly												
Orange/Yellow emergency warning light												
Roadside Assistance Information												
Recommend spotter cones available												
Cargo — Cargo Secure and Properly Distributed												
Securing Devices in Good Condition												
Registration — License Plate /Tags												
Registration and Insurance												
City/State Inspection Decal												
Lease Plan information/Fuel Card												

[1] **Note all damages to the vehicle on the back of this page**

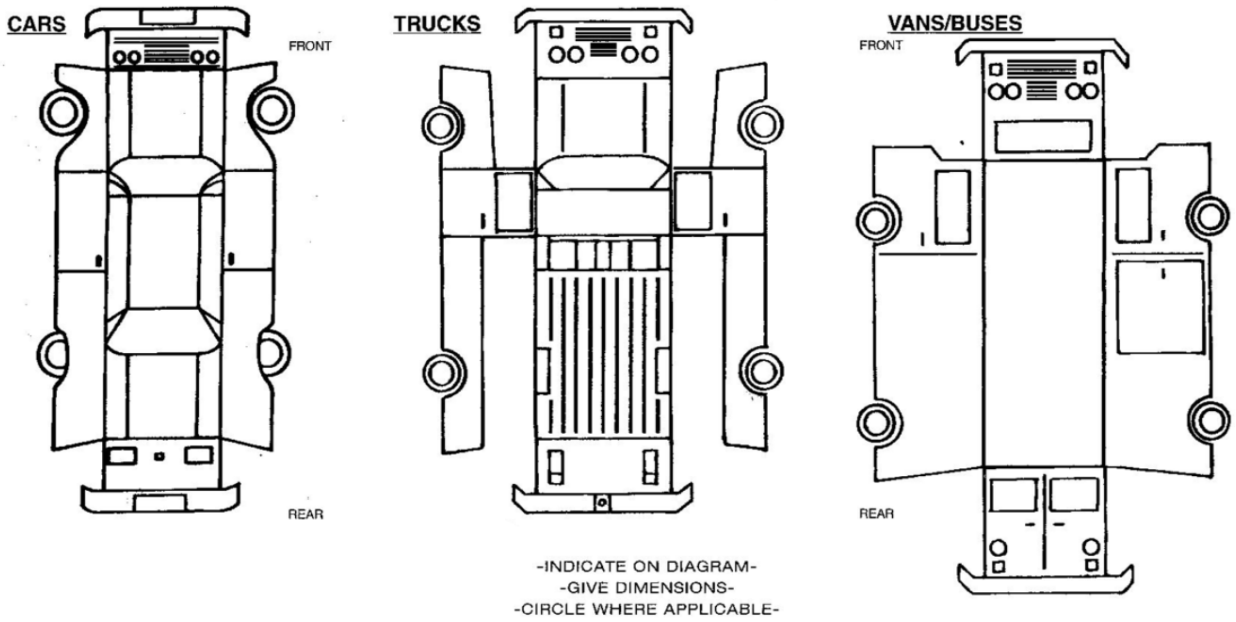
[2] **Emergency Equipment required per Motor Vehicle Standard ARC HSGE024**

Note All Vehicle Damage Below

All Vehicle Damage must be reported to Sue Berndt (Corporate Legal), Andrew McDonald (Corporate H&S), and Roger Elliot (Corporate Fleet Manger)

CODES:

B-BENT
BR-BROKEN
BU-BULGE
C-CHAFED
CH-CHIPPED
CPM-COVERED WITH PROTECTIVE MATERIAL-UNABLE TO DETERMINE DEFECTS IF ANY
CSA-CHAFED AND SCRATCHED ALL OVER
CR-CRACKED
D-DENTED
DMC-DUST AND MUD COVERED UNABLE TO DETERMINE OTHER DEFECTS IF ANY
G-GOUGED OR CUT
GC-GLASS CRACKED
HS-HAIRLINE SCRATCH
M-MISSING
P-PUNCTURED
R-RUSTY
S-SCRATCHED
SC-SCRAPED
SM-SMASHED
ST-STAINED AND/OR SOILED
T-TORN



Notes:

Tread guide: If a tread gauge is not available coins may be used to determine remaining tread. 2/32” is the minimum by law in most states (top of Lincoln’s head on penny), 4/32” is minimum recommended for wet surfaces (top of Washington’s head on quarter), 6/32” is minimum recommended for snowy surfaces (top of Lincoln Memorial on penny).Vehicle tires should be replaced if the tread depth is less than 6/32”.

2/32” remaining 4/32” remaining 6/32” remaining

Reference JSA 10907 For Weekly Vehicle Inspection

Attachment I - Blank Tip Form

Task Improvement Process

General

TIP ID	
Observed Company	
Observation Type	
TIP Form	
Task Observed	
Observee Name	
Observer Name	
Observation Date	
Project Number	
Project Name	
Supervisor	
Equipment On Site	
Pertinent Information	

Observations

Task	Correct	Questionable	Comments
H&S - Drilling-Borings/Well Installation			
Equipment Care and Maintenance			
PPE worn according to HASP/JLA specifications and inspected before use	☐	☐	
STOP work authority used where appropriate	☐	☐	
Electrical systems grounded, lock out / tag out performed, cords / fixtures in good condition	☐	☐	
Corded portable power tool or other cord connected equipment plugged into a GFCI whip and GFCI whip plugged directly into power source (electrical outlet)	☐	☐	
GFCI whip inspected, tested, and appropriate size for the equipment	☐	☐	
Wheel chocks in place on heavy vehicles and trailers	☐	☐	
Tool selection/use appropriate for job and inspected before	☐	☐	
Air monitoring equipment is on site, calibrated	☐	☐	
Containers with hazardous materials properly labeled; other containers appropriately labeled; compressed gas bottles separated, secured & upright	☐	☐	
Drill rig appropriate for task, inspected prior to use and in good condition	☐	☐	

Observations

Task	Correct	Questionable	Comments
High energy systems -mud/air/water (hose condition, hose routing, whip checks, and pop offs) inspected and functional	☐	☐	
Hoisting equipment, slings, tag lines and chains inspected prior to use, in good condition and used properly	☐	☐	
Emergency shut-off locations functional	☐	☐	
Work Environment			
Onsite vehicles and equipment located and marked properly, backed in when possible	☐	☐	
Underground utility, piping locates completed and locations marked, utilities and structures checklist used and minimum of 3 lines of evidence	☐	☐	
Maintains appropriate distance between equipment and power lines/ overhead obstructions	☐	☐	
Exclusion zone set up properly with correct type and number of barricades	☐	☐	
Work areas and pathways designated and clear of trip/slip hazards; uneven surfaces identified/addressed	☐	☐	
Work Procedures (Driller)			
Proper lifting/pushing/pulling techniques	☐	☐	
3 points of contact maintained on ladders/steps, no jumping from equipment/platforms	☐	☐	
Pinch points and rotating hazards marked or guarded	☐	☐	
Follows sawcutting and jackhammering procedures and best management practices including mitigation of dust hazards	☐	☐	
Drill rig blocking stable; drill rig not moved when mast is up; spotters used when rig is moved	☐	☐	
Flying debris hazards addressed	☐	☐	
Proper use of tools to handle soil, water during drilling or hole clearance	☐	☐	
Using correct cutting tools to open liners containing soils	☐	☐	
Good housekeeping maintained	☐	☐	
Surface water/run-off diverted from boring	☐	☐	
Soil/water/waste materials stored properly, labeling complete	☐	☐	
Rig movement completely stopped before approaching with workers clear before beginning rotation/movement; rods, auger, casing moved properly, guided with lines	☐	☐	
Use of proper methods to break rods (no use of cheater bars, etc)	☐	☐	
Tag/sand lines used during hoist operations	☐	☐	
Maintain safe distance from moving equipment at full reach	☐	☐	

Observations

Task	Correct	Questionable	Comments
Fall protection available and used at heights greater than 6’	☐	☐	
Open holes protected Proper tools used when installing or opening well lids; well heads closed/locked	☐	☐	
Hands clear of cable when developing new wells	☐	☐	
Personnel deconned per HASP/JLA	☐	☐	
Equipment deconned per HASP/JLA (pressure washer used properly)	☐	☐	
Equipment in passenger compartment/bed of vehicle secured; load distributed evenly	☐	☐	
Any additional safety issues identified?	☐	☐	
Work Procedures (ARCADIS)			
Observee performing required air monitoring at specified intervals	☐	☐	
Uses proper lifting techniques	☐	☐	
Not using awkward body positions or heavy lifting when logging samples	☐	☐	
Not using hand tools or hands near borehole to obtain cuttings when rig is in operating	☐	☐	
Using correct cutting tools to open liners containing soils	☐	☐	
Maintains communication with driller	☐	☐	
Maintains good housekeeping in work area and in vehicle	☐	☐	
Maintains safe distance from drill stem when rig is operating	☐	☐	
Establishes work area upwind of drill rig to extent possible	☐	☐	
Has established and maintains any required exclusion zones specified by the HASP or JLA	☐	☐	
Use best practices to perform decontamination of soil sampling equipment (avoids over spraying, contain rinsate, avoids spraying towards body, etc)	☐	☐	
Any additional safety issues identified?	☐	☐	

TIP Summary

Enter the details of the TIP and follow-up discussion. Provide details on how any questionable items were resolved.

Discussion following the TIP led by	
Date of follow-up discussion	
Positive Comments	
Discussion Summary Completed	☐ Supervisor Led ☐ Peer to Peer ☐ Arcadis Employee to Subcontractor
Summary of Questionable Items	

Action Items (Optional)

Assign appropriate action items based on the observations made. You can add more than one action item if needed.

Item No.	Action Item	Responsible Person	Due Date	Completed Date
1				
2				
3				

Standard Review

Reviewed By	Position / Title	Completed Date

Quality Review

Reviewed By	Position / Title	Completed Date

Field Validation and Verification Review

Reviewed By	Position / Title	Completed Date

Task Improvement Process

General

TIP ID	
Observed Company	
Observation Type	
TIP Form	
Task Observed	
Observee Name	
Observer Name	
Observation Date	
Project Number	
Project Name	
Supervisor	
Equipment On Site	
Pertinent Information	

Observations

Task	Correct	Questionable	Comments
H&S - Excavation			
Equipment Care and Maintenance			
PPE worn according to HASP/JLA specifications and inspected before use	☐	☐	
Conduct equipment walk- around for any obstacles that can damage heavy equipment	☐	☐	
Excavation shield systems inspected for damage prior to installation	☐	☐	
Hoisting and rigging systems inspection and documentation before use	☐	☐	
Ladders inspected before use	☐	☐	
STOP work authority used where appropriate	☐	☐	
Work Environment			
Underground utility locates completed, and locations marked	☐	☐	
Work zones and equipment swing radius demarcated	☐	☐	
Excavation sidewalls properly sloped/Benched to meet design requirements of soil type	☐	☐	
Excavation support systems provide stability of adjacent structures, walls, roadways, etc.	☐	☐	
Excavation inspected by competent person prior to entry and anytime conditions change	☐	☐	

Observations

Task	Correct	Questionable	Comments
Excavation atmosphere tested prior to and during entry per HASP/JLA	☐	☐	
Surface water/run-off diverted from excavation	☐	☐	
Excavation spoils back minimum 2 feet from sidewall edge	☐	☐	
Entrants protected from falling/loose soils, rocks, etc.	☐	☐	
Entrants provided with appropriate entry ramps, ladders	☐	☐	
For trenches > 4 ft. deep, means of escape provided every 25 ft	☐	☐	
Open excavations protected to prevent falls	☐	☐	
Work Procedures – Equipment Operator			
Routinely checks edge of excavation for potential sidewall collapse	☐	☐	
Conduct 360° walk-around prior to operating equipment	☐	☐	
Stops work, grounds equipment attachments when ground personnel approach equipment and before exiting machine	☐	☐	
3-Points of contact when mounting and dismounting equipment	☐	☐	
Does not exceed rated lifting load for equipment Tag lines used during hoist operations	☐	☐	
Not working under elevated loads	☐	☐	
Operates at safe distance when excavation occupied	☐	☐	
Equipment deconned per HASP/JLA	☐	☐	
Work Procedures – Working around/in excavation			
Maintains safe distance from equipment at full reach	☐	☐	
Makes eye contact with equipment operator when approaching equipment	☐	☐	
Maintains safe distance from excavation edge	☐	☐	
Emergency and rescue equipment available	☐	☐	
Deconned per HASP/JLA	☐	☐	
Any additional safety issues identified?	☐	☐	

TIP Summary

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Date of follow-up discussion	
Positive Comments	
Discussion Summary Completed	☐ Supervisor Led ☐ Peer to Peer ☐ Arcadis Employee to Subcontractor

TIP Summary

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Summary of Questionable Items	

Action Items (Optional)

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Standard Review

Reviewed By	Position / Title	Completed Date

Quality Review

Reviewed By	Position / Title	Completed Date

Field Validation and Verification Review

Reviewed By	Position / Title	Completed Date

Task Improvement Process

General

TIP ID	
Observed Company	
Observation Type	
TIP Form	
Task Observed	
Observee Name	
Observer Name	
Observation Date	
Project Number	
Project Name	
Supervisor	
Equipment On Site	
Pertinent Information	

Observations

Task	Correct	Questionable	Comments
H&S - Field Multi-task (General)			
General			
PPE worn according to HASP/JLA specifications and inspected before use	☐	☐	
STOP work authority used where appropriate	☐	☐	
Body Use/Positioning			
Proper lifting/pushing / pulling techniques used (no awkward positions/posture; no twisting or excessive reaching; no straining; no excessive weight; load under control/stable; etc.)	☐	☐	
Body parts away from pinch points (clear or protected from being caught between objects/equipment or from contacting sharp objects/edges, etc.)	☐	☐	
Body parts not in the Line of Fire (protected from being struck by traffic, equipment, falling/flying objects, etc.)	☐	☐	
Work Procedures/Environment			
Correct type and number of barricades/warning devices/cones	☐	☐	
Communication with others when necessary (hand signals, flags, etc.)	☐	☐	
Right tools and equipment selected for the job and inspected before use	☐	☐	

Observations

Task	Correct	Questionable	Comments
Tools and equipment used properly	☐	☐	
Housekeeping performed (work areas and pathways clear of hazards, uneven surfaces addressed, etc.)	☐	☐	
Slip/trip/fall hazards addressed (path selected and cleared, eyes on path, speed, footing, etc.)	☐	☐	
Proper energy control (electrical systems grounded, lock out / tag out performed, isolated, cords / fixtures in good condition, GFCI inspected and utilized when appropriate and used properly, etc.)	☐	☐	
Protected from overhead/underground utilities (proper clearance, properly marked, spotters as necessary, etc.)	☐	☐	
Safe work on/near water (appropriate flotation device, appropriate boat for body of water and operation of boat, etc.)	☐	☐	
Chemical/Radiation protection (decontamination ones set up properly, air monitoring completed and logged, etc.)	☐	☐	
Fall from elevated height prevention (maintains 3 -points of contact, appropriate ladder, mounting/dismounting vehicle/equipment, fall arrest system, etc.)	☐	☐	
Any additional safety issues identified?	☐	☐	

TIP Summary

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Date of follow-up discussion	
Positive Comments	
Discussion Summary Completed	☐ Supervisor Led ☐ Peer to Peer ☐ Arcadis Employee to Subcontractor
Summary of Questionable Items	

Action Items (Optional)

Assign appropriate action items based on the observations made. You can add more than one action item if needed.

Item No.	Action Item	Responsible Person	Due Date	Completed Date
1				
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Action Items (Optional)

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Item No.	Action Item	Responsible Person	Due Date	Completed Date
3				

Standard Review

Reviewed By	Position / Title	Completed Date

Quality Review

Reviewed By	Position / Title	Completed Date

Field Validation and Verification Review

Reviewed By	Position / Title	Completed Date

Task Improvement Process

General

TIP ID	
Observed Company	
Observation Type	
TIP Form	
Task Observed	
Observee Name	
Observer Name	
Observation Date	
Project Number	
Project Name	
Supervisor	
Equipment On Site	
Pertinent Information	

Observations

Task	Correct	Questionable	Comments
H&S - Groundwater Sampling			
Equipment Care and Maintenance			
PPE worn according to HASP/JLA specifications and inspected before use	☐	☐	
Spill kit, absorbent pads, or other materials available to contain spills. Storm drains or surface water drainage areas protected	☐	☐	
Required monitoring equipment calibrated and used	☐	☐	
Right tools for the job are identified, available, inspected and in good condition	☐	☐	
Electrical systems: a) Grounded b) Lock out / tag out performed	☐	☐	
Battery powered equipment properly connected and disconnected (connect positive then negative, disconnect negative then positive)	☐	☐	
Corded portable power tool or other cord connected equipment is plugged into a GFCI whip and the GFCI whip is plugged directly into the power source (electrical outlet)	☐	☐	
GFCI whip has been inspected and tested, and is appropriate size for the equipment	☐	☐	
Battery posts protected from short circuit	☐	☐	

Observations

Task	Correct	Questionable	Comments
Air monitoring equipment is on site, calibrated according to manufacturer instructions	☐	☐	
STOP work authority used where appropriate	☐	☐	
Work Environment			
Exclusion zone set up properly with correct type and number of barricades, warning devices, delineators	☐	☐	
Site specific traffic hazards addressed	☐	☐	
Well manhole/vault inspected for hazards	☐	☐	
Proper tools or equipment used to remove well manhole/vault covers	☐	☐	
Standing water in well manholes/vaults adequately removed prior to opening well	☐	☐	
Observee not directly over well equipped with water tight cap when removing cap	☐	☐	
Vapors in well allowed to ventilate after opening well	☐	☐	
Well headspace vapor concentration measured when required by HASP or work plan	☐	☐	
Work areas and pathways designated and clear of trip/slip hazards; uneven surfaces addressed	☐	☐	
Work Procedures: Well Gauging/Purging/Sampling			
Knee pads used when kneeling for extended periods of time	☐	☐	
Proper lifting/pushing/pulling techniques	☐	☐	
Correct body positioning (e.g., not bending at waist to gauge wells)	☐	☐	
Proper handling of sample bottles (for example, hand positioning, PPE, not over tightening lids and avoiding glass bottle contact with other objects)	☐	☐	
Dedicated bailers, disposable bailers or properly decontaminated sampling equipment placed in well, water level indicators and oil/water interface probes properly decontaminated	☐	☐	
Purge water containerized or disposed of per the HASP/JLA	☐	☐	
Purge water is containerized, observee is using the proper labeling and marking requirements as required by the project work plan and/or shipping determination	☐	☐	
DOT HazMat #1 trained person collecting samples	☐	☐	
Work Procedures: Free Product Purg/Bail/Samp/Coll			
PPE as specified in HASP/JLA is donned	☐	☐	
Ensured vehicles and structures adequately ventilated to minimize organic vapor levels	☐	☐	

Observations

Task	Correct	Questionable	Comments
Free product is managed for shipment in accordance with the project shipping determination	☐	☐	
Purge water, product, decontamination rinsate water, and other wastes properly stored and secured; disposable equipment containerized or disposed of properly	☐	☐	
Work Procedures: End of Job			
All well caps/plugs and well/vault lids secure and locked	☐	☐	
Housekeeping/site left in proper condition and secured	☐	☐	
Materials of Trade (e.g., compressed gas cylinders, preservatives, calibration solutions) properly secured during transport	☐	☐	
Items stowed in vehicle properly	☐	☐	
Any additional safety issues identified?	☐	☐	

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Summary of Questionable Items	

Action Items (Optional)

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Standard Review

Reviewed By	Position / Title	Completed Date

Standard Review		
Reviewed By	**Position / Title**	**Completed Date**

Quality Review		
Reviewed By	**Position / Title**	**Completed Date**

Field Validation and Verification Review		
Reviewed By	**Position / Title**	**Completed Date**

Attachment J - H&S Standards

EXECUTIVE SUMMARY

This Standard sets forth the accepted practice for and establishes the requirements for workplace safety near excavations and trenches and employee and subcontractor entry into such.

It is ARCADIS' policy that ARCADIS staff will not enter excavations and trenches unless it is absolutely necessary and that an OSHA-defined Excavation Competent Person is on-site for all excavation work under ARCADIS contractual control. The competent person will be provided by the entity on site responsible for performing the excavation work unless otherwise required by the client. Thus, if an ARCADIS subcontractor is conducting the excavation work, that subcontractor will provide the competent person. If ARCADIS is self-performing the excavation services, then ARCADIS will provide a competent person whether a specialized subcontractor or authorized employee.

An excavation Competent Person must be involved in the excavation/trenching hazard assessment process. This will assist in determining the need for an engineering opinion when excavating near or adjacent to structures and determining the need and timing of inspections.

Prior to excavation, all underground installations (water, electric, telephone, gas, etc.) must be located and documented in accordance with ARCADIS Utility Clearance Policy and Standard ARC HSFS019.

All excavations over four feet in depth (or less than 4 feet in depth if deemed necessary by the Competent Person) shall be provided with a stairway, ladder, ramp, or other safe means of egress so as to require no more than 25 feet of lateral travel.

Water must not be allowed to accumulate in open excavations where employees are working. When necessary, means such as diverting natural drainage around the excavation or actively pumping water must be used to prevent or control water accumulation.

Excavated materials (spoil) must be placed no closer than 2 feet from the edge of an open excavation, and otherwise retained to prevent loose material from falling into the excavation.

Each employee at the edge of an excavation 6 feet (1.8 m) or more in depth shall be protected from falling by guardrail systems, fences, or barricades *when the excavations are not readily seen because of plant growth or other visual barrier*.

Any excavation over 5 feet in depth into which employees will enter that is not entirely in stable rock as defined in this Standard requires use of a protective system.

All excavations over 20 feet in depth must be designed by a registered professional engineer regardless of whether personnel will enter it or not.

All excavations over 4 feet in depth must be tested for hazardous atmospheres whenever personnel are required to enter and a potential exists for the existence of hazardous contaminants or oxygen deficiency. Excavations less than 4 feet in depth must be evaluated by the competent person and at the competent person's discretion be tested for hazardous atmospheres whenever personnel are required to enter and a potential exists for the existence of hazardous contaminants or oxygen deficiency.

1. POLICY

It is ARCADIS US policy to be proactive in the identification, assessment and control of health and safety hazards and associated risks. To those means, any work involving trenching and excavation that is under the control or direction of ARCADIS or an ARCADIS subcontractor will be accomplished following, at a minimum, this Standard.

It is ARCADIS' policy that ARCADIS staff will not enter excavations and trenches unless it is absolutely necessary. If there are no suitable alternatives and it becomes necessary to enter excavations or trenches, this standard, at a minimum will be strictly followed.

It is also the policy of ARCADIS to ensure an OSHA-defined Excavation Competent Person is on-site for all excavation work under ARCADIS contractual control. The competent person will be provided by the entity on site responsible for performing the excavation work unless otherwise required by the client. Thus, if an ARCADIS subcontractor is conducting the excavation work, that subcontractor will provide the competent person. If ARCADIS is self-performing the excavation services, then ARCADIS will provide a competent person whether a specialized subcontractor or authorized employee.

2. PURPOSE AND SCOPE

2.1 Purpose

To effectively control or eliminate the hazards presented by working near or entry into excavations or trenches, this Standard sets forth the accepted practice for and establishes the requirements for workplace safety near excavations and trenches and employee and subcontractor entry into such.

2.2 Scope

This standard along with associated checklists and the Utility Location Standard (ARC HSFS019) apply to all employees of ARCADIS-US. Only trained and authorized personnel are permitted to work near or enter excavations and trenches, perform rescue services, or act as the excavation competent person.

3. DEFINITIONS

Exhibit 1 includes relevant definitions to this Standard including that for competent person qualifications.

4. RESPONSIBILITIES

4.1 Corporate H&S with Division and Practice Experts

- On a routine basis, review and update, as necessary, this standard.
- As requested by Operations Leadership, review cancelled checklists periodically to ensure conformance to this standard.
- Coordinate with the Training Group to ensure that the excavation competent person qualifications and training/retraining requirements are met.

- Conduct excavation competent person evaluations for nominated individuals as necessary, in order to approve and designate them as competent.
- Recommend qualified training provider for excavation awareness training for employees working in or around excavation/trenching operations.
- Provide technical assistance regarding excavation and trench protocol, atmospheric testing equipment, PPE, hazard assessment and research information on unusual hazards.
- Audit project-specific excavation sites for compliance with this standard.

4.2 Principal in Charge (PIC), Project Manager (PM), and/or Task Manager (TM)

- Verify that excavation and trench protocols are properly identified and addressed within the project work plan, project health & safety plan, and/or other project-related documents.
- Verify that their divisional or project team employees have received the proper training provided by Corporate Health & Safety or qualified training source prior to conducting excavation/trenching entry activities.
- Verify that any ARCADIS employee acting as the Excavation Competent person has been designated and authorized to do so per the requirements specified in section 4.4 of this standard.
- Verify that the proper entry equipment, including personal protective equipment (PPE), atmospheric testing equipment and safety equipment, is available for use by their divisional employees.
- Verify that copies of the completed checklists are available for Corporate Health and Safety review and retained with the project files.
- Request that Corporate Health and Safety review cancelled checklists as necessary and appropriate

4.3 Health and Safety Plan Writers and Reviewers

Use this standard as guidance to ensure the appropriate identification, assessment and control of excavation and trenching hazards for documentation in project HASPs and development of task specific Job Safety Analysis (JSA).

4.4 Competent Person

Competent Person responsibilities include:

- Anticipation, identification and control of excavation and trenching hazards, as well as the signs and symptoms of exposure to the hazard(s), and the Authority to implement all corrective actions including Stopping Work.

  Note: An excavation Competent Person must be involved in the excavation/trenching hazard assessment process. This will assist in

determining the need for an engineering opinion when excavating near or adjacent to structures and determining the need and timing of inspections.

- Review existing soil sampling data (if any) or other pertinent hazard characterization information recorded by the client.
- Investigate the client's excavation/trenching protocol, to verify that any identified hazards and previous experience with earthwork at the site is properly communicated.
- Coordinate entry operations with the client's employees when both client and ARCADIS employees will be working in or near an excavation/trench.
- Offer all entrants an opportunity to review the applicable control measures and testing results and an opportunity to request a reevaluation as necessary.
- Design of structural ramps that are used solely by employees as a means of access or egress from excavations.
- Monitoring of water removal equipment and operations, if water is controlled or prevented from accumulating by the use of water removal equipment,
- Inspection of excavations subject to runoff from heavy rains.
- Daily inspections of excavations, the adjacent areas, and protective systems when required.
- If evidence of a situation that could result in a possible cave-in, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions are present, the Competent Person is responsible for ensuring that exposed employees are removed from the hazardous area until the necessary precautions have been taken to ensure their safety.
- Examining material or equipment used for protective systems that is damaged to evaluate its suitability for continued use. If the competent person cannot assure the material or equipment is able to support the intended loads or is otherwise suitable for safe use, then such material or equipment shall be removed from service, and shall be evaluated and approved by a registered professional engineer before being returned to service.
- For excavations less than 5 feet (1.52 m) in depth, in which employees will be entering, a Competent Person must examine the ground to determine if there are indications of a potential cave-in hazard. If there are potential indicators of a cave-in

hazard, the Competent Person will require some form of cave-in protection be implemented before employees can enter.

- Classifying soil and rock deposits based on site and environmental conditions, and on the structure and composition of the earth deposits.

- Soil and rock deposits shall be classified by a Competent Person as Stable Rock, Type A, Type B, or Type C based on the results of at least one visual and at least one manual analysis.

- If, after classifying a deposit, the properties, factors, or conditions affecting its classification change in any way, the changes shall be evaluated by a Competent Person. The deposit shall be reclassified as necessary to reflect the changed circumstances.

- When surcharge loads from stored material or equipment, operating equipment, or traffic are present, a competent person shall determine the degree to which the actual slope must be reduced below the maximum allowable slope, and shall assure that such reduction is achieved.

- Order evacuation of the excavation/trench if an uncontrolled hazard develops, either within or outside the space, or upon observing a behavioral effect of hazard exposure among excavation/trench entrants.

- Verify that all tests and precautionary measures identified on the Daily/Periodic Inspection Checklist located in Exhibit 2 and the ARCADIS Utility Location Policy and Standard ARC HSFS019 has been performed prior to authorizing subsurface work or entry into an excavation or trench.

ARCADIS employees must meet the following requirements to be a designated and approved Competent Person:

- Attend an Excavation Competent Person training course approved by Corporate Health and Safety or have equivalent training; and

- Approval by Corporate Health and Safety through demonstration of practical field experience and/or knowledge of the subject matter.

    - Documentation of the evaluation and approval of each excavation competent person will be completed using the form provided in Exhibit 3.

    - This documentation and a listing of the approved ARCADIS excavation competent person will be maintained by the Training Group; and

- If on an Environmental project where HAZWOPER training is required by ARCADIS, the Competent Person must also have completed the 40 Hour HAZWOPER training, be current on their annual 8 Hour HAZWOPER refresher and it is recommended, but

not required, that the Competent Person completed the HAZWOPER Supervisor training course.

4.5 Site Safety Officer (SSO)

When ARCADIS and/or our subcontractor is in control of an excavation project, the SSO will be responsible for the following:

- Interface with the client representative and Competent Person to identify and understand hazards associated with the client's excavation and trenching and/or work permit programs.
- Implement the ARCADIS Utility Clearance Policy and Procedure and complete the Daily/Periodic Excavation Inspection Checklist, when the excavation project is under the control of ARCADIS.
- Verify adequate training and experience of those ARCADIS employees working in and around excavations.
- Verify that the safety procedures identified in this Standard, the site specific HASP, and applicable regulatory requirements are used when required to protect employees during excavation activities.
- Verify that the client takes the necessary precautions in notifying their employees that our employees will be installing an excavation or trench.
- Review the lockout/tagout and isolation measures implemented by ARCADIS, our subcontractor and/or the client as necessary based on proximity of utilities or other energy sources in the area of the excavation/trench.
- Immediately report any unusual or unplanned excavation or trenching hazards to both the Competent Person and the Project Manager or Task Manager.
- Keep unauthorized persons away from the excavation area.
- Confirm that the ARCADIS Utility Location Policy and Standard ARC HSFS019 has been performed prior to authorizing subsurface work or entry into an excavation or trench.
- Issue, authorize, and have the Utility Clearance and Daily/Periodic Inspection forms readily available for review
- Verify that copies of the completed clearance forms and checklists are properly disseminated to Corporate Health and Safety and retained with the project files, as specified in Section 8.0 – Records.

4.6 Employees

- Notify the PIC, PM, TM or SSO if they have not received appropriate training.
- Review the site specific HASP, task specific JSAs, and other written plans that are associated with their work.

- Use the TRACK process regularly and frequently to recognize the hazards which may be faced during work around or in excavation/trenches, as well as to understand the signs and symptoms of exposure to airborne hazard(s).

- Never enter an excavation/trench without verifying that the required Utility Location Procedure, Daily/Periodic Inspection Checklist and required air monitoring is conducted.

- Use Stop Work Authority if excavation/trenching hazard(s) have not been appropriately addressed. Immediately consult with SSO, Competent Person and ARCADIS Project/Task Manager.

- Use the PPE, air monitoring and testing equipment that has been provided or have access to the information documenting that results are within the defined Action Levels established within the HASP.

- Maintain an awareness of all required hazard controls and consult with the Competent Person as necessary.

- If unexpected conditions arise during entry, immediately notify other entrants, evacuate the space and inform the designated Competent Person

- Obey evacuation orders given by the Competent Person, SSO, automatic alarm activation, or when self-perceived.

- At least one person on site must maintain current certification in basic first aid and cardiopulmonary resuscitation (CPR).

5. PROCEDURE

5.1 General Safety Requirements for all Excavations

- If excavation work encounters unanticipated groundwater contamination, soil contamination or other unanticipated contaminants, ARCADIS staff will Stop Work and notify the Project Manager. An appropriate work plan to sample the suspected contaminants shall be developed, samples collected by HAZWOPER trained personnel, the HASP modified and a contaminant management plan developed, as necessary.

- All surface obstructions must be moved or supported so as to protect employees and equipment.

- Prior to excavation, all underground installations (water, electric, telephone, gas, etc.) must be located and documented in accordance with ARCADIS Utility Clearance Policy and Standard ARC HSFS019.

- When excavating in areas near underground installations, proper precautions must be taken to determine the exact location of the installations and to adequately protect and support them. While an excavation is open, underground installations shall be protected, supported or removed as necessary to protect employees.

- Structural ramps that are used solely by employees as a means of access or egress from excavations shall be designed by a competent person.

- Structural ramps used for access or egress of equipment shall be designed by a competent person qualified in structural design, and shall be constructed in accordance with the design.

- Ladders must extend at least 36” (3 feet) above the landing surface.

- All excavations over four feet in depth shall be provided with a stairway, ladder, ramp, or other safe means of egress so as to require no more than 25 feet of lateral travel. As deemed necessary by the competent person, excavations less than 4 feet in depth will be provided with a stairway, ladder, ramp, or other safe means of egress so as to require no more than 25 feet of lateral travel.

- If personnel are working in a location exposed to vehicular traffic they must be provided with and be required to wear reflective safety vests. Adequate, signs, barriers or other equivalent traffic controls must be used to protect employees.

- Personnel are not permitted to be beneath elevated loads handled by equipment or be in excavations when heavy equipment is digging in or near the excavation.

- Mobile equipment located near open excavations must be adequately protected from falling or rolling into excavations by the use of barricades or warning devices.

- Employees entering bell-bottom pier holes, or other similar deep and confined footing excavations, shall wear a harness with a lifeline securely attached to it. The lifeline shall be separate from any line used to handle materials, and shall be individually attended at all times while the employee wearing the lifeline is in the excavation.

- Water must not be allowed to accumulate in open excavations where employees are working. When necessary, means such as diverting natural drainage around the excavation or actively pumping water must be used to prevent or control water accumulation.

- Where the stability of adjoining buildings, walls, or other structures is endangered by excavation operations, support systems such as shoring, bracing, or underpinning shall be provided to ensure the stability of such structures for the protection of employees.

- All structures adjacent to an open excavation must be supported, or a registered professional engineer (PE) must determine that the structure will not be affected by the excavation activities.

- Excavated materials (spoil) must be placed no closer than 2 feet from the edge of an open excavation, and otherwise retained to prevent loose material from falling into the excavation.

- Each employee at the edge of an excavation 6 feet (1.8 m) or more in depth shall be protected from falling by guardrail systems, fences, or barricades when the excavations are not readily seen because of plant growth or other visual barrier.

- Employees at the edge of a well, pit, shaft, and similar excavation 6 feet (1.8m) or more in depth shall be protected from falling by guardrail systems, fences, barricades, or covers.

- Work tasks will be designed to limit the number of personnel required to enter any excavation. All tasks that can be completed remotely from outside the excavation (such as soil sampling) will be conducted in such a manner.

- Personnel will not be allowed to enter any excavation unless required protective systems and procedures are used to prevent accidents and injury.

Best Management Practice: *In some instances, an excavation will not have any protective systems in place when employees will not be entering into the excavation. Even if employees are not entering into this type of excavation, a competent person should be consulted to establish a safe zone distance away from the edge of any open excavation to minimize the hazard of falling into this type of excavation. Standing at the edge of an excavation places an employee at risk of falling into the excavation, thereby subjecting themselves to the hazard of excavation/trench collapse, which then triggers the requirement for protective system use as defined in this standard. General guidance would be for employees to remain 6 feet or more away from the edge of any excavation.*

- Dust control measures will be implemented during excavation and soil-moving activities as required by the Health and Safety Plan (HASP). As necessary, dust control measures will also be used to manage soil located in temporary storage areas or stockpile areas. Specific dust control measures will be detailed in the HASP. The Competent Person must be consulted prior to initiating “wet” dust control measures to discuss limits/impact to protective systems.

- Excavations cut through a firewall or containment berm/bund shall provide alternate means of containment while the job is progressing. A specific containment procedure or diversion procedure will be included as a supplement to the HASP or defined in the Remedial Work Plan.

- Excavating in archeological sites requires special consideration and compliance with local legal requirements and shall be avoided wherever possible. Archaeological investigations on federal and state lands have additional requirements. For example, permit provisions are established in federal (specifically the federal Archaeological Resources Protection Act) and some state statutes. If an artifact or archeological feature is unearthed during excavation, ARCADIS shall stop work and consult with client, regulatory agencies and professional archaeologist, as necessary.

5.2 Excavations Requiring Protective Systems

This section defines excavations that require protective systems.

- All excavations into which employees will enter, regardless of depth, where the potential for cave-in exists.
- Any excavation over 5 feet in depth into which employees will enter that is not entirely in stable rock as defined in this Standard.
- Any excavation near a structure, (e.g. foundations, piers, footers, walls, sidewalks, tanks, roadways, etc.), as required by the registered professional engineer reviewing the stability of the excavation and the structure.
- All excavations over 20 feet in depth must be designed by a registered professional engineer regardless of whether personnel will enter it or not.
- All excavations that could potentially impact adjacent structures shall be reviewed by a registered professional engineer to determine if the stability of the structure will be affected by the excavation.
- Support systems for an adjacent structure must be designed by a registered professional engineer.

5.3 Selection and Use of Protective Systems

5.3.1 Shoring or Shielding

If shoring or shielding is selected as the protective system for an excavation, soil classification in accordance with 1926 Subpart P Appendix A is required.

One of the following options must be used for excavations which will be shored or shielded.

- Timber shoring as specified in 1926 Subpart P Appendix C must be utilized
- Hydraulic shoring, trench jacks, air shores, or shields as required in 1926.652 (c)(2) must be utilized following the system manufacturer's data
- A system which follows other tabulated data (approved by a registered professional engineer) must be utilized
- The excavation must be designed by a registered professional engineer

5.3.2 Sloping

If sloping is selected as the protective system for an excavation, the excavation sides must be sloped at a maximum of 34 degrees (1.5 Horizontal: 1 Vertical), unless the procedure listed above is followed.

Soil classification is required for all excavations with sides which will be sloped greater than 34° (1.5 Horizontal: 1 Vertical). If it will be sloped greater than 34°, the one of the following options must be utilized:

- Option 1 - assume Type C and slope 1.5/1 - default sloping classification
- Option 2 - classify soil according to the standard and use Type A/B sloping requirements
- Option 3 – use other tabulated data with PE approval
- Option 4 – PE approval of sloping/benching design

5.4 Atmospheric Testing for Entry

All excavations over 4 feet in depth must be tested for hazardous atmospheres whenever personnel are required to enter and a potential exists for the existence of hazardous contaminants or oxygen deficiency. Excavations less than 4 feet in depth must be evaluated by the competent person and at the competent person's discretion be tested for hazardous atmospheres whenever personnel are required to enter and a potential exists for the existence of hazardous contaminants or oxygen deficiency.

Emergency rescue equipment, such as breathing apparatus, a safety harness and line, or a basket stretcher, shall be readily available where hazardous atmospheric conditions exist or may reasonably be expected to develop during work in an excavation. This equipment shall be attended when in use.

The site designated "Competent Person" and/or SSO will document initial and periodic air monitoring results for all activities requiring entry into the excavation. All atmospheric testing of excavations must be conducted in the following sequence and meet the following air quality criteria.

- Oxygen content must be between 19.5% to 23.5%
- Combustible gas or vapor less than (<) or equal to 5% of its lower explosive limit (LEL): Level D. Continue to monitor atmospheric conditions as detailed in project specific Health and Safety Plan.
- Combustible gas or vapor levels greater than (>) 5%, but < 10% of its LEL: Continuous atmospheric monitoring required; review use/implementation of engineering controls (ventilation, etc.) and PPE; evaluate potential source(s) of ignition and where feasible, remove from the area; fire extinguisher must be available; and use TRACK to assess condition/controls and proceed with caution.
- Combustible gas or vapor levels > or equal to 10% of its LEL: Stop Work; evacuate the excavation/trench; contact the Competent Person and SSO; and re-evaluate source/controls of combustible gas,
- Carbon monoxide levels must not exceed 25 ppm as an 8-hour Time Weighted Average (TWA).

- Hydrogen sulfide must not exceed 5 ppm as a Short-Term Exposure Limit (STEL) value or 1 ppm as an 8-hour TWA.

- Toxic air contaminant levels must not exceed 50% of the PEL or the TLV for the specific contaminant (whichever is lower).

5.5 Location of Underground/Overhead Utilities

- The competent person and the project manager shall both verify that local underground facilities location/protection agencies are notified within the required time frame prior to the initiation of excavation activities and meet all requirements in the ARCADIS Utility Location Policy and Standard ARC HSFS019.

- Prior to initiation of excavation or trenching operations the competent person shall verify that all utilities have been located.

5.6 Daily/Periodic Inspections

Daily inspections of excavations, the adjacent areas, and protective systems shall be made by a Competent Person for evidence of a situation that could result in possible cave-ins, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions. An inspection shall be conducted by the Competent Person:

- Prior to initiation of daily excavation or trenching operations the competent person shall complete a daily inspection of the excavation.

- During excavation or trenching operations the competent person shall complete a periodic inspection after any event (e.g., thunderstorm, vibration, excessive drying) that may affect excavation stability.

Note: In order to correctly ascertain the soil types, the competent person must identify the locations and the limits of each type of soil, and must conduct visual and all appropriate manual tests to classify the initial (opening) soil types observed.

Note: These inspections are only required when employee exposure can be reasonably anticipated. Not just in-trench exposure, but also ANY hazardous condition in the area that an employee could be exposed to.

The competent person shall complete the daily/periodic inspection checklist (A copy of the checklist is attached to this Policy as Exhibit A) – Subcontractors must complete the ARCADIS checklist or an equivalent inspection form for each inspection of excavation and trenching activities.

5.7 Soil Classification for Selection of Protective Systems

5.7.1 Soil Classification

This section describes a method of classifying soil and rock deposits based on site and environmental conditions, and on the structure and composition of the earth deposits. This

section contains definitions, sets forth requirements, and describes acceptable visual and manual tests for use in classifying soils.

This section applies when a sloping, benching or shoring system is utilized as a method of protection for employees from cave-ins.

5.7.2 Soil Classification Definitions

5.7.2.1 Types/Classes of Soil

5.7.2.1.1 Type Class A Soils

Type/Class A Soils are cohesive soils with an unconfined, compressive strength of 1.5 ton per square foot (tsf) (144kPa) or greater. Examples of cohesive soils are: Clay, silty clay, sandy clay, clay loam and in some cases, silty clay loam and sandy clay loam. Cemented soils such as caliche and hardpan are also considered Type A. However, no soil is Type A if the following apply.

- The soil is fissured;
- The soil is subject to vibration from heavy traffic, pile driving, or similar effects;
- The soil has been previously disturbed;
- The soil is part of a sloped, layered system where the layers dip into the excavation on a slope of four horizontal to one vertical (4 Horizontal:1 Vertical) or greater;
- The material is subject to other factors that would require it to be classified as a less stable material

5.7.2.1.2 Type Class B Soils

Type/Class B Soils are:

- Cohesive soils with an unconfined compressive strength greater than 0.5 tsf (48 kPa) but less than 1.5 tsf (144 kPa)
- Granular cohesion-less soils including angular gravel (similar to crushed rock), silt, silt loam, sandy loam and, in some cases, silty clay loam and sandy clay loam
- Previously disturbed soils except those which would otherwise be classed as Type C soil
- Soil that meets the unconfined compressive strength or cementation requirements for Type A, but is fissured or subject to vibration
- Dry rock that is not stable
- Material that is part of a sloped, layered system where the layers dip into the excavation on a slope less steep than four horizontal to one vertical (4 Horizontal:1 Vertical), but only if the material would otherwise be classified as Type B

5.7.2.1.3 Type/Class C Soils

Type/Class C Soils are:

- Cohesive soil with an unconfined compressive strength of 0.5 tsf (48 kPa) or less

- Granular soils including gravel, sand, and loamy sand
- Submerged soil or soil from which water is freely seeping
- Submerged rock that is not stable
- Material in a sloped, layered system where the layers dip into the excavation or a slope of four horizontal to one vertical (4 Horizontal:1 Vertical) or steeper

5.7.2.2 Methods for Classifying Soils

Each soil and rock deposit shall be classified by a competent person as Stable Rock, Type A, Type B, or Type C in accordance with the definitions set forth in this section. The classification of the deposits shall be made based on the results of at least one visual and at least one manual analysis conducted by a competent person using tests described below, or in other recognized methods of soil classification and testing such as those adopted by the American Society for Testing Materials, or the U.S. Department of Agriculture textural classification system.

The visual and manual analyses, such as those noted as being acceptable in this section, shall be designed and conducted to provide sufficient quantitative and qualitative information as may be necessary to identify properly the properties, factors, and conditions affecting the classification of the deposits. Visual analysis is conducted to determine qualitative information regarding the excavation site in general, the soil adjacent to the excavation, the soil forming the sides of the open excavation, and the soil taken as samples from excavated material.

Observe the following:

- Samples of soil that are excavated and soil in the sides of the excavation. Estimate the range of particle sizes and the relative amounts of the particle sizes. Soil that is primarily composed of fine grained material is cohesive material. Soil composed primarily of coarse grained sand or gravel is granular material.

- Soil as it is excavated. Soil that remains in clumps when excavated is cohesive. Soil that breaks up easily and does not stay in clumps is granular.

- The side of the open excavation and the surface area adjacent to the excavation. Crack like openings such as tension cracks could indicate fissured material. If chunks of soil spall off a vertical side, the soil could be fissured. Small spalls are evidence of moving ground and are indications of potentially hazardous situations.

- The area adjacent to the excavation and the excavation itself for evidence of existing utility and other underground structures, and to identify previously disturbed soil.

- The open side of the excavation to identify layered systems. Examine layered systems to identify if the layers slope toward the excavation. Estimate the degree of slope of the layers.

- The area adjacent to the excavation and the sides of the opened excavation for evidence of surface water, water seeping from the sides of the excavation, or the location of the level of the water table.

- The area adjacent to the excavation and the area within the excavation for sources of vibration that may affect the stability of the excavation face.

Manual analysis of soil samples is conducted to determine quantitative as well as qualitative properties of soil and to provide more information in order to classify soil properly.

5.7.2.3 Classifications

- *Plasticity*. Mold a moist or wet sample of soil into a ball and attempt to roll it into threads as thin as 1/8 inch in diameter. Cohesive material can be successfully rolled into threads without crumbling. For example, if at least a two inch (50 mm) length of 1/8 inch thread can be held on one end without tearing, the soil is cohesive.

- *Dry strength*. If the soil is dry and crumbles on its own or with moderate pressure into individual grains or fine powder, it is granular (any combination of gravel, sand, or silt). If the soil is dry and falls into clumps which break up into smaller clumps, but the smaller clumps can only be broken up with difficulty, it may be clay in any combination with gravel, sand or silt. If the dry soil breaks into clumps which do not break up into small clumps and which can only be broken with difficulty, and there is no visual indication the soil is fissured, the soil may be considered unfissured.

- *Thumb penetration*. The thumb penetration test can be used to estimate the unconfined compressive strength of cohesive soils. Type A soils with an unconfined compressive strength of 1.5 tsf can be readily indented by the thumb; however, they can be penetrated by the thumb only with very great effort. Type C soils with an unconfined compressive strength of 0.5 tsf can be easily penetrated several inches by the thumb, and can be molded by light finger pressure. This test should be conducted on an undisturbed soil sample, such as a large clump of spoil, as soon as practicable after excavation to keep to a minimum the effects of exposure to drying influences. If the excavation is later exposed to wetting influences (rain, flooding), the classification of the soil must be changed accordingly.

- *Other strength tests*. Estimates of unconfined compressive strength of soils can also be obtained by use of a pocket penetrometer or by using a hand operated shearvane.

- *Drying test*. The basic purpose of the drying test is to differentiate between cohesive material with fissures, unfissured cohesive material, and granular material. The procedure for the drying test involves drying a sample of soil that is approximately one inch thick (2.54 cm) and six inches (15.24 cm) in diameter until it is thoroughly dry:

    1. If the sample develops cracks as it dries, significant fissures are indicated.

    2. Samples that dry without cracking are to be broken by hand. If considerable force is necessary to break a sample, the soil has significant cohesive material content. The soil can be classified as an unfissured cohesive material and the unconfined compressive strength should be determined by using the thumb penetration or other test.

5.7.2.4 Cohesive with Fissures vs Granular

If a sample breaks easily by hand, it is either a fissured cohesive material or a granular material. To distinguish between the two, pulverize the dried clumps of the sample by hand or by stepping on them. If the clumps do not pulverize easily, the material is cohesive with fissures. If they pulverize easily into very small fragments, the material is granular.

5.7.2.5 Layered system

A layered system shall be classified in accordance with its weakest layer. Each layer may be classified individually where a more stable layer lies under a less stable layer.

5.7.2.6 Reclassifying Soils

A layered system shall be classified in accordance with its weakest layer. Each layer may be classified individually where a more stable layer lies under a less stable layer.

In most instances the ARCADIS designated Excavation/Trenching Competent person will assume Type C soil, unless they have conclusive data to validate Type A or B.

5.7.2.7 Excavation Construction Based on Soil Type

The maximum allowable slope means the steepest incline of an excavation face that is acceptable for the most favorable site conditions as protection against cave-ins, and is expressed as the ratio of horizontal distance to vertical rise (H:V). Short-term exposure means a period of time less than or equal to 24 hours that an excavation is open. Soil and rock deposits must be classified in accordance with Appendix A to Subpart P of Part 1926. The maximum allowable slope for a soil or rock deposit must be determined from the table provided below. The actual slope must not be steeper than the maximum allowable slope. The actual slope must be less steep than the maximum allowable slope, when there are signs of distress. If that situation occurs, the slope must be cut back to an actual slope which is at least horizontal to one vertical (1/2H:1V) less steep than the maximum allowable slope. When surcharge loads from stored material or equipment, operating equipment, or traffic are present, a competent person must determine the degree to which the actual slope must be reduced below the maximum allowable slope, and must assure that such reduction is achieved. Surcharge loads from adjacent structures must be evaluated in accordance with 1926.651(I). Configurations of sloping and benching systems must be in accordance with 29 CFR 1926 Subpart P, Appendix B.

EXCAVATION SLOPE INFORMATION FROM 29 CFR 1926 SUBPART P APPENDIX B MAXIMUM ALLOWABLE SLOPES	
Soil or Rock Type	**Maximum Allowable Slopes (H:V)[1] for Excavations Less Than 20 Feet Deep[2]**
Stable Rock	Vertical (90 degrees)
Type A[3]	¾:1 (53 degrees)
Type B	1:1 (45 degrees)
Type C	1½:1 (34 degrees)

1. Numbers shown in parentheses next to maximum allowable slopes are angles expressed in degrees from the horizontal (H). Angles have been rounded off.

2. Sloping or benching for excavations greater than 20 feet deep must be designed by a registered professional engineer.
3. A short-term maximum allowable slope of 1/2H:1V (63 degrees) is allowed in excavations in Type A soil that are 12 feet (3.67 m) or less in depth. Short-term maximum allowable slopes for excavations greater than 12 feet (3.67 m) in depth must be 3/4H:1V (53 degrees).

6. TRAINING

6.1 Project - Specific Orientation

All staff working on a site where trenching and excavation activities are being conducted by ARCADIS or its subcontractors will be provided with site orientation on excavation projects and participate in daily safety meetings that include a discussion of the following:

- Site excavation hazards and procedures;
- Requirements for conducting activities remotely whenever possible;
- Client requirements and procedures for excavation activities;
- Review of applicable federal, state and/or local excavation requirements; and
- This Excavation and Trenching Standard, as appropriate

6.2 Employee Training

Besides site orientation training, additional training will be provided as follows based on the employee's activities:

- All employees who work in the area of potential excavation/trenching sites will receive awareness level training as provided and/or approved by ARCADIS Corporate H&S in order to recognize and to understand the hazards associated with trenching/excavation work.
- On an as needed basis, employees will receive site specific instruction regarding the excavation/trenching operation from the Competent Person and/or the SSO.

6.3 Competent Person Training

Competent Persons will be provided training as follows:

In order for ARCADIS employees to be assigned duties as a competent person, with respect to excavation and trenching, in addition to the criteria noted in section 4.4, personnel must attend an Excavation Competent Person training course approved by Corporate Health and Safety or have equivalent training. The course shall include, but is not limited to the following:

- Introduction to and definition of trenches and excavations.
- General requirements of OSHA 29 CFR 1926 Subpart P.
- Responsibilities and requirements of a competent person.
- Hazards associated with trenches/excavations and Identification and Assessment of these hazards.
- Hazard controls

- Soil analysis and testing (visual and manual;
- Protective systems;
- Personal protective equipment;
- Utility location;
- Atmospheric testing;
- Water drainage and pumping;
- Site housekeeping and management;
- Communications;
- Access and egress

- Emergency Procedures.
- Inspections.

All training provided must be reviewed and approved by Corporate Health & Safety and will be managed through the Training Team.

Documentation of training certification received by attendance at any training course including externally provided training courses will be kept by the employee with copies provided to the Training Team.

7. REFERENCES

ARCADIS Health and Safety Standard ARC HSFS010– Health and Safety Planning

ARCADIS Health and Safety Standard ARC HSFS004 – Control of Hazardous Energy (Lockout/Tagout)

ARCADIS Utility Clearance Policy and Standard ARC HSF019

OSHA 29 CFR Part 1926 Subpart P - Excavations

8. RECORDS

8.1 Training records will be kept by the individual employee with copies of such certificates kept by the Training Team. Training dates and times will be kept by the Training Team.

8.2 Completed clearance forms and checklists will be kept in the project files with copies available for Corporate H&S review.

8.3 Copies of all HASPs that document excavation trenching procedures will be kept in the project files.

9. APPROVALS AND HISTORY OF CHANGE

Approved By: Anthony Tremblay, CSP, CIAQP – Corporate H&S, Director of Technical Programs

History of Change

Revision Date	Revision Number	Standard Developed/Reviewed By or Revised By	Reason for change
12 May 2008	01	Greg Ertel	Original document
13 June 2008	02		Modified Section 5.1 – 4th bullet related to structural ramps. Modified Section 5.2 to designate a 6x factor for structural integrity of structures near the excavation. Revised Exhibit 1 to modify the definition of a Competent person
9 January 2009	03		Cleaned up definitions, deleted training requirements from Section 5.0 and moved them to Section 6.0, modified purpose statement
31 March 2011	04		Updated Competent Person training and qualification requirements in section 4.6, section 6.2 and definition in Exhibit 1.
27 March 2012	05	Tremblay	Section 4 competent person, SSO and employee responsibilities revised; Confined Space references eliminated; Training requirements clarified; use of ladders detailed; Fall prevention requirements clarified in section 5.1; depth of protective system requirement corrected to 5 feet; spoils pile must be minimum 2 feet from edge of excavation; Atmospheric Monitoring Action Levels revised; Employee Awareness Training and Competent Person Training requirements clarified
4 June 2012	06	Tremblay	Section 4.4 typo corrected; 8-hour HAZWOPER Supervisor course for competent person was made a recommended practice instead of a requirement; Section 4.5 SSO responsibilities revised to eliminate those responsibilities that belong with the Competent Person; Section 5 Best Management Guidance to maintain safe distance from the edge of excavation; checklists hyperlinked

Revision Date	Revision Number	Standard Developed/Reviewed By or Revised By	Reason for change
18 September 2013	07	Tremblay	Tracking table format updated; Section 5.1 revised to include information about encountering unanticipated contaminants, implementing dust control measures, instituting containment measures when breeching a containment berm and avoiding excavating in archeological sites
26 September 2013	08	Tremblay	Section 5.7.2.7 Maximum Allowable Slope Table had a typo in Type C soil line H:V ratio (corrected the ratio to read 1 ½ : 1). The value of 34 degrees is correct; Header format update and pages renumbered
23 February 2015	09	Tremblay	Page numbering correction; Exhibit 2 checklist and Exhibit 3 Competent Person Checklist inserted to supplement the existing hyperlink to documents

Exhibit 1 – Definitions

Attendant is a trained qualified individual stationed outside the excavation whose duty is to monitor authorized entrants inside the excavation or trench and have a means of communication with the designated rescue services.

Benching/Benching system means a method of protecting employees from cave-ins by excavating the sides of an excavation to form one or a series of horizontal levels or steps, usually with vertical or near-vertical surfaces between levels.

Cave-in means the separation of a mass of soil or rock material from the side of an excavation, or the loss of soil from under a trench shield or support system, and its sudden movement into the excavation, either by falling or sliding, in sufficient quantity so that it could entrap, bury or otherwise injure and immobilize a person.

Cemented soil means a soil in which the particles are held together by a chemical agent, such as calcium carbonate, such that a hand size sample cannot be crushed into powder or individual soil particles by finger pressure.

Cohesive soil means clay (fine grained soil), or soil with a high clay content, which has cohesive strength. Cohesive soil does not crumble, can be excavated with vertical sides, and is plastic when moist. Cohesive soil is hard to break up when dry, and exhibits significant cohesion when submerged. Cohesive soils include clayey silt, sandy clay, silty clay, clay and organic clay.

Competent person means one who, through education, training, and/or experience, is capable of identifying existing and predictable hazards or working conditions which are unsanitary, hazardous, or dangerous to employees and who has authorization to take prompt corrective measures to eliminate them.

Dry soil means soil that does not exhibit visible signs of moisture content.

Excavation means any man-made cut, cavity, trench, or depression in an earth surface formed by earth removal into which a person can bodily enter.

Entry constitutes the act by which an employee proceeds into an excavation or trench. Consideration of hazards, especially cave-ins and fall protection must still be considered and accounted for when equipment or personnel are near an excavation or trench, even if personnel will not be entering.

Entrants are employee's who are trained and authorized to enter a trench or excavation. Entrants must have attended a Qualified Excavation Training course offered or approved by Corporate Health and Safety.

Failure means the breakage, displacement, or permanent deformation of a structural member or connection so as to reduce its structural integrity and its supportive capabilities.

Fissured means a soil material that has a tendency to break along definite planes of fracture with little resistance, or a material that exhibits open cracks, such as tension cracks, in an exposed surface.

Granular soil means gravel, sand, or silt (coarse grained soil) with little or no clay content. Granular soil has no cohesive strength. Some moist granular soils exhibit apparent cohesion. Granular soil cannot be molded when moist and crumbles easily when dry.

Hazardous Atmosphere is an atmosphere which exposes employees to a risk of death, incapacitation, injury, or acute illness from one or more of the following:

- An atmospheric concentration of any substance in excess of 50% of its established permissible exposure limit (PEL); or its assigned threshold limit value (TLV) or other value listed on the Material Safety Data Sheet (MSDS) for the chemical constituent, whichever is lower.
- A flammable gas, vapor, or mist in excess of 10% of its lower explosive limit (LEL).
- An airborne combustible dust at a concentration that obscures vision at a distance of 5 feet or less.
- An atmospheric oxygen concentration below 19.5% (oxygen-deficient atmosphere) or above 23.5% (oxygen-enriched atmosphere).
- An atmosphere which is immediately dangerous to life and health.

Immediately Danger to Life and Health (IDLH) means any condition which poses an immediate threat to loss of life; may result in irreversible or immediate-severe health effects; may result in eye damage, irritation, or other conditions which could impair escape from the space.

Layered system means two or more distinctly different soil or rock types arranged in layers. Micaceous seams or weakened planes in rock or shale are considered layered.

Moist soil means a condition in which a soil looks and feels damp. Moist cohesive soil can easily be shaped into a ball and rolled into small diameter threads before crumbling. Moist granular soil that contains some cohesive material will exhibit signs of cohesion between particles.

Plastic means a property of a soil which allows the soil to be deformed or molded without cracking, or appreciable volume change.

Protective system means a method of protecting employees from cave-ins, from material that could fall or roll from an excavation face or into an excavation, or from the collapse of adjacent structures. Protective systems include support systems, sloping and benching systems, shield systems and other systems that provide protection.

Ramp means an inclined walking or working surface that is used to gain access to one point from another, and is constructed from earth or from structural materials such as steel or wood.

Registered Professional Engineer means a person who is registered as a professional engineer in the state where the work is to be performed. However, a professional engineer, registered in any state is deemed to be a "registered professional engineer" within the meaning of this standard when approving designs for "manufactured protective systems" or "tabulated data" to be used in interstate commerce. To oversee an excavation/trench activity the PE must have experience with and expertise in excavation, soil and stability considerations.

Saturated soil means a soil in which the voids are filled with water. Saturation does not require flow. Saturation, or near saturation, is necessary for the proper use of instruments such as a pocket penetrometer or sheer vane.

Sheeting means the members of a shoring system that retain the earth in position and in turn are supported by other members of the shoring system.

Shield (Shield system) means a structure that is able to withstand the forces imposed on it by a cave-in and thereby protect employees within the structure. Shields can be permanent structures or can be designed to be portable and moved along as work progresses. Additionally, shield can be

either pre-manufactured or job-built in accordance with 1926.652 (c)(3) or (c)(4). Shields used in trenches are usually referred to as "trench boxes" or "trench shields".

Shoring (Shoring system) means a structure such as a metal hydraulic, mechanical or timber shoring system that supports the sides of an excavation and which is designed to prevent cave-ins.

Sloping (Sloping system) means a method of protecting employees from cave-ins by excavating to form sides of an excavation that are inclined away from the excavation so as to prevent cave-ins. The angle of incline required to prevent a cave-in varies with differences in such factors as the soil type, environmental conditions of exposure, and application of surcharge loads.

Soil classification system means, for the purpose of this procedure, a method of categorizing soil and rock deposits in a hierarchy of Stable Rock, Type A, Type B and Type C, in decreasing order of stability. The categories are determined based on an analysis of the properties and performance characteristics of the deposits and the characteristics of the deposits and the environmental conditions of exposure.

Stable rock means natural solid mineral material that can be excavated with vertical sides and will remain intact while exposed. Unstable rock is considered to be stable when the rock material on the side or sides of the excavation is secured against caving-in or movement by rock bolts or by another protective system that has been designed by a registered professional engineer.

Submerged soil means soil which is underwater or is free seeping.

Support system means a structure such as underpinning, bracing, or shoring, which provides support to an adjacent structure, underground installation, or the sides of an excavation.

Trench means a narrow excavation (in relation to its length) made below the surface of the ground to which a person can bodily enter. In general, the depth is greater than the width, but the width of a trench (measured at the bottom) is not greater than 15 feet (4.6 meters). If forms or other structures are installed or constructed in an excavation so as to reduce the dimension measured from the forms or structure to the side of the excavation to 15 feet (4.6 meters) or less (measured at the bottom of the excavation), the excavation is considered to be a trench.

Unconfined compressive strength means the load per unit area at which a soil will fail in compression. It can be determined by laboratory testing, or estimated in the field using a pocket penetrometer, by thumb penetration tests, and other methods.

Wet soil means soil that contains significantly more moisture than moist soil, but in such a range of values that cohesive material will slump or begin to flow when vibrated. Granular material that would exhibit cohesive properties when moist will lose those cohesive properties when wet.

Exhibit 2 – Daily / Periodic Excavation Inspection Checklist

Daily / Periodic Excavation Inspection Checklist

ARCADIS	Daily / Periodic Excavation Inspection Checklist
Project Name:	Date / Time:
Project Number:	Location:
Prepared By:	Project Manager:

This checklist must be completed for all excavations. It documents that daily and post-event / periodic inspections are conducted.

Soil Classified As:	☐ Stable Rock	☐ Type A	☐ Type B	☐ Type C
Soil Classified On:	By:			
Type of Protective System in Use	☐ Sloping	☐ Shoring	☐ Shielding	☐ Benching	☐ Other

Description:

Inspection Item	YES	NO	N/A	Comments
Has the ARCADIS Utility Clearance Procedure been completed?	☐	☐	☐	
Are underground installations protected from damage?	☐	☐	☐	
Has a Competent Person been identified?	☐	☐	☐	
Are adequate means of entry / exit available in the excavation – at least every 25 feet?	☐	☐	☐	
If exposed to traffic, are personnel wearing reflective vests and adequate barriers/traffic controls installed?	☐	☐	☐	
Do barriers exist to prevent equipment from rolling into the excavation?	☐	☐	☐	
Was air monitoring conducted prior to and during excavation entry?	☐	☐	☐	
Was the stability of adjacent structures reviewed by a registered P.E.?	☐	☐	☐	
Are spoil piles at least 2 feet from the excavation edge?	☐	☐	☐	
Is the excavation(s) readily visible ? If no, employees must be protected from falling by guardrail systems, fences, or barricades?	☐	☐	☐	
If the well, pit, shaft, or similar excavation is 6 feet (1.8m) or more in depth, are employees protected from falling by guardrail systems, fences, barricades?	☐	☐	☐	
Are work tasks completed remotely if feasible?	☐	☐	☐	
Is a protective system in place and in good repair?	☐	☐	☐	
Is excavation isolated from the effects of vibration?	☐	☐	☐	
Are employees protected from falling / elevated material?	☐	☐	☐	
Is soil classification adequate for current environmental / weather conditions?	☐	☐	☐	
Do portable ladders extend at least 3 feet above the excavation?	☐	☐	☐	
Are portable ladders or ramps secured in place?	☐	☐	☐	
Have all personnel attended safety meeting on excavation hazards?	☐	☐	☐	
Are support systems for adjacent structures in place?	☐	☐	☐	
Is the excavation free from standing water?	☐	☐	☐	
Is water control and diversion of surface runoff adequate?	☐	☐	☐	
Are employees wearing required protective equipment?	☐	☐	☐	
Excavation Competent Person:				Date/Time:

Exhibit 3 – Competent Person Evaluation Form for Excavation / Trenching

Exhibit 3 – Competent Person Evaluation Form for Excavation / Trenching

Name of Employee:_____Job Title:_____

Department: _____Office Location: _____

Experience with Excavations/Trenching:

_____

_____

_____

_____

_____

_____

Relevant Training:

_____

_____

_____

_____

_____

_____

_____

Other Relevant Qualifications:

_____

_____

_____

_____

_____

_____

_____

*Include documentation from employee's Supervisor that acknowledges their capacity to work as a designated competent person.

Based on the information listed above and an evaluation of this employee's knowledge and experience, I consider them to be a Competent Person for Excavation and Trenching.

Evaluation By: _____ Job Title: _____

Signature: _____ Date: _____

EXECUTIVE SUMMARY

The following is a requirements summary applicable to the Motor Vehicle Safety Program (MVSP):

- The MVSP applies to all Arcadis drivers operating Arcadis owned, leased, rented, or personal motor vehicles used for business purposes and all Arcadis owned, leased or rented motor vehicles used for non-business (personal) purposes.
- Arcadis expects 100 percent compliance with all applicable driving laws and regulations.
- Employees operating Arcadis owned, leased or rented vehicles for personal use must have written supervisor's approval.
- All Arcadis drivers with an assigned driving function for Arcadis may have their Motor Vehicle Record (MVR) reviewed by approved representatives of Corporate Human Resources, Health and Safety and/or Legal Departments.
- Newly hired drivers with an assigned driving function for Arcadis and a clean MVR must complete, at a minimum, on-line defensive driving training within 30 days of hire.
- Existing Arcadis drivers with an assigned driving function for Arcadis must participate, at a minimum, in on-line defensive driving training at intervals prescribed by Health and Safety.
- Weekly vehicle inspections are required for all Arcadis owned, leased, or rented vehicles used during the previous 7 days. Inspections will be documented.
- All Arcadis owned, leased, or rented motor vehicles will be properly maintained in accordance with manufacturer's recommendations. All defects affecting safe operation of the motor vehicle will be promptly repaired.
- Arcadis employees are prohibited from modifying Arcadis owned or leased vehicles unless the modification is approved in writing by Corporate Health and Safety and/or Corporate Procurement.
- Arcadis prohibits use of cellular phones, including hands free mode, while driving any vehicle for Arcadis.

1. POLICY

It is the policy of Arcadis to implement sound defensive driving training and education to employees. It is also Arcadis policy to provide administrative management that ensures vehicles are well maintained and driven by qualified employees.

2. PURPOSE AND SCOPE

2.1 Purpose

Arcadis is committed to providing a healthy and safe work environment for our employees, subcontractors, clients and visitors. To this end, Arcadis embraces this Health and Safety MVSP Standard.

This standard and accompanying requirements provides consistent practices with regards to defensive driving and vehicle administration for Arcadis vehicles.

2.2 Scope

Generally, this Standard applies to all employees operating motor vehicles for Arcadis

2.2.1 Business Driving – This MVSP applies to the operation of any motor vehicle during the conduct of Arcadis business. It applies to every Arcadis Driver operating an Arcadis, rental, leased or personal vehicle used for company business.

2.2.2 Area Involved **–** This MVSP applies to the operation of motor vehicles for company business in any country in which Arcadis employees or temporary agency employees are working.

2.2.3 Exceptions

2.2.3.1 Operation of Commercial Motor Vehicles

Additional requirements apply to operation of commercial motor vehicles (CMVs). Refer to the Arcadis Transportation Safety Program for Commercial Motor Vehicles (CMV Program) for additional information. When client requirements are more restrictive than this MVSP, the more restrictive requirement will apply for all work activities involving driving for that client.

2.2.3.2 Drivers without an Assigned Driving Function for Arcadis

Drivers without an assigned driving function for Arcadis are still subject to the requirements of the Arcadis Vehicle Use Policy maintained by Human Resources.

3. DEFINITIONS

Definitions relating this MVSP can be found in Exhibit 1.

4. RESPONSIBILITIES

The following have responsibilities under this standard:

4.1 **Corporate Health and Safety Department (Health and Safety)** – Has the responsibility for: revising and updating this standard, communicating MVSP requirements to employees. They also ensure this MVSP is being implemented effectively. Health and Safety has a primary focus of identifying defensive driving education and training resources. Health and Safety is also responsible for stewarding programs involving vehicle inspections and maintenance requirements. Health and Safety has the authority to request and evaluate motor vehicle reports on Arcadis drivers at any time.

4.2 **Health and Safety MVSP Specialist (MVSP Specialist) –** Is the primary contact for all issues related to implementation of this MVSP, including reporting of all accidents and incidents involving a motor vehicle. The MVSP Specialist will coordinate with other Corporate departments, as required, related to MVSP implementation requirements.

Contact the MVSP Specialist for all MVSP related reporting, questions or concerns.

4.3 **Corporate Human Resources Department (Human Resources)** – Has the responsibility to review applicable portions of this standard for the purposes of ensuring consistency with Human Resource's policies and procedures regarding motor vehicle operation. Human Resources have a primary focus of ensuring administrative procedures concerning vehicle use are followed by employees. Human Resources has the authority to request and evaluate motor vehicle reports on Arcadis drivers at any time.

4.4 **Corporate Legal Department (Legal) –** Has the responsibility to provide oversight of the requirements stipulated in this standard to ensure Arcadis risks are properly managed. Legal has the authority to request and evaluate MVRs on Arcadis drivers at any time.

4.5 **Corporate Purchasing (Purchasing)** – Has the responsibility to oversee leasing and maintenance management vendors and facilitate maintenance issues associated with Arcadis owned or leased vehicles. Purchasing will also work with Health and Safety on safety equipment needs for owned or leased vehicles.

4.6 **Health and Safety Managers and Specialists** – Are responsible for facilitating and educating staff on MVSP requirements. These individuals may also perform audits or conformance assessment to ensure compliance with the requirements of this standard.

4.7 **Arcadis Managers and Supervisors (including project and task managers)** – These managers and supervisors provide stewardship concerning the requirements of this standards to lower tier managers and employees. In addition, they assure that appropriate time is provided to ensure implementation of MVSP requirements and facilitate maintenance request approvals.

4.8 **Arcadis Employees** – Each employee has the responsibility to adhere to this MVSP and to communicate Health and Safety concerns, issues and questions to their supervisor or to Health and Safety staff. In addition, all employees have the responsibly to use TRACK prior to any driving activity and will follow all applicable Arcadis, federal, state, provincial, and local jurisdiction regulatory; and client requirements when driving an Arcadis owned, leased, rented vehicle.

5. PROCEDURE

5.1 General Procedure and Requirements

Employees must report all moving violations that may affect their driving status for Arcadis

Only Arcadis Drivers as defined in Section 3.0 are permitted to drive Arcadis vehicles. Exceptions to this policy are limited only to individuals authorized by the Arcadis Driver or fleet administrator to perform short term driving and parking activities involving Arcadis vehicles such as maintenance employees and valets. Use of joint venture and temporary agency employees working with or for Arcadis to operate Arcadis vehicles requires pre- approval of the Business Line President and Legal.

Arcadis Drivers who drive Arcadis vehicles or personal vehicles used for Arcadis business will maintain a valid driver's license, appropriate for the vehicle they are operating, that is free from any driving restrictions or suspension. An Arcadis Driver who is asked to drive for business purposes in any type of vehicle, shall notify their supervisor or designated Arcadis contact by the next business day if:

- Their license is suspended, revoked, or restricted;
- They receive a moving violation while driving for Arcadis-related business; or

- Receive a moving violation during non-business related driving in any type of motor vehicle that might affect their driving status with Arcadis.

If one of these issues occurs, the employee's supervisor will contact the MVSP Specialist. The MVSP Specialist (or his/her designate), in cooperation with Human Resources and Legal, as deemed necessary, will evaluate the employee's driving status (especially in instances of license suspension, revocation or restriction) and, as appropriate, corrective action recommendations will be made.

Employees who fail to report a driving violation to their supervisor that might affect their driving status for Arcadis purposes (a restricted driver) will face disciplinary action which may include termination if the conviction is discovered through routine MVR pulls, criminal background checks or other official documentation transmitted or made available to Arcadis. Arcadis will work to the extent practical with employees who report driving violations that might affect their driving status for Arcadis purposes if Arcadis operations management can accommodate a driving restriction for the driver or other suitable arrangement is made consistent with Human Resources (HR) and Legal policies.

All Arcadis Drivers driving an Arcadis motor vehicle or personal vehicle for Arcadis business will:

Arcadis prohibits use of cellular phones, including hands free mode, when driving vehicles for Arcadis

- Wear seat belts at all times in any vehicle with seat belts (this includes taxis and shuttle buses equipped with seat belts);
- Have a valid unrestricted operators license appropriate for the vehicle being driven;
- Operate and license the vehicle in accordance with applicable laws;
- Operate the vehicle consistent with client driving rules, speed limits, and requirements when operating the vehicle on project sites;
- Drive defensively as learned through training, education, and experience;
- Exercise caution when taking any prescription or over-the-counter medication that may cause drowsiness or an altered mental state;
- Not use controlled substances, illegal drugs, or be under the influence of alcohol while driving on Arcadis business;

- Not drive in a manner that could be deemed reckless or aggressive by other drivers;
- Not use radar/laser-type detectors;
- Not pick up hitchhikers;
- Not smoke in company vehicles; and
- For drivers with an assigned driving function for Arcadis, if permanently assigned an Arcadis motor vehicle will ensure the vehicle is maintained as directed by the Arcadis maintenance vendor.

Use of headlights at all times, even during daylight hours is recommended. Additionally, Arcadis expects all drivers to use pull through parking or back into parking places consistent with their defensive driving training specified in this standard and as permitted by local laws.

5.2 MVR Review

5.2.1 New Hire MVR Review

MVSP Guide-005 provides details of the MVR review process

Human Resources will perform a MVR review on potential new hires of positions that have an assigned driving function for Arcadis. The MVR review process for potential new hires follows an established review process that will result in a Pass, Conditional, or Restricted status. A MVR review resulting in restricted status will prevent hiring of the candidate unless excepted as specified in section 5.2.5. Human Resources will communicate the MVR review results to the hiring manager prior to finalizing the new hire process.

5.2.2 Existing Employee MVR Review

Human Resources may perform a MVR review on existing employees with an assigned driving function for Arcadis at a frequency stipulated by Corporate. The MVR review process for existing employees follows an established review process that will either result in a Pass, Conditional, or Restricted status. Human Resources will communicate the MVR review results to the supervisor of any employee having a Conditional or Restricted status resulting from the MVR review.

5.2.3 Post-Accident MVR Review

Any vehicle related accident classed as a preventable Motor Vehicle Accident (MVA) will require a MVR review for the employee involved in the MVA. Preventable VLEs are not generally subject to the MVR review process; however, Corporate reserves the right to perform a MVR review on any employee involved in a vehicle related accident regardless of accident classification. The MVSP Specialist will report the need to run a MVR to HR upon determination of a preventable MVA and HR will communicate the MVR results to the employee and their supervisor.

5.2.4 Commercial Motor Vehicle MVR Reviews

Detailed requirements concerning MVR review and evaluation for drivers participating in the Arcadis CMV Program is not addressed in this standard. MVR reviews related to CMV drivers are performed by Arcadis Director of Transportation Safety or his/her approved designate.

5.2.5 Appeals

MVR reviews that result in restricted driving status for a potential new hire or existing employee may be appealed to the applicable Business Line President through the applicable business line H&S Director. The Business Line President may elect to maintain the restriction or overturn the restriction. An overturned restriction may be referred by the Business Line President to the Accident Review Committee for additional corrective action based on the circumstances of the restriction.

5.3 Defensive Driving Training, Evaluation, and Education Requirements

The Arcadis Training Center provides instructions on how to enroll into defensive driving training courses or tutorials

5.3.1 New Hire Defensive Driving Training

All new hires (regardless of driving assignment) with an active driver's license will complete on-line defensive driving training prescribed by Health and Safety within 30 days of employment.

New hires with conditional driving status may be required to complete on-line defensive driving training prior to operating a vehicle for Arcadis.

5.3.2 Existing Employee Defensive Driving Training

On a frequency defined by Corporate Health and Safety, in cooperation with operations senior management, employees who have an assigned driving function for Arcadis shall complete an on-line defensive driving training course designated by Health and Safety or an equivalent course approved by Health and Safety.

Note: For existing employees hired before the implementation date of this policy, the supervisor will determine if the employee drives on average 5 or more days per month to warrant participation in this training.

In furtherance of Arcadis' goal of promoting safe driving, employees who do not have an assigned driving function for Arcadis are also eligible to voluntarily participate in the same on-line defensive driving training concurrent with prescribed timeframes for any assigned Arcadis driver training.

If a client requires classroom or hands-on defensive driver's training, the Arcadis Training Center will arrange for the required classroom training. The Arcadis required on-line training will not be required for those driving employees who attend classroom training (hands-on or subject matter training) consistent with a Health and Safety recognized defensive driving system during the same calendar year.

All Arcadis drivers are expected to review and be familiar with the contents of the Operator's Manual(s) for the vehicles they will be operating. Additional training may be provided or required at the request of an employee's supervisor, Health and Safety, or as required by a client.

Supervisors should discuss with their direct reports about their abilities to operate large vehicles and address direct report concerns

5.3.3 Inexperienced Drivers

New hires or existing employees having an assigned driving function for Arcadis and known to have only possessed a valid drivers license for less one year or experienced drivers that are unfamiliar with driving large vehicles may warrant additional evaluation and training in the operation of the vehicle(s) they are expected to drive while working for Arcadis. Supervisors are encouraged to review with their direct reports their license and driving history to ensure the driver is comfortable and

knowledgeable of expected vehicle operation. If determined by the supervisor that additional evaluation is warranted, a Commentary Drive (see Section 5.4) should be considered. The supervisor may schedule an additional TIP at a later date to ensure safe driving of larger vehicles is being performed.

Supervisors may opt to enroll drivers in additional defensive driving on-line training or hands-on defensive driver training if the driver expresses concerns about their ability to safely drive a vehicle.

5.3.4 Drivers Requiring Training or Evaluation due to Corrective Action from MVR Review

Any driver subject to Corrective Action arising from an MVR review will be trained or evaluated as prescribed in the MVR evaluation process (MVSP Guide-005).

5.3.5 Additional Defensive Driving Training and Education Requirements for Employees Involved in a Vehicle Loss Event

Corrective actions associated with an employee involved in a preventable or non-preventable VLE will be determined by the supervisor based on the severity and circumstances of the incident as determined by the Incident Reporting and Investigation H&S Standard (ARC HSMS010).

5.3.6 Additional Criteria for Temporary Agency Employees

Temporary agency employees are only permitted to drive Arcadis Vehicles or Rental Vehicles under the following requirements:

- The temporary agency employee's MVR is clear of any violation for the prior three (3) years and lists no prior critical violations. Critical violations include such issues as:
    - Alcohol-related offenses
    - Driving while impaired or under the influence of alcohol or drugs
    - Homicide, negligent homicide, or manslaughter by vehicle
    - Fleeing or attempting to elude police officer
    - Hit and run
- If a temporary agency employee receives a convicted violation or has an accident while driving, regardless of fault or preventability, on Arcadis business, they are

immediately prohibited from driving Arcadis vehicles, rental vehicles or a personal vehicle for Arcadis business unless otherwise permitted by the applicable Business Line President or the ANA Director of Health and Safety.

5.4 Sources for On-Line and Video Based Defensive Driving Training

The on-line defensive driving training or equivalent training will be provided by, or based on, a nationally recognized defensive driving training company such as Smith System or other recognized provider as approved by Health and Safety and arranged through the Arcadis Training Center. Video based defensive driving training modules will be arranged through the Arcadis Training Center.

5.5 Commentary Drive Program

The Commentary Drive evaluates driver understanding of safe driving behaviors by having the driver verbalize their observations to the Commentary Drive observer when operating the vehicle. The observer will use a standard Commentary Drive Evaluation Form to document driver understanding of safe driving principles such as the Smith System "5 Keys". The observer will also provide real time feedback on questionable driving behaviors. Commentary Drives are expected to last a minimum of 1 hour behind the wheel driving time.

MVSP Guide-001 provides criteria for observers used in Commentary Drives

Employees performing observer functions for Commentary Drives must be current on Health and Safety defensive driving on-line training obligations as described in Section 5.3 above and meet additional criteria approved by Health and Safety.

5.6 Driving TIPs

The driving TIP may be used to evaluate driver performance and provide solutions related to questionable driving behaviors for routine driving evaluations under the Arcadis Behavior Based Safety (BBS) Program. Solutions generated using the TIP process will be consistent with the expectations of the Arcadis BBS Program.

5.7 Sources of Hands-On Defensive Driving Training

When used, hands-on defensive driving training will be provided by, or based on, a nationally recognized defensive driving training course such as Smith System or other provider approved by Health and Safety. The trainer must be certified in the program upon which they are instructing and can be either internal or external to Arcadis. Arrangements for hands-on defensive driving courses are handled by the Arcadis Training Center.

5.8 Additional Training and Education for Other Driving Conditions

Working together, supervisors, managers, and Health and Safety have the responsibility of determining additional training for employees driving under special conditions such as CMVs, towing trailers, riding and operating all-terrain vehicles or other non-routine driving conditions. Training approved by Health and Safety will be arranged through the Arcadis Training Center.

5.9 Driving Distractions and Cell Phone Use While Operating a Motor Vehicle

Arcadis strictly prohibits employee use of personal or company-provided cellular phones (including but not limited to voice communication, texting, video, internet browsing and gaming) either in hands-on or hands free mode, speaker, or use of similar devices while the employee is operating any motor vehicle for Arcadis purposes.

5.10 Additional Defensive Driving Procedures

Arcadis promotes additional defensive driving techniques to assist in the elimination or minimization of MVAs and VLEs. These techniques include:

- When a second Arcadis employee is available, and where it is safe to do so, all vehicle backing operations should use a spotter to assist with the backing operation.
- As a best practice, use of the cone program to promote awareness of hazards around parked vehicles.
- To assist drivers in their potential lack of familiarity with the location in which they are driving, one of the following should be utilized by drivers traveling to unfamiliar locations:
  - The use of GPS systems in rental cars, and/or
  - Pre-Trip Route Planning through the use of Google® Maps or MapQuest®, and/or

MVSP Guide-007 provides best practices for spotting and cone placement

- o Preparation of a Journey Management Plan (JMP) using the template provided in the Excel Standard HASP Template

5.11 Vehicle Inspections and Maintenance

All company owned or leased vehicles will be maintained in safe operating condition. To ensure vehicles are properly maintained, a daily pre-trip visual inspection must be informed prior to operating the vehicle. The pre-trip inspection should include, but is not limited to:

- Seat belts;
- Doors and door locks;
- Lights;
- Mirrors;
- Horn;
- Back up alarms, if equipped;
- Parking brake;
- Instrument panel;
- Steering;
- Windows;
- Windshield wipers;
- Tires; and
- Emergency equipment.

A more comprehensive weekly documented inspection (daily if required by the client, manager or supervisor or if vehicle is operated in harsh environments) is also required. Rental vehicles operated by Arcadis for more than one week also must also use the documented weekly inspection process. Inspections are required to be documented on the Weekly Vehicle Inspection Checklist or equivalent.

Documented vehicle inspections are required weekly and use of approved fuel cards is also required

Deficiencies identified in inspections or at any other time will be managed through the Arcadis vehicle leasing company vendor or maintenance provider specified by Corporate Purchasing. Routine maintenance (gasoline, oil, etc.) will also be managed through these vendor(s) using

approved fuel cards. Use of assigned fuel cards is critical to help ensure maintenance schedules are maintained for the vehicle. Records of vehicle inspections should be maintained at the office or project location where the vehicle is assigned.

Employees operating company owned or leased vehicles (including qualifying rental vehicles) required to be maintained under the CMV program will follow inspection and maintenance requirements specified in the CMV program. **Use of Weekly Vehicle Inspection checklist for CMV operation is not permitted.**

5.12 Safety Equipment for Arcadis Vehicles

All Arcadis owned or leased vehicles are expected to have, at a minimum, a 2.5 lb. A,B,C fire extinguisher (permanently mounted), first aid kit and an orange strobe or oscillating light. The orange oscillating light/strobe may be permanently affixed or removable; however, owned or leased vehicles obtained after April 4, 2016 must have permanently installed amber warning lights installed in or on the vehicle. Rental vehicles and Arcadis owned, leased, or rented vehicles will be subject to equivalent requirements, if used for field work unless otherwise excepted from a specific safety equipment requirement by the project specific HASP or Job Safety Analysis. Rental vehicles are not required to have fire extinguishers permanently mounted.

Arcadis Trucks:
- ✓ Fire Extinguisher
- ✓ First Aid Kit
- ✓ Orange Strobe

All Arcadis owned or leased vehicles obtained on or after June 1, 2012 will be required to be equipped with back up alarms. Arcadis owned or leased vehicles obtained prior to June 1, 2012 will be required to have a functioning back up alarm if used for project work with client mandated back up alarm requirement.

All Arcadis owned or leased pickup trucks with an open bed obtained on or after April 4, 2016 will be required to be equipped with a rear window protector.

Refer to MVSP Guide-010 for additional recommendations for safety and emergency equipment that may be required for specific project needs.

All Arcadis vehicles managed under the Arcadis approved vendor maintenance program have Emergency Roadside Assistance. Documentation, including the phone number, for the vendor providing assistance must be maintained in the glove box of the vehicle.

5.13 Securing Loads in Vehicles

All luggage, equipment and supplies loaded into a vehicle operated by Arcadis will be stowed in a manner that will prevent appreciable movement. Luggage, equipment and supplies placed in the passenger compartment of vehicles will be placed in a manner that will prevent rapid forward movement in the event of a hard stop or frontal collision. Objects will not be placed on the dashboard of vehicles unless they are secured in place by friction mats, suction cups, or similar securing device.

Securing straps, tiesdowns (all types) and securing nets used to secure loads on trucks must be inspected prior to each use. Damaged, worn or frayed securing straps or tiedowns must not be used.

Chemicals transported in Arcadis vehicles must conform to the requirements of the Arcadis Transportation Safety Program for HazMat Shipping and Transportation including, but not limited to, securement provisions of DOT Facts-108a, “Materials of Trade”.

Arcadis CMVs are subject to additional load securement requirements specified by the Arcadis Transportation Safety Program for CMVs.

5.14 Vehicle Modification

Arcadis employees are prohibited from modifying Arcadis owned or leased vehicles unless the modification is approved in writing by Corporate Health and Safety and/or Corporate Procurement.

5.15 Special Considerations for Rental Vehicles

Rental vehicles will be treated and driven in a manner equivalent to an Arcadis owned or leased vehicle. Additionally, Arcadis employees renting vehicles will plan and select a vehicle appropriate for the conditions anticipated when driving. Careful planning is required to preferentially use Arcadis owned or leased vehicles for off road use instead of using rental vehicles when reasonable, practical and permitted under contract (client or rental company) terms. Due to operating unfamiliarity typically encountered when renting vehicles, use of TRACK to identify and mitigate atypical or unfamiliar vehicle functionality or performance is required.

MVSP Guide-006 provides safety best practices information for rental vehicles. Arcadis drivers must be 21 years of age to rent vehicles.

6. VEHICLE USE AND INSURANCE

6.1 Non-Business Use of Company Vehicles

Non-business use during business hours and/or having non-business related passengers in an Arcadis Vehicle or Rental Vehicle during such business use is prohibited. In the event of an accident in these situations, the employee is personally liable for injuries and damages associated with such an accident and the employee, and not Arcadis, will be responsible for all rental charges. Operating an Arcadis Vehicle or Rental Vehicle for strictly personal use on weekends, evenings and holidays is prohibited, unless prior approval by the employee's supervisor is given, and the vehicle possession is necessary due to remote location and assignments, and the employee has all required personal automobile liability insurance. Supervisors should assess the requirement and may place any other appropriate limitations on such use.

Use of an Arcadis Vehicle or Rental Vehicle to commute to and from work should be limited to those situations where there is a sound business reason to do so and must be authorized by the operations manager.

6.2 Insurance

Arcadis has vehicle insurance coverage for Arcadis Vehicles and Rental Vehicles. If an accident occurs or damage is sustained, there is a $2,000 deductible for damage to the Arcadis Vehicle or Rental Vehicle ("collision") and a $10,000 deductible for damage to another vehicle, property damage or injury to another party ("liability"). These deductibles are paid by the relevant Arcadis office.

If an accident should occur during non-business hours while an employee is driving an Arcadis Vehicle or Rental Vehicle, in accordance with state law, the Arcadis employee could be personally liable for injuries and damages associated with such an accident.

6.2.1 Vehicle Rental in the United States

As stated above, Arcadis has insurance for all Arcadis Vehicles. When renting for business in the United States, the rental should be arranged through World Travel, and there is no need to accept the insurance coverage offered by Arcadis preferred rental car vendors (currently Enterprise and National).

6.2.2 Vehicle Rental Outside of the United States

If an Arcadis employee is renting a vehicle for business **outside of the United States, the employee must accept the insurance offered by the local rental car company in order to be fully covered under the company's Foreign Package policy.** In addition, check with Corporate H&S about any additional coverage that may be needed for the country in which you are renting.

6.2.3 Personal Vehicles

Employees who drive their own vehicle for company business, as a condition for performance of his or her duties, shall comply with all minimum state requirements for auto insurance as required by their state. This requirement includes auto liability insurance with the minimum amounts of coverage meeting or exceeding that state's requirements. If requested, employees shall provide a current insurance card which indicates the amount of coverage as adequate proof of insurance coverage.

If a personal vehicle is damaged or involved in an accident while being driven for company business, the insurance covering that personal vehicle is primary. Arcadis does not reimburse employees for personal auto insurance deductibles.

7. TRAINING

See section 5.3 of this standard for training requirements.

8. REFERENCES

Arcadis Transportation Safety Program for Commercial Motor Vehicles

MVSP Guide-001, Staff Approved for Conducting Commentary Drives

MVSP Guide-002, Guidelines for Conducting Commentary Drives

MVSP Guide-003, Automated Enforcement Conviction Evaluation Criteria

MVSP Guide-004, Criteria for Defining a Motor Vehicle Accident

MVSP Guide-005, Guide for MVR Corrective Actions

MVSP Guide-006, Rental Vehicle Safety Requirements and Best Practices

MVSP Guide-007, Spotter and Cone Program Best Practices

MVSP Guide-008, MVSP Restricted Driving Appeal Process

MVSP Guide-009, Reserved

MVSP Guide-010, Safety Requirements for Arcadis Vehicles

MVSP Guide-011, Reporting Requirements for all Vehicle Damage

Incident Reporting and Investigation H&S Standard (ARC HSMS010)

9. RECORDS

Records will be maintained as follows:

- MVRs pulled as required under this MVSP and associated notifications, approvals, releases, and findings information will be maintained by Human Resources.
- TIP results, incident reports and near miss reports related to MVSP activities will be maintained in the 4-Sight database.
- Commentary Drive documentation will be provided to the employee unless otherwise specified by the MVSP Specialist.
- Any training certificates or documentation arranged through the Arcadis Training Center (hands-on defensive driving, defensive driving on-line, defensive driving videos, etc.) will be maintained by the Arcadis Training Center.

10. APPROVALS AND HISTORY OF CHANGE

Approved By: Julie Santaniello, CSP, Corporate H&S, Manager of Technical Programs

History of Change

Revision Date	Revision Number	Standard Developed/Reviewed By or Revised By	Reason for change
26 March 2007	01		Original document
18 August 2007	02		Change in required on-line defensive drivers training
22 October 2007	03		Changing over to new template format and addition of the “Comments on My Driving?” program
21 January 2008	04		Change to new template; change to 2008 organization job titles; change to prohibit texting/emailing while driving
13 June 2008	05		Addition of Sections 5.10 and 5.11 on other defensive driving techniques and cone placement.
6 October 2008	06		Clarified who is required to complete online training in Section 5.3 and modified section on when hands-on defensive driving is required after an accident.
8 April 2009	07		Incorporated references to the CMV program and vehicle inspection requirements. Incorporated Vehicle Use Policy. Added fatigue management requirements. Deleted references to the Commentary Drive which is obsolete.
3 November 2009	08		Incorporated Smith System videos as a corrective action, Commentary Drive Program and revised Exhibit 2 and added new Exhibit 4.
1 November 2010	09		Deleted Comments on my driving section as program was discontinued.

Revision Date	Revision Number	Standard Developed/Reviewed By or Revised By	Reason for change
25 May 2011	10		Revised content and restructured selected exhibits and standard sections. Most content duplicated in the Vehicle Use policy removed. Vehicle Use policy incorporated by reference
August 16, 2011	11		Replaced section 5.7, added new definitions and guide references, clarified fatigue management recommendations, modified terminology for BBS program, provided MVR report clarifications.
May 2, 2012	12		Comprehensive restructuring, Revisions to training and MVR processes, expanded rental vehicle safety, inclusion of additional MVSP guidance documents, roles and responsibilities clarification. Inclusion of vehicle safety equipment information. Formalization of the ARC process.
14 March 2013	13		Clarified MVR review and training for new hires. Clarified standard conflict with other corporate department policies. Restructuring of section 5.2. Removal of assigned driving function. Revision to headlight use. Section 4.2 MVSP Specialist e-mail link address updated
8 December 2013	14		Added definition for assigned driving function, Restructured MVR review requirements, Newly licensed driver requirements, and add references to new MVSP Guides. Title changes and minor editing throughout.

Revision Date	Revision Number	Standard Developed/Reviewed By or Revised By	Reason for change
29 January 2014	15	Sam Moyers	Addition of new section 5.13 addressing load securement to harmonize with other H&S standards and guidance. Addition of pre trip visual inspection information to harmonize with other H&S standards and guidance. Clarification of expectations in the cone and spotter program. Revised header and footer to current standard and modified revision history table.
4 February 2014	16	Sam Moyers	Section 5.1 was modified to clarify Arcadis parking expectations
22 September 2015	17	Sam Moyers	Revised appeal process and relinked revised MVSP Guide-005. Rebranding. Revised signature block
6 May 2016	18	Sam Moyers	Revised with new section 6 dealing with insurance issues. New section 5.3.6 dealing with temporary agency employees. Both were included from integrated HR Vehicle Use Policy. Revised sections 5.3.5, 5.9 and 5.12 to clarify current policy. Added a definition for field work in Exhibit 1. Added additional references concerning cell phone prohibition.

EXHIBIT 1 - DEFINITIONS

Arcadis vehicle or Arcadis motor vehicle: Any motor vehicle owned or leased by Arcadis employee.

Arcadis driver or driver: Any Arcadis US employee or temporary agency employee who drives an Arcadis vehicle, leased vehicle, rental vehicle, or personal vehicle for business reasons whether the use of the vehicle includes operation from the local office or for travel while away from the local office.

Arcadis employee: Any full-time, part-time, temporary, as needed employee, and interns employed by Arcadis US.

Assigned Driving Function for Arcadis: Any Arcadis driver who drives on average 5 or more days per month in the interest of Arcadis.

Business use of Arcadis owned, leased, rented, or personal motor vehicle: For the purposes of this standard, business use of an Arcadis, rental, leased or personal vehicle including but not limited to: attending meetings; driving to and from a client location; driving to dinner while out of town on business; and driving to an office supply store to pick up office supplies. Use of the vehicle for business would not include personal use as described below.

Corporate: As used in this standard and materials incorporated by reference, the term “Corporate” means Corporate Health and Safety, Corporate Human Resources, and/or Corporate Legal departments unless otherwise specified.

Field Work: As used in this standard means any Arcadis work activity outside of an office environment.

Manager: The employee’s administrative supervisor or an Operations Manager

Motor vehicle accident (MVA): Any incident on a reasonably anticipated route during the course of work where an Arcadis owned, leased, or rented motor vehicle is:

MVSP Guide-004 provides detailed MVA information and FAQs

- On a public or established private roadway or parking area involving a third party motor vehicle, excluding load securement failures by a third party motor vehicle.
- On a public roadway involving damage to public or private property, excluding road debris damage.
- Involved in any type of pedestrian impact resulting in injury or property damage.
- Involved in an Arcadis load securement failure or mechanical component failure on a public or established private roadway involving a third party motor vehicle or public property damage.
- On a public roadway involving damage or injury associated with another Arcadis operated vehicle, including load securement failures.

Personal use of Arcadis vehicle, leased vehicle or rented motor vehicle: For the purposes of this standard, personal use of an Arcadis vehicle, leased vehicle or rental vehicle include but are not limited to supervisor approved: driving to dinner with a non-business-related person(s) in the vehicle; driving for the purposes of personal entertainment or personal business; using an Arcadis vehicle or rental vehicle for staying over period of time not required for business (e.g., staying over a weekend to visit friends, etc.).

Potential New Hire or Candidate: For the purpose of this standard means an individual who has had an written offer made and accepted for employment with Arcadis.

Preventable MVA: A MVA where the Arcadis driver was as fault or was determined through the Arcadis LNL Investigation process failed to exercise reasonable care while driving an Arcadis vehicle. The classification of Preventable MVA is assigned by Corporate Health and Safety.

Rental vehicle: For the purposes of this policy, any motor vehicle rented from an established rental car company for Arcadis business whether the use of the vehicle is operated from the local office or for travel while away from the local office.

Supervisor: The employee's administrative supervisor (project supervisor if approved by the administrative supervisor).

Hiring managers should review contracts for driving related issues involving temp agency employees

Temporary agency employee: A temporary agency employee utilized by Arcadis for temporary work. Temporary Employee Agency agreements shall provide for standard automobile insurance and other terms consistent with this policy.

Vehicle loss event (VLE): Any incident involving a motor vehicle that does not meet the definition of a MVA. VLEs may be preventable or non-preventable based on findings of the Arcadis LNL Investigation process and is assigned by Corporate Health and Safety.

Implementation Date	Arcadis HS Standard Name	ARCADIS
13 December 2006	Utility Location and Clearance	
Revision Date	Arcadis HS Standard No.	Revision Number
10 May 2016	ARCHSFS019	15

EXECUTIVE SUMMARY

Damaging an underground or aboveground utility can result in serious injury and loss of life, disrupt essential services, and create significant liability to Arcadis, clients, and subcontractors. Therefore, it is Arcadis policy that the following steps be completed prior to beginning any subsurface intrusive work (i.e., any work or activity that breaks the plane of the ground surface):

- The presence of existing or known utilities will be investigated and cleared (to the extent feasible) by locating and marking before the start of any subsurface intrusive work and where appropriate, visually verifying through soft dig methods (referred to as potholing or daylighting) before the start of any subsurface intrusive activity.

- A minimum of **three (3) reliable lines** of evidence are required for an acceptable utility clearance. Each location of subsurface intrusive work must have at least 3 reliable lines of evidence. All lines of evidence used during the utility clearance procedure will be recorded on the Utility and Structures Checklist or equivalent client-provided checklist or permit. If a line of evidence is lost or not apparent, STOP WORK, and re-establish the line of evidence prior to resuming subsurface intrusive work.

- The lines of evidence used will be reasonable and appropriate for the conditions expected to be encountered (soil type, water table, etc.) and the type of utilities expected to be encountered (e.g., gas line versus an irrigation line).

- Contact the State One Call or equivalent service (Nationwide "811") as required by law. The State One Call or equivalent service (Nationwide "811") can only be used as a reliable line of evidence when working within the public right-of-way or easement.

- For point clearance (single intrusive point, used as 1 of the 3 required reliable lines of evidence), the borehole must be cleared to 110% of the diameter of the intrusive device (e.g., auger, drill head, etc.) or an additional 2 inches of overall diameter, whichever is greater.

- Utility clearance information will be documented on the Arcadis Utility and Structures Checklist (USC) or equivalent client-provided checklist or permit. The Utility Structures and Checklist is valid for 15 business days from the date of completion. A copy of the completed Utility and Structures Checklist will remain on-site during all subsurface intrusive work.

- Employees overseeing utility clearance activities will:

    - Be familiar with the contents of this standard and ARC HSFS-019 Supplement 2;
    - Have one year of field experience in the visual identification of utilities; and
    - If operating equipment, have training and six months of experience in the proper operation and results interpretation of any clearance equipment, including without limitation, magnetometers and ground penetrating radar.

- A utility strike is an unplanned contact of a utility during the course of work that results in damage requiring repairs, making a report to the utility owner, or requiring further assessment to evaluate the potential for damage. All utility strikes must be reported within 24 hours using the Utility Line Strike Investigation Form. **Do not enter the incident into 4-Sight until approved to do so by Corporate Legal. Refer to** ARC HSFS-019 Supplement 5**, Utility Strike Emergency Action Plan Guidelines.**

Report Utility Incident Now

1. POLICY

It is the practice of Arcadis and its affiliated companies to implement appropriate, reasonable, and practical standards within acceptable and customary industry practices to promote the health and safety of its employees and avoid and mitigate exposure of risk in the performance of their work. In furtherance of this policy, Arcadis promotes and encourages compliance by all employees with this policy and standards relating to work in the vicinity of subsurface, submerged, or aboveground utilities.

2. PURPOSE AND SCOPE

2.1 Purpose

This standard directs general safety standards and best practices associated with the identification and management of subsurface, submerged, and aboveground utilities on project sites. Utility location standard operating procedures (SOP) for submerged utilities can found in ARC HSFS-019 Supplement 6.

2.2 Scope

This standard assigns responsibilities and expectations for proper utility clearance by both Arcadis employees and Arcadis subcontractors at project sites.

3. DEFINITIONS

Definitions relating to Utility Clearance can be found in Exhibit 1.

4. RESPONSIBILITIES

4.1 Project Manager Responsibilities

For every project site having the potential to come into contact with utilities, Project Managers must ensure that:

- The requirements of this standard are followed.
- Local regulations governing utility clearance are followed. This includes ensuring local and/or state laws defining activities or depth of intrusive work/excavation requiring utility clearance are reviewed as they vary by location. For further information, refer to One Call and State Law Directory.
- Efforts are made to work with the client, project site representatives, public utility companies, and subcontractors to identify the nature of any utilities and to determine control processes that need to be implemented by Arcadis and the subcontractors to prevent damage to these utilities and to properly manage the effects in the event there is utility damage.
- Utility clearance activities are only delegated to a Task Manager or other individual meeting the requirements of Section 4.2 below, as appropriate. However, even if the Project Manager delegates certain responsibilities, the Project Manager maintains primary responsibility for a complete utility clearance.

For additional information on Project Manager responsibilities and best practices, refer to ARC HSFS-019 Supplement 1.

- Project Managers or designee must review the Utility and Structures Checklist with staff and Arcadis subcontractors conducting subsurface intrusive work (including "Sub-of-Subs" when conducting subsurface intrusive work) prior to staff beginning subsurface intrusive work. The Project Manager or designee review must be documented on the Utility and Structures Checklist prior to starting subsurface intrusive work.

4.2 Field Personnel Responsibilities

Arcadis field personnel conducting work on a project site having the potential to come into contact with utilities have the responsibility to:

- Read, understand, and follow this standard and ARC HSFS-019 Supplement 2 and complete the appropriate checklists during the on-site utility and structures locate and clearance process.

- Complete a minimum of one year of utility clearance-related experience before accepting responsibility for any utility clearance tasks. This requires on-site training led by another Arcadis employee with detailed knowledge and experience in identifying utilities and structures.

- Complete training and have 6 months of experience in operating and interpreting the results of remote sensing technologies, including without limitation, magnetometers and ground penetrating radar, before operating such technologies. Field staff should understand the technologies being utilized by a private utility locate contractor and how they are operating in comparison with the site conditions. Refer to ARC HSFS-019 Supplement 3 for more information.

- Prior to beginning subsurface intrusive work, the Utility and Structures Checklist must be completed and signed by the staff member completing or overseeing the clearance. Confirm that the Utility and Structures Checklist was reviewed by the Project Manager or designee as discussed in Section 4.1 above. Review the Utility and Structures Checklist daily prior to starting subsurface intrusive activities to ensure all utilities are identified and markings are present. A copy of the completed Utility and Structures Checklist will remain on-site during all subsurface intrusive work (i.e., any work or activity that breaks the plan of the ground surface).

- Use their STOP WORK Authority to eliminate any reasonable concern if utilities cannot be reasonably located and contact the Project Manager to review the STOP WORK situation and confirm the direction of action before moving forward.

- Ensure that Arcadis subcontractors conduct their own reasonable independent utility clearance efforts as required by Arcadis' standard subcontract and are aware of any Arcadis clearance standards used on-site.

- Be on-site and provide oversight during utility locate activities and any active subsurface intrusive work or activities involving contractor under contract to Arcadis.

- If a utility is damaged and repaired during the course of the field event, field staff must provide oversight and document that the repair appears competent and complete to prevent further damage to the site when the damaged utility is re-activated.

4.3 Arcadis Subcontractor Responsibilities

According to Arcadis' standard subcontract, subcontractors have agreed to take responsibility for any damages resulting from a utility impact caused by their work. Therefore, Arcadis subcontractors are expected to take reasonable time and diligence to conduct their own independent utility clearance using reasonable standards and processes. Subcontractors have the responsibility to stop their work if utility concerns are identified and will report those concerns to the Arcadis employee overseeing their work activities. Arcadis staff should reinforce these responsibilities with subcontractors during job safety briefings.

In jurisdictions where the actual contractor performing the subsurface intrusive work is required to perform utility clearance notifications, the contractor will perform the clearance notification and will provide evidence of the notification to Arcadis (ticket or ticket number, etc.). Refer to ARC HSFS-019 Supplement 4 for Best Practices for State One Call procedures.

- If overhead utilities are present in areas where heavy equipment will be operated, ensure adequate clearance is provided. For heavy equipment that is extendable or telescoping (e.g., excavators, dump trucks, extendable lift trucks), evaluate whether the use of a spotter is necessary prior to operating heavy equipment when in proximity to the overhead utility.

- If a utility is damaged and repaired during the course of the field event, the field subcontractor must verify that the repair is competent and complete to prevent further damage to the site when the damaged utility is re-activated.

5. PROCEDURE

5.1 General

Protocols to be followed during utility and structures location and clearance activities are outlined in:

- Best Practices for Project Managers (or Their Delegates) Concerning Utility Clearance (ARC HSFS-019 Supplement 1).

- Best Practices for Field Personnel Concerning Utility Clearance (ARC HSFS-019 Supplement 2).

- Use and Limitations of Common Underground Locating Technologies and Clearance Methods (ARC HSFS-019 Supplement 3).

- Best Practices for State One Call Procedures (ARC HSFS-019 Supplement 4).
- Emergency Action Plan guidelines for Utility Strikes (HSFS-019 Supplement 5).
- Utility Location Standard Operating Procedure for Aquatic Work Activities (ARC HSFS-019 Supplement 6).

5.2 Lines of Evidence

When locating underground utilities, three (3) reliable "lines of evidence" must be established to help determine where a subsurface utility may be located. A line of evidence may be a site drawing that shows where a utility is located, it could be anecdotal information obtained from owners or employees, it could be established using any number of non-intrusive geophysical methods [e.g., ground penetrating radar (GPR), electromagnetic survey (EM), radio-frequency methods (RF), etc.], or it could involve probing for or exposing the utility by soft dig technologies (i.e., daylighting or potholing). Some lines of evidence will identify utility locations with a high degree of certainty (e.g., direct connect radio-frequency technique, daylighting or potholing, sonde tracing, etc.). Other lines of evidence will identify utilities will less certainty (e.g., anecdotal reports, design drawings, etc.).

Effective utility locate practices must use multiple lines of evidence until there is a high degree of certainty that the underground services have been adequately located. Three (3) reliable lines of evidence are required for an appropriate utility clearance as defined in this standard. All reliable lines of evidence used during the utility clearance procedure will be recorded on the Utility and Structures Checklist or equivalent client-provided checklist or permit. If three (3) reliable lines of evidence have not established certainty in the location of a utility, STOP WORK and do not proceed. Additional reliable lines of evidence must be utilized until the presence or absence of the underground utility can be established. During work activities, if a line of evidence is lost or not apparent (e.g., paint markings have faded), STOP WORK, and re-establish the line of evidence prior to resuming subsurface intrusive work.

Generally, the following lines of evidence may be used to meet this minimum utility clearance requirement:

1. Contacting the State One Call or equivalent service (Nationwide "811") is REQUIRED BY LAW regardless if it will be used as a line of evidence. Contacting the State One Call or equivalent service (Nationwide "811") is an acceptable reliable line of evidence when working within the public right of way or easement. Note that the State One Call can provide valuable information regarding locations and types of utilities entering the private property.

   Note: For work on private property or in areas not served by State One Call or equivalent service, consider using a reputable private utility locating company to locate and mark the utilities. **Use of a reputable private utility locator is encouraged for all projects with subsurface or submerged utilities.** When working with a private locater, it is best practice to pre-plan clearance areas, review required clearance equipment and the re-clearing/confirmation of any public utility mark outs (State One Call or equivalent service Nationwide "811").

2. Use detailed, scaled site utility plans, preferably in the form of an "as-built" or "record" drawing, to identify and/or confirm utility locations. Document request and/or receipt of utility drawings from the property owner/client on the Utilities and Structures Checklist.

3. Interview(s) with knowledgeable site or client personnel. The following questions should be asked during the interview and answers documented on the Utility and Structures Checklist:

   o Employees(s) Name and Affiliation(s) with the site;

   o Types of utilities, including utility composition and location of utilities on-site;

   o Depths of known utilities; and

   o Any other pertinent information regarding utilities on the site.

View the Utilities and Structures Checklist

4. Conduct a detailed visual site inspection of areas around all planned subsurface intrusive work points or areas to identify and/or confirm utility locations. For underground utilities, conduct an inspection for structures that tend to indicate the presence and general location of such utilities, including, but not limited to manholes, vaults, valve covers, valve markers, telephone pedestals, transformer housings, fire hydrants, spigots, sprinkler heads, air relief valves, backflow preventers, meters, downspouts going into the subsurface, power poles with wiring going into the subsurface and line markers. Saw cut lines and concrete/asphalt repairs often yield valuable information regarding utility locations.

   Always discuss the presence of utilities with the site owner, operator, and/or occupant to identify any potential utilities that might not be readily identified by non-intrusive clearing methods or may be:

   o At depths > 5 feet below ground surface; or

   o At very shallow depths (< 2 feet below ground surface), such as communication lines, electrical conduits/wiring, irrigation lines, etc.

If one of the above lines of evidence cannot be utilized or if using the above lines of evidence does not adequately identify utilities with reasonable certainty, one or more additional lines of evidence must be utilized. Commonly used lines of evidence are listed on the Utility and Structures Checklist.

A discussion of use and limitations associated with common utility location and clearance methods is provided in ARC HSFS-019 Supplement 3.

Standard operating procedures for utility location in submerged settings are presented in ARC HSFS-019 Supplement 6.

The lines of evidence will be recorded on the Utility and Structures Checklist or equivalent client-provided checklist or permit.

Note: If a line of evidence is lost, utility markings are removed/worn, or area of previous clearance is not confirmed, STOP WORK and re-establish the

line(s) of evidence prior to resuming subsurface intrusive work. Each location of subsurface intrusive work must have 3 reliable lines of evidence. All lines of evidence used during the utility clearance procedure will be recorded on the Utility and Structures Checklist of equivalent client-provided checklist or permit. If a line of evidence is lost or not apparent, STOP WORK, and re-establish the line of evidence prior to resuming subsurface intrusive work. The Utility Structures and Checklist is valid for 15 business days from the date of completion.

If and when any line of evidence reveals that planned subsurface work will be located inside the 30-inch Tolerance Zone of known/marked/located/observed utilities, the project team must Stop Work and contact Corporate H&S as early as possible for pre-approval.

5.3 Color Codes used for Utility Markings

The following colors are used for marking utilities. Some government agencies or large industrial facilities may use additional colors not provided below. Arcadis policy is to assume any paint marking or pin flag color not provided below is a subsurface utility marking until proven otherwise.

If utilities or subsurface anomalies are identified but the utility type or anomalies are not classified, it is recommend that a pink (Temporary Survey Marking) marking be used. Once the type of utility is established, the pink marks should be repainted/remarked to represent the correct type of utility.

COLOR	Utility Line
WHITE	Proposed Excavation
PINK	Temporary Survey Markings
RED	Electrical Power Lines, Cables, Conduit and Lighting Cables
YELLOW	Gas, Oil, Steam, Petroleum or Gaseous Materials
ORANGE	Communication, Alarm or Signal Lines, Cables or Conduit
BLUE	Potable Water
PURPLE	Reclaimed Water, Irrigation and Slurry Lines
GREEN	Sewer and Drain Lines

APWA and ANSI standard Z-53.1

5.4 Locating Technologies

There are several types of locating technologies that can be used to identify and locate utilities in the subsurface. Project teams need to work closely with private utility locators (PUL) in order to best match locating technology with site conditions. To provide the best results, all possible locating technologies should be available for use and implementation at the project location. Any potential interferences should also be discussed up front and then at the project site during utility location activities. Potential interferences could be soil moisture, soil type, standing water on concrete/asphalt, rebar, fencing, and metal

structures that are in the subsurface. Employees overseeing locating technology activities should have an understanding of device operation and limitations. For further information, refer to ARC HSFS-019 Supplement 3, Use and Limitations of Common Utility Location Technologies and Clearance Methods.

5.5 Clearance Methods

In some cases, proposed subsurface intrusive locations may be pre-cleared using other intrusive methods. Determine the clearance or soft dig method based on-site conditions and utilize the least invasive method possible. The number of subsurface intrusive locations and soil type should be taken into consideration. The following clearance methods are listed from least invasive to most:

1. Vacuum Extraction/Potholing (air or water-based),
2. Air knifing,
3. Hydroknifing,
4. Probing,
5. Hand augering,
6. Hand digging, and
7. Posthole digging.

Single-Point clearance must be 110% of the proposed subsurface intrusive area or the diameter plus 2 inches, whichever is greater. Three-Point clearance must be installed in a triangular pattern around the proposed borehole and in a configuration not to allow for utilities to enter the borehole. Three-Point clearance must be 110% of the proposed intrusive area or the diameter of the intrusive area plus 2 inches, whichever is greater. Each method of clearance should be documented on the Utility and Structure Checklist.

Manual clearing methods, such as shoveling, using pick axes, digging bars and other hand tools, should be avoided completely or only used when absolutely necessary and used with caution. Excessive downward force, prying or use in poor/obstructed visibility conditions is prohibited as these tools can damage utilities.

Surface cover (e.g., asphalt) removal methods within the 30-inch Tolerance Zone that pose excessive downward force, such as jackhammering, should be used with extreme caution. Methods that only cut the surface cover (coring or saw cutting) present less risk due to the absence of the downward force, which could cause collateral damage to shallow subsurface utilities. Note that utilities are often present at the concrete or pavement/soil interface or encased within the concrete or pavement and are easily damaged during concrete coring or pavement removal. Always work slowly, methodically and frequently STOP WORK to evaluate conditions during these work activities.

For borings and excavations, if the utility is known to be at depths where hand clearing is not feasible or creates additional safety concerns, no work will be performed within the 30-inch Tolerance Zone vertically or horizontally of the utility unless manual clearing is performed under the oversight of an Excavation Competent Person as defined in ARC HSCS005 Arcadis Excavation and Trenching.

5.5.1 Temporary Backfilling of Pre-Cleared Boreholes

In some cases, it may be necessary to temporarily backfill a pre-cleared location until the remaining subsurface activities are performed. At these locations where subsurface intrusive work does not immediately follow pre-clearance, it is important to properly backfill and mark the pre-cleared location in order to relocate the pre-cleared location. In general, wooden stakes, survey markers, whiskers, paint marking or other surficial markings alone are inadequate because these markings can be easily removed, damaged or otherwise lost leading to uncertainty regarding the pre-cleared location. Although the specific steps for backfilling a pre-cleared location will depend on site-specific conditions, use the following additional steps to prevent loss of the pre-cleared location:

- Backfill a pre-cleared location with clean sand or other granular material that is significantly different than the surrounding subsurface native material. Native soil should not be used to backfill a pre-cleared location that may require further subsurface work.
- Backfill the top 2 feet of a pre-cleared location with dyed sand or gravel to facilitate re-location.
- Use hammered wooden stakes or delineators to mark locations as an additional measure, if practical.
- In the event that the pre-cleared borehole is located on asphalt or concrete and an asphalt cold patch is required, use white paint to mark the intrusive location with a circle over the asphalt cold patch.
- In some instances, such as projects potentially affected by unexploded ordinance (UXO), the pre-cleared borehole may require that a PVC of matching diameter pipe be inserted into the pre-cleared borehole, filled with clean sand and affixed with a matching cap. Contact the project manager to identify any client-specific requirements.
- Always use a physical subsurface marker such as described above to identify the pre-cleared borehole location. Never rely solely on field measurements or GPS coordinates.
- If a utility or anomaly/obstruction is encountered during the pre-clearing process, backfill the hole with the native soil and mark the location with a pink-painted X and/or NO.

In the event that a previously pre-cleared location cannot be located, the location must be re-cleared prior to performing subsurface intrusive work.

5.6 Clearance for Working in Vicinity of Subsurface Utilities

Prior to the start of subsurface intrusive activities (i.e., excavations, vertical drilling, installing grounding rod, and soil sampling), all utilities must be located and measures must be instituted to avoid subsurface utility hazards. See exemptions for subsurface intrusive work in Exhibit 1 (Definitions). Do not conduct subsurface work within 30 inches of a line marking in all directions. If the centerline of the utility is marked, the diameter of

the utility or utility bank (Exhibit 1) must be incorporated into the 30-inch Tolerance Zone, see Figure 1 located in Exhibit 2 for further instructions.

If and when any line of evidence reveals that planned subsurface work will be located inside the 30-inch Tolerance Zone of known/marked/located/observed utilities, the project team must Stop Work and contact Corporate H&S as early as possible for pre-approval.

If subsurface work must take place within the 30-inch Tolerance Zone of the line marking, the utility must be exposed (potholed) by soft dig/clearance methods prior to starting subsurface intrusive activities (see Section 5.5 for options); **no mechanized equipment is permitted for the exposing of the utility**.

Once the utility has been exposed, if mechanized equipment is planned for use within the 30-inch Tolerance Zone of the utility, such activity must receive pre-approval by Corporate H&S, as necessary, to mitigate or accept the risk associated with the planned work. Additional excavation safety procedures may have to be developed as part of the approval to proceed. It should be noted that any disturbance within the 30 inches or disruption of the bedding materials could affect the integrity of the utility.

For horizontal borings, to avoid striking a utility, damage from vibration, damage by pressure of the advancing boring, do not drill within 30 inches in all directions (3-Dimensional cylinder) of a line marking. Make sure to factor the diameter of the line or utility bank when computing 30-inch Tolerance Zone. When crossing a utility during horizontal drilling, it is recommend that the utility be exposed 30 inches in a 360°-direction. When exposing utilities for horizontal borings, the utility must be exposed (potholed) by soft dig/clearance methods. This recommendation applies even if the operating contractor has technology that places the location to within a few inches. Make sure to factor the diameter of the utility when determining the 30-inch Tolerance Zone. If subsurface work must take place within the 30-inch Tolerance Zone of the line marking, the utility must be exposed (potholed) by soft dig/clearance methods prior to starting subsurface intrusive work (see Section 5.5 for options); **no mechanized equipment is permitted for the exposing of the utility**. Once the utility has been exposed, if mechanized equipment is planned for use within the 30-inch Tolerance Zone of the utility, such activity must receive pre-approval by Corporate H&S, as necessary, to mitigate or accept the risk associated with the planned work. Additional excavation safety procedures may have to be developed as part of the approval to proceed. It should be noted that any disturbance within the 30 inches or disruption of the bedding materials could affect the integrity of the utility.

Additional cautions for horizontal borings include gravity utilities, such as sewers and storm drains, as the depth of these utilities will change (sometimes significantly) as they run across the project site. Always obtain the utility depth at the location where the boring will actually cross the line by collecting sewer depth inverts from identified manholes and interpolating those depths to the area of the subsurface intrusive work.

During well installations and well abandonment via mechanical equipment, the 30-inch Tolerance Zone rule applies outward from the outside edge of the largest diameter auger or tool to be used for installation and abandonment (over drilling). In cases where wells have been previously installed and the 30-inch rule has not been followed, work proposed using mechanized equipment to work within the 30-inch Tolerance Zone will

require approval from Corporate H&S. For more information, see Exhibit 2 for further instructions.

5.6.1 Aboveground Activities causing Subsurface Disturbance in the Vicinity of Underground Utilities

Aboveground activities can cause damage to shallow underground utilities or structures. Plan the intended path/mobilization/operation of Heavy Equipment is cleared to ensure that shallow utilities are not damaged. If Heavy Equipment must cross over shallow utilities, the utilities will be protected. Other subsurface disturbances may lead to damage such as clearing trees/shrubs/vegetation as roots may be entangled with underground piping or structures. For more information, see Best Practices for Field Personnel Concerning Utility Clearance (ARC HSFS-019 Supplement 2).

5.7 Acceptable Clearance for Working in Vicinity of Overhead Power Lines and Other Overhead Lines and Structures

No work will be performed by Arcadis or our subcontractor near overhead power lines where any Unqualified Person or equipment is within the limits specified below unless the power line has been properly covered or de-energized by the owner or operator of the power line. Qualified Person approach distances are defined in Exhibit 5A and 5B of ARC HSFS0006 Electrical Safety Standard.

Power Line Voltage Phase to phase (kV)	Minimum Safe Clearance (feet)
50 or below	10
Above 50 to 200	15
Above 200 to 350	20
Above 350 to 500	25
Above 500 to 750	35
Above 750 to 1,000	45

ANSI standard B30.5-1994, 5-3.4.5

5.7.1 Reducing Vehicle and Mechanical Equipment Clearance Requirements

Any vehicle or mechanical equipment capable of having parts of its structure elevated near energized overhead lines shall be operated so that a clearance of 10 feet (305 centimeters (cm)) is maintained. If the voltage is higher than 50 kilovolts (kV), the clearance shall be increased 4 inches (10 cm) for every 10 kV over that voltage. However, under any of the following conditions, the clearance may be reduced:

- If the vehicle is in transit with its structure lowered, the clearance may be reduced to 4 feet (122 cm). If the voltage is higher than 50 kV, the clearance shall be increased 4 inches (10 cm) for every 10 kV over that voltage.

- If insulating barriers are installed to prevent contact with the lines and if the barriers are rated for the voltage of the line being guarded and are not a part of or an attachment to the vehicle or its raised structure, the clearance may be reduced to a distance within the designed working dimensions of the insulating barrier.

- If the equipment is an aerial lift that is insulated for the voltage involved and if the work is performed by a qualified person, the clearance (between the uninsulated portion of the aerial lift and the power line) may be reduced to the distance given in OSHA 1910.333(c)(3)(ii)(C) Table S-5. Reference information from OSHA 1910.333 Table S-5 and NFPA 70E Table 130.4(C)(a) for alternating-current systems and 130.4(C)(b) for the distances associated with direct-current voltage systems is included as Exhibit 5 of ARC HSFS0006 Electrical Safety Standard.

Employees standing on the ground may not contact the vehicle or mechanical equipment or any of its attachments unless:

- The employee is using protective equipment rated for the voltage; or

- The equipment is located so that no uninsulated part of its structure (that portion of the structure that provides a conductive path to employees on the ground) can come closer to the line than permitted in this section of this standard.

If any vehicle or mechanical equipment capable of having parts of its structure elevated near energized overhead lines is intentionally grounded, employees working on the ground near the point of grounding may not stand at the grounding location whenever there is a possibility of overhead line contact. Additional precautions, such as the use of barricades or insulation, shall be taken to protect employees from hazardous ground potentials, depending on earth resistivity and fault currents, which can develop within the first few feet or more outward from the grounding point.

When a machine is in contact with an overhead power line, do not allow anyone to come near or touch the machine. Stay away from the machine and summon outside assistance.

5.7.2 Acceptable Clearance for Working in Vicinity of Non-Electrical Overhead Utilities and Structures

Arcadis field personnel will identify non-electrical overhead utilities and structures and where possible, work is not be conducted within the 30-inch Tolerance Zone of these overhead utilities and structures. It is recommended that if work will be completed in the vicinity of non-electric overhead utilities, the overhead utilities should be labeled with warning signs, protective barricades, and/or flags. Non-electrical overhead utilities and structures may include, but is not limited to, pipe chases, water lines, ceilings in buildings, etc. Arcadis field personnel will notify its site workers

(employees, subcontractors, vendors, etc.) of known overhead utilities and structures during the tailgate safety meeting. See Exhibit 2 for additional details.

5.8 Reporting Utility Incidents

Arcadis field personnel involved with any subsurface, submerged, and aboveground utility strikes should immediately STOP WORK and contact the Project Manager to discuss the incident unless there are injuries, then call 911 or the available emergency services number for the area and then the Project Manager. The utility strike must be reported to Corporate Health and Safety and Legal Departments immediately and no later than 24 hours. Use the Utility Line Strike Investigation Form as part of the notification process.

Selected utility strike incidents may also utilize a conference call with operations management to review findings and lessons learned. The Business Line Health and Safety Director will make the determination concerning the need to have the incident review call and will arrange the call, if deemed necessary.

5.9 Relationship of this standard to the Project Specific HASP

With the exception of the Utility and Structures Checklist, this standard, including most supplements, are not designed to be printed off and attached to project HASPs. During project health and safety planning, this standard will be reviewed and applicable clearance technologies and methods will be documented on the Utility and Structures Checklist.

Additionally, emergency action standards specific to utility strikes should be addressed. ARC HSFS-019 Supplement 5 provides general guidelines for emergency response to utility strikes. Applicable information may be attached to the Utility and Structures Checklist to facilitate communication of response expectations.

5.10 Required Contract Terms and Conditions

Arcadis' standard client and subcontractor contracts contain required terms and conditions defining responsibility for utility clearance and the allocation of risk associated with an impacted utility. These terms and conditions have prescribed language concerning subsurface work that is presented in Arcadis client contracts and Arcadis' subcontractor contracts, which can be found on the Legal Source site. If such provisions cannot be agreed upon, the reasons are documented and other risk-management actions should be identified, such as limits of liability, add additional physical investigations, additional lines of evidence or utility location, assignment of risk to subcontractors, etc. In addition, any changes to these terms and conditions require approval by Legal Services.

6. TRAINING

Employees responsible for coordinating or conducting utility clearance activities will be familiar with the requirements of this standard. Arcadis in-house 8-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) refresher may provide awareness-level training regarding this utility location and clearance standard.

7. REFERENCES (regulation citation, technical links, publications, etc.)

- Utility and Structures Checklist
- Utility Line Strike Investigation Form
- ARC HSFS-019 Supplement 1, Best Practices for Project Managers (or Their Delegates) Concerning Utility Clearance
- ARC HSFS-019 Supplement 2, Best Practices for Field Personnel Concerning Utility Clearance
- ARC HSFS-019 Supplement 3, Use and Limitations Associated with Location Technologies and Common Utility Clearance Methods
- ARC HSFS-019 Supplement 4, Best Practices for State One Call Procedures and Notifications
- ARC HSFS-019 Supplement 5, Emergency Action Plan guidelines for Utility Strikes
- ARC HSFS-019 Supplement 6, Utility Location SOP for Aquatic Work Activities
- Figure 1 – 30-Inch Tolerance Zone
- ARC HSCS005 Excavation and Trenching
- ARC HSFS0006 Electrical Safety Standard
- One Call and State Law Directory

8. RECORDS - DATA RECORDING AND MANAGEMENT

8.1 Utility Clearance Records

All records (maps, checklists and documentation of communications) used to determine the location of utilities should be retained and kept in the project file.

9. APPROVALS AND HISTORY OF CHANGE

Approved By: Julie Santaniello, CSP – Corporate H&S, Manager of Technical Programs

History of Change

Revision Date	Revision Number	Standard Developed/Reviewed By or Revised By	Reason for change
13 December 2006	01	Mike Thomas/Pat Vollertsen	Original document
26 March 2007	02	Mike Thomas/Pat Vollertsen	Put in new company format
15 May 2007	03	Mike Thomas/Pat Vollertsen	Added nation-wide 811 number
6 September 2007	04	Mike Thomas/Pat Vollertsen	Changing over to new template format
22 February 2008	05	Mija Coppola	Changing over to new template format
13 January 2009	06	Mija Coppola	Define lines of evidence
4 October 2010	07	Sam Moyers/Mija Coppola	Reformatting and addition of utility clearance information
13 February 2012	08	Sam Moyers/Mija Coppola	Modified link information for utility strike reporting, clarified local/state requirements in section 4.1 and 4.3
28 January 2013	09	Tony Tremblay	Utility and Structures Checklist revised; hyperlink updated
12 February 2013	10	Amanda Tine/Tony Tremblay	Clarified clearance boundaries for Unqualified staff in Section 5.7 and added information about vehicles and equipment being used near power lines in Section 5.7.1

Implementation Date 13 December 2006	Arcadis HS Standard Name Utility Location and Clearance	ARCADIS
Revision Date 10 May 2016	Arcadis HS Standard No. ARCHSFS019	Revision Number 15

Revision Date	Revision Number	Standard Developed/Reviewed By or Revised By	Reason for change
15 March 2013	11	Kurt Merkle, Rebecca Lindeman / Tony Tremblay	Added additional text to standard for recent lessons learned, added section 5.4 (Locating Technologies) and 5.5 (Clearance Methodologies), added additional details to section 5.6 when working in close proximity to subsurface utilities, and added Supplement 6 - Utility Location SOP for Aquatic Work Activities.
07 July 2013	12	Andrew McDonald/ Tony Tremblay	Removed HSFS-019 Supplement 1, Utility Definitions. Added hyperlink for One Call and State Law Directory. Segregated evidence of sewer or storm drains in USC list. Removed Sam Moyers and added Andrew McDonald as author.
26 September 2014	13	Andrew McDonald/Tony Tremblay	Added Exhibit 1. Definitions and 30 inch tolerance zone. Clarified use of 811 or state one call as a reliable line of evidence. Added best practice to cover backfilling of pre-cleared boreholes. Updated USC list to cover soft dig termination depths and PM review.
23 February 2015	14	Tony Tremblay	Page number correction

Revision Date	Revision Number	Standard Developed/Reviewed By or Revised By	Reason for change
10 May 2016	15	Denis Balcer/Sharon Lingle/Alec MacAdam/Andrew McDonald/Tony Tremblay/Julie Santaniello	ES and Section 4.2 - define subsurface intrusive work; clarify employees providing oversight of utility contractors, Arcadis requirements of operating and interpreting results of utility clearance equipment, and utility clearance before all subsurface intrusive work. Sections 1 and 5.8- changed submarine to submerged. Section 4.1 – added contacting public utility companies to help clear utilities. Section 4.2 – Clarified requirement to complete one year of utility clearance-related experience. Section 4.2 and 4.3 - Added discussion on aboveground activities causing subsurface disturbances. Added responsibility to clear overhead utilities when heavy equipment will be used and to evaluate use of a spotter. Added that repairs to damaged utilities need to be verified as competent and complete. Section 5.2 – Clarified reliable lines of evidence for each subsurface intrusive work point and degrees of certainty. Added all work within 30-inch Tolerance Zone needs Corp H&S preapproval. Section 5.6 and Exhibit 1- Clarify subsurface intrusive work and activity and exemptions for subsurface intrusive work. Section 5.6.1 – Add requirement to evaluate aboveground activities that may lead to subsurface disturbances that may cause damage to shallow underground utilities or structures.

Implementation Date 13 December 2006	Arcadis HS Standard Name Utility Location and Clearance	ARCADIS
Revision Date 10 May 2016	Arcadis HS Standard No. ARCHSFS019	Revision Number 15

Revision Date	Revision Number	Standard Developed/Reviewed By or Revised By	Reason for change
10 May 2016	15	Denis Balcer/Sharon Lingle/Alec MacAdam/Andrew McDonald/Tony Tremblay/Julie Santaniello	Section 5.7.2 – added non-electric overhead utilities and structures other than power lines need to be identified and marked if working in that area. Section 9 – Changed reviewer from Tony Tremblay to Julie Santaniello. Exhibit 1 – added definitions of Utility Strike, Daylighting, Potholing, Subsurface Intrusive Work, Subsurface Intrusive Activities, and Utility Bank. Standard and Supplements placed on new Arcadis headers. Updated Supplement revision numbers to be consistent with standard. Supplement 2 revised. Utility Clearance and Structures Checklist and Utility Strike Investigation Form revised.

EXHIBIT 1 – DEFINITIONS

Aboveground Utilities - For the purpose of this procedure, aboveground utilities include, but are not limited to: any aboveground line, pipe, conduit, system, or facility used for producing, storing, conveying, transmitting or distributing communication or telecommunications signals, electricity, gas, liquid, petroleum and petroleum products, coal slurry, hazardous liquids or gases, water under pressure, steam, sanitary sewage, storm water, or other materials, liquids, or gases.

Daylighting – exposing underground utilities or structures through soft dig technology/clearance prior to completing subsurface intrusive activities.

Excavation - Any man-made cut, cavity, trench, or depression, in an earth surface formed by earth removal into which a person can bodily enter.

Overhead Utilities and Structures – Overhead water lines, overhead pipe chases, ceilings in buildings.

Potholing – exposing underground utilities or structures through soft dig technology/clearance prior to completing subsurface intrusive activities.

Subsurface Intrusive Activities – For the purposes of this procedure, subsurface intrusive activities include, but are not limited to: excavations, vertical drilling, installing grounding rod, soil sampling, etc,

Subsurface Intrusive Work – Is any work or activity that breaks the plane of the ground surface. Exemptions include soil sampling using a non-conductive sampling tool to a depth of 6 inches below ground surface (bgs), placement of survey flagging to a depth of 6 inches bgs, and placement of non-conductive survey stake(s) to a depth of 6 inches bgs).

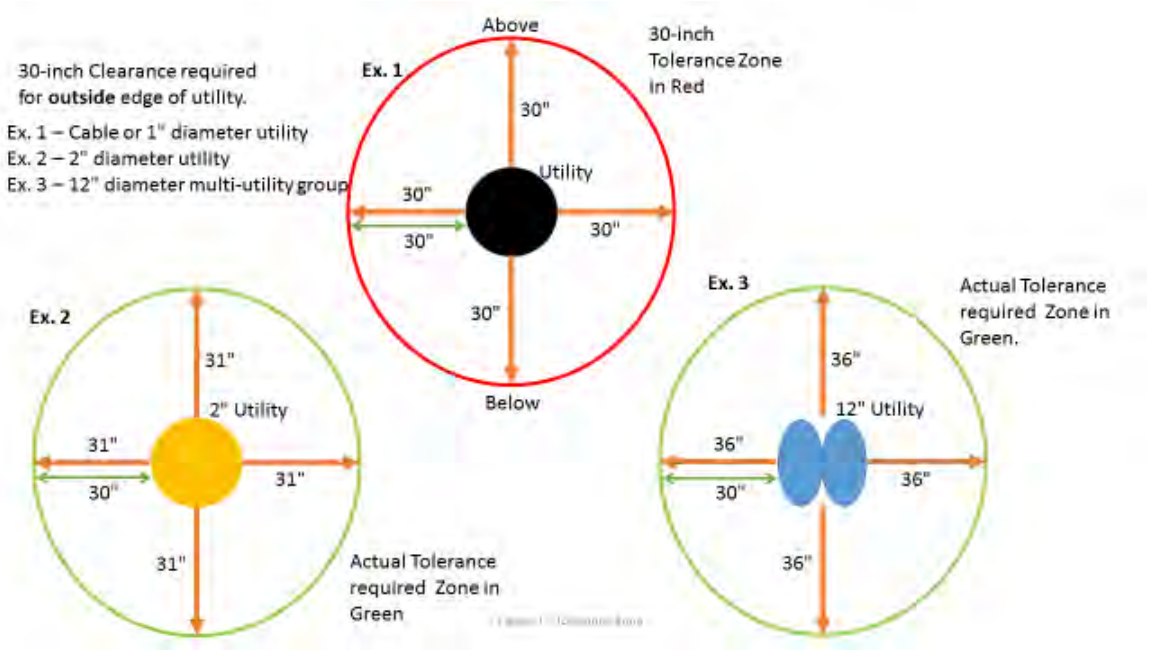
Subsurface Utilities - For the purposes of this procedure, subsurface utilities include, but are not limited to: any underground line, pipe, conduit, system, or facility used for producing, storing, conveying, transmitting or distributing communication or telecommunications signals, electricity, gas, liquid, petroleum and petroleum products, coal slurry, hazardous liquids or gases, water under pressure, steam, storm water, or sanitary sewage; underground storage tanks; tunnels and cisterns; and septic tanks and lines.

Tolerance Zone – The area within 30 inches in all directions from the outside diameter of a located/marked utility in which special care is to be taken. If the centerline of the utility is marked, the diameter of the utility or utility bank/trench must be incorporated into the 30 inches. This area must be hand cleared with non-mechanized equipment. Once the utility has been exposed, if mechanized equipment is planned for use within the 30-inch Tolerance Zone of the utility, such activity must receive pre-approval by Corporate H&S, to mitigate or accept the risk associated with the planned work. See Figure 1 – 30-inch Tolerance Zone.

Utility Bank – a structure containing two or more conduits. A conduit is a single enclosure containing one or more facilities.

Utility Strike – An unplanned contact of a utility (i.e., overhead and structures, aboveground, underground or submerged) during the course of work that results in damage requiring repairs, making a report to the utility owner or requiring further assessment to evaluate the potential for damage

EXHIBIT 2 – FIGURE 1 – TOLERANCE ZONE



Attachment K - Shipping Determinations

SHIPPING/TRANSPORTATION DETERMINATION FORM Revision 9

Date:	3/31/2017
Project Name:	Newark Former MGP Site
Project Number:	B0013094
Supplemental Information:	None

1) Description of the Material to be Transported or Shipped

1a	Select a description category ===>	Samples
1b	*Water samples and soil/sludge samples with ppb or low ppm concentrations of volatile, semivolatile and/or inorganic constituents with no sheens or odors*	
1c	Benzene, Toluene, Ethylbenzene, Xylenes, Polycyclic Aromatic Hydrocarbons	

- ☑ This material is mixed with water, soil or other inert material
- ☑ This material will be shipped on wet or blue ice
- ☐ Consignment contains dry ice
- ☐ Consignment contains containers with acid/base preservatives prepared by an analytical laboratory.

2) Classification and Identification

This material is: Not Restricted/Not Regulated

Do not complete sections 2a or 2b below

Complete for Hazardous Materials ONLY:

2a UN/NA/ID# : NA 2b PG: NA Primary Hazard Class: NA

Subsidiary Hazard Class: NA NA

PSN: NA

Add the word "mixture" or "solution" in cell G29 above if not already included in the PSN.

☐ See Section 7a

2c This material is a: No additional criteria applies to this material

3) Packaging, Exceptions and Shipping Information

Consider entering your desired bottle set in section 3f prior to completing 3a-3c to see if exceptions can be used.

This material will be shipped (mode of transport and type of shipment):

3a Air as a non-restricted consignment

If using an exception/exemption, list the exception/exemption below

3b None

Carrier/Transporter information:

3c FedEx Express (Air)

Auth. Air Limits for EQ, LQ and Fully Reg. Shipments and Selected Ground LQ and SQE:
Inner Container Limit (NA- Not Applicable; F- Forbidden; mg, g, or kg for solids; ml or L for liquids):

Glass	NA	NA
Metal	NA	NA
Plastic	NA	NA

Plastic Bag	NA	NA
Paper Bag	NA	NA
Fibre	NA	NA

Outer Package Limit

NA	NA

Air Shipping Specification Package Requirements (NA-Not Available or Not Applicable):

Combination Packages

Drums:	Steel	Aluminum	Plywood	Fibre	Plastic
	NA	NA	NA	NA	NA
Jerricans:	Steel	Aluminum	Plastic		
	NA	NA	NA		
Boxes:	Steel	Aluminum	Plywood	Fibreboard	Plastic
	NA	NA	NA	NA	NA

Single Packages

Drums:	Steel	Aluminum	Fibre	Wood	Plastic
	NA	NA	NA	NA	NA
Jerricans:	Steel	Aluminum	Plastic		
	NA	NA	NA		
Boxes:	Steel	Aluminum	Plywood	Fibreboard	Plastic
	NA	NA	NA	NA	NA
Bags:	Textile	Plastic	Paper		
	NA	NA	NA		

Specification packages are not required.

Complete 3d-3f for all Shipments HazMat and Not Regulated/Not Restricted :

3d Packaging Type: Combination Package - Non-Bulk
3e Inner Container Category: Glass receptacles
3f Inner Container Specific/Pkg:

	Number	Container type		Net Qty. Each Container	
Container type #1	20	4 oz	Glass	4	oz
Container type #2	40	40 ml	Glass	40	ml
Container type #3	0	None	None		None
Container type #4	0	None	None		None
Container type #5	0	None	None		None
Container type #6	0	None	None		None

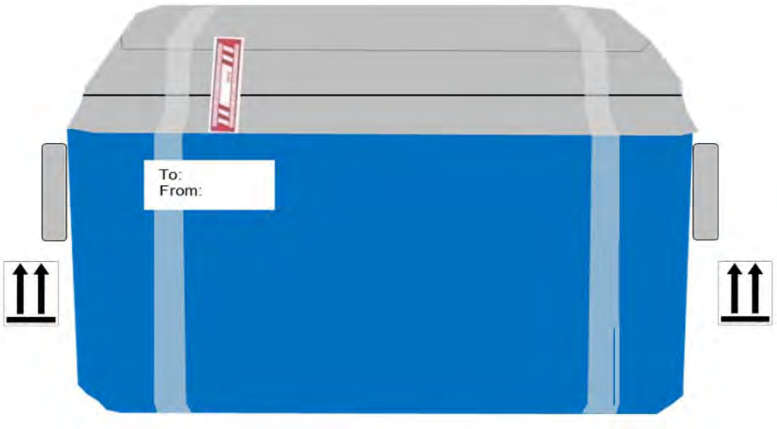
<= Select units here
TIP: Do not place units in the yellow column.

3g Intermediate Packaging: Plastic bag/liner
3h Outer Packaging: Non-specification box- plastic (sample cooler)
3i Other: None Type: None

☑ Arcadis Shipping Guide US-001 attached
☐ Specific package closure instructions are attached
☐ Arcadis Shipping Guide or HSSP is available for this shipment: NA

4) Marks and Labels for Non-Bulk Packages

Orientation arrows, if shown, may be red or black in color.



Place all marks and labels checked in this section on same side of package (excludes orientation arrows, if shown).

5) Documentation

- ☑ No special documentation required
- ☐ Requires a Shipper's Declaration (air) prepared using : None
- ☐ Requires HazMat ground shipping papers prepared using: None
- ☐ Requires a Bill of Lading or Manifest (>MOT, Freight,Trucking Co., Waste Hauler, etc.)
- ☐ Requires Special Permit DOT-Special Permit #: _____
- ☐ Other: _____

6) Emergency Response

- ☐ Use ChemTel 24/7 Emergency Phone and Contract Number or approved equivalent (authorized client or vendor) for this shipment:
  1-800-255-3924 (ChemTel #MIS0007883) Register this shipment with ChemTel:
  Have carrier tracking number available. http://Arcadis.chemtel.net/
- ☐ Ensure current edition of North American Emergency Response Guidebook in vehicle (this applies to Arcadis Transport requiring a shipping paper)

7) Special Instructions (Specify any "See Section 7" details in 7a)

7a

8) References and Rationale for the Determination (add additonal sheets, if requried. See cell B178 for guidance)

	NA
ICAO/IATA Special Provisions:	
Soil and groundwater samples in either unpreserved or preserved conatiners are expected to be classified as non-hazardous. Therefore, no special packing provisions, labeling, manifesting or tracking is required.	
❑ See attached for rationale (IF CHECKED, DETERMINATION IS VOID IF RATIONALE NOT ATTACHED)	

9) Signatures

Determination performed by: Nicholas (Klaus) Beyrle

Phone (XXX-XXX-XXXX): 585-662-4044

Determination QA/QC performed by:

APPENDIX D

Generic Community Air Monitoring Plan

Appendix 1A
New York State Department of Health
Generic Community Air Monitoring Plan

Overview

A Community Air Monitoring Plan (CAMP) requires real-time monitoring for volatile organic compounds (VOCs) and particulates (i.e., dust) at the downwind perimeter of each designated work area when certain activities are in progress at contaminated sites. The CAMP is not intended for use in establishing action levels for worker respiratory protection. Rather, its intent is to provide a measure of protection for the downwind community (i.e., off-site receptors including residences and businesses and on-site workers not directly involved with the subject work activities) from potential airborne contaminant releases as a direct result of investigative and remedial work activities. The action levels specified herein require increased monitoring, corrective actions to abate emissions, and/or work shutdown. Additionally, the CAMP helps to confirm that work activities did not spread contamination off-site through the air.

The generic CAMP presented below will be sufficient to cover many, if not most, sites. Specific requirements should be reviewed for each situation in consultation with NYSDOH to ensure proper applicability. In some cases, a separate site-specific CAMP or supplement may be required. Depending upon the nature of contamination, chemical- specific monitoring with appropriately-sensitive methods may be required. Depending upon the proximity of potentially exposed individuals, more stringent monitoring or response levels than those presented below may be required. Special requirements will be necessary for work within 20 feet of potentially exposed individuals or structures and for indoor work with co-located residences or facilities. These requirements should be determined in consultation with NYSDOH.

Reliance on the CAMP should not preclude simple, common-sense measures to keep VOCs, dust, and odors at a minimum around the work areas.

Community Air Monitoring Plan

Depending upon the nature of known or potential contaminants at each site, real-time air monitoring for VOCs and/or particulate levels at the perimeter of the exclusion zone or work area will be necessary. Most sites will involve VOC and particulate monitoring; sites known to be contaminated with heavy metals alone may only require particulate monitoring. If radiological contamination is a concern, additional monitoring requirements may be necessary per consultation with appropriate DEC/NYSDOH staff.

Continuous monitoring will be required for all ground intrusive activities and during the demolition of contaminated or potentially contaminated structures. Ground intrusive activities include, but are not limited to, soil/waste excavation and handling, test pitting or trenching, and the installation of soil borings or monitoring wells.

Periodic monitoring for VOCs will be required during non-intrusive activities such as the collection of soil and sediment samples or the collection of groundwater samples from existing monitoring wells. APeriodic@ monitoring during sample collection might reasonably consist of taking a reading upon arrival at a sample location, monitoring while opening a well cap or

overturning soil, monitoring during well baling/purging, and taking a reading prior to leaving a sample location. In some instances, depending upon the proximity of potentially exposed individuals, continuous monitoring may be required during sampling activities. Examples of such situations include groundwater sampling at wells on the curb of a busy urban street, in the midst of a public park, or adjacent to a school or residence.

VOC Monitoring, Response Levels, and Actions

Volatile organic compounds (VOCs) must be monitored at the downwind perimeter of the immediate work area (i.e., the exclusion zone) on a continuous basis or as otherwise specified. Upwind concentrations should be measured at the start of each workday and periodically thereafter to establish background conditions, particularly if wind direction changes. The monitoring work should be performed using equipment appropriate to measure the types of contaminants known or suspected to be present. The equipment should be calibrated at least daily for the contaminant(s) of concern or for an appropriate surrogate. The equipment should be capable of calculating 15-minute running average concentrations, which will be compared to the levels specified below.

1. If the ambient air concentration of total organic vapors at the downwind perimeter of the work area or exclusion zone exceeds 5 parts per million (ppm) above background for the 15-minute average, work activities must be temporarily halted and monitoring continued. If the total organic vapor level readily decreases (per instantaneous readings) below 5 ppm over background, work activities can resume with continued monitoring.

2. If total organic vapor levels at the downwind perimeter of the work area or exclusion zone persist at levels in excess of 5 ppm over background but less than 25 ppm, work activities must be halted, the source of vapors identified, corrective actions taken to abate emissions, and monitoring continued. After these steps, work activities can resume provided that the total organic vapor level 200 feet downwind of the exclusion zone or half the distance to the nearest potential receptor or residential/commercial structure, whichever is less - but in no case less than 20 feet, is below 5 ppm over background for the 15-minute average.

3. If the organic vapor level is above 25 ppm at the perimeter of the work area, activities must be shutdown.

4. All 15-minute readings must be recorded and be available for State (DEC and NYSDOH) personnel to review. Instantaneous readings, if any, used for decision purposes should also be recorded.

Particulate Monitoring, Response Levels, and Actions

Particulate concentrations should be monitored continuously at the upwind and downwind perimeters of the exclusion zone at temporary particulate monitoring stations. The particulate monitoring should be performed using real-time monitoring equipment capable of measuring particulate matter less than 10 micrometers in size (PM-10) and capable of integrating over a period of 15 minutes (or less) for comparison to the airborne particulate action level. The equipment must be equipped with an audible alarm to indicate exceedance of the action level. In addition, fugitive dust migration should be visually assessed during all work activities.

1. If the downwind PM-10 particulate level is 100 micrograms per cubic meter (mcg/m^3) greater than background (upwind perimeter) for the 15-minute period or if airborne dust is observed leaving the work area, then dust suppression techniques must be employed. Work may continue with dust suppression techniques provided that downwind PM-10 particulate levels do not exceed 150 mcg/m^3 above the upwind level and provided that no visible dust is migrating from the work area.

2. If, after implementation of dust suppression techniques, downwind PM-10 particulate levels are greater than 150 mcg/m^3 above the upwind level, work must be stopped and a re-evaluation of activities initiated. Work can resume provided that dust suppression measures and other controls are successful in reducing the downwind PM-10 particulate concentration to within 150 mcg/m^3 of the upwind level and in preventing visible dust migration.

3. All readings must be recorded and be available for State (DEC and NYSDOH) and County Health personnel to review.

December 2009

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