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Niagara Mohawk Power Corporation

Remedial Design Work Plan

Superfund Site – Operable Unit 2
Saratoga Springs, New York
EPA ID # NYD980664361

May 2014

ARCADIS

Certification

I, Terry W. Young, P.E., as a Professional Engineer registered in the State of New York, to the best of my knowledge, and based on my inquiry of the persons involved in preparing this document under my direction, certify that this *Remedial Design Work Plan* for Operable Unit 2 of the Saratoga Springs former manufactured gas plant (MGP) site was completed in general accordance with the following:

- Section VI.10.b of the Consent Decree (No. 97-CV-0136) between NMPC and the United States Environmental Protection Agency (EPA), dated May 15, 1997.
- EPA guidance documents, including *Guidance on Oversight of Remedial Designs and Remedial Actions performed by Potentially Responsible Parties*, (OSWER directive 9355.5-01, EPA/540/g-90-001), dated April 1990.
- Section 5.2 of the NYSDEC document titled "DER-10 Technical Guidance for Site Investigation and Remediation," (DER-10) issued on May 3, 2010.
- The Record of Decision (ROD) issued by the EPA on March 29, 2013.

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Remedial Design Work Plan

Niagara Mohawk Superfund Site – Operable Unit 2
Saratoga Springs, New York

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1. Introduction

This Remedial Design Work Plan (RDWP) describes the activities to be performed by Niagara Mohawk Power Corporation (NMPC) to prepare the design of the final remedy for the Operable Unit 2 Project Area (OU 2 Project Area) of the NMPC Superfund Site located in Saratoga Springs, New York. The remedy was selected in the Record of Decision (OU 2 ROD) issued by the United States Environmental Protection Agency (EPA) on March 29, 2013. This RDWP has been prepared in accordance with the following:

- Section VI.10.b of a Consent Decree (CD; No. 97-CV-0136) between NMPC and the EPA, dated May 15, 1997.
- EPA guidance documents, including *Guidance on Oversight of Remedial Designs and Remedial Actions performed by Potentially Responsible Parties*, (OSWER directive 9355.5-01, EPA/540/g-90-001), dated April 1990.
- Section 5.2 of the New York State Department Environmental Conservation (NYSDEC) document titled, "DER-10 Technical Guidance for Site Investigation and Remediation," (DER-10) issued on May 3, 2010.
- The OU 2 ROD.

An initial "draft" version of the RDWP was submitted to the EPA and NYSDEC on June 18, 2013. The NYSDEC provided comments on the June 2013 "draft" RDWP in an August 2, 2013 letter to the EPA. In turn, the EPA forwarded the NYSDEC's comments and provided EPA comments on the June 2013 "draft" RDWP to National Grid in September 18, 2013 e-mail correspondence. National Grid responded to the EPA's and NYSDEC's comments in a letter to the EPA dated October 18, 2013. The EPA subsequently made redline changes to the RDWP that were forwarded to National Grid on February 14, 2014. The EPA provided markups of the RDWP figures to National Grid on March 5, 2014. National Grid incorporated further changes to the RDWP in response to the EPA's and NYSDEC's feedback and submitted the revised "draft" RDWP to the EPA and NYSDEC on March 31, 2014. The EPA provided additional comments in e-mail correspondence dated April 8 and 14, 2014 that were addressed in e-mail correspondence from ARCADIS dated April 25, 2014. A final set of minor edits was provided by the EPA on April 30, 2014. This finalized version of the RDWP incorporates the changes referenced above.

In general, the remedial design approach includes the completion of a pre-design investigation (PDI) to support the development of a detailed, comprehensive Remedial Design to implement the remedy selected in the OU 2 ROD.

1.1 Site Description

The NMPC Superfund Site (the Site) is located in Saratoga Springs, New York (Figure 1). The Site includes: (1) an OU 1 Project Area (OU 1), selected by EPA in a 1995 ROD and amended by a 2001 Explanation of Significant Differences (ESD); (2) the OU 2 Project Area (described below); and (3) all areas where hazardous substances migrating from the NMPC (also known as the National Grid) Property have come to be located or may migrate, and areas very close to the contamination that are necessary for implementation of the work. The Site location and surrounding properties are shown on an aerial photograph (see Figure 2) and in a drawing of the OU 2 Project Area and surrounding properties (see Figure 3).

As shown in Figures 2 and 3, the OU 2 Project Area occupies approximately 0.5 acres. It is bounded to the north by a property formerly owned by Spa Steel and the NMPC Property, to the south by High Rock Avenue, to the east by Warren Street, and to the west by property owned by The Mill, LLC (a remediated and delisted NYSDEC inactive hazardous waste site, number 546036, known as the Van Raalte Knitting Mill Site). The OU 2 Project Area consists of the following: (1) a portion of Excelsior Avenue; (2) a grass-covered parcel owned by the City of Saratoga Springs that contains an active bedrock groundwater well known as the Old Red Spring Well and an associated pavilion (collectively referred to as the Old Red Spring Area); and (3) a small portion of a paved parking lot for a commercial business property owned by The Mill, LLC located west of the Old Red Spring Area.

1.2 Site History

Beginning in 1868, gas for use in lighting and heating was manufactured from coke, coal and petroleum oils at a manufactured gas plant (MGP) facility on the NMPC Property. Gas manufacturing operations continued at this location until 1929. The early gas production operations generated a dense, oily liquid known as coal tar and other waste materials, which were by-products of the gas production processes. These wastes, which contain hazardous substances, were disposed of at various locations on the NMPC property. MGP operations resulted in areas of soil, sediment, and groundwater impacts.

In 1982, NMPC notified EPA that the NMPC Property was once the location of a MGP facility and that NMPC's corporate predecessors disposed of coal tar on the NMPC Property.

Based on the findings of environmental studies conducted at the NMPC Property, EPA proposed the Site for inclusion in the National Priorities List (NPL) in June 1988, and subsequently placed it on the NPL on February 21, 1990. In September 1989, EPA entered into an Administrative Order on Consent requiring NMPC to conduct a remedial investigation/feasibility study (RI/FS) to determine the nature and extent of contamination at the NMPC Property and to evaluate cleanup alternatives. Information provided by this RI/FS was used as part of the basis for the Operable Unit 1 ROD, which was issued in September 1995.

On May 15, 1997, a CD between the United States and NMPC was entered by the U.S. District Court for the Northern District of New York. The objectives of the CD were for NMPC to implement the 1995 Operable Unit 1 ROD pursuant to the CD and an attached Statement of Work, to draft a work plan for approval by EPA to implement the remedy selected in the 1995 ROD, and to reimburse EPA for its response costs.

In September 2001, an Explanation of Significant Differences (ESD) was signed, which described changes to the September 1995 ROD. The ESD modified the cleanup approach for a property known as the former Skating Rink property and properties containing a section of an abandoned brick storm sewer. The ESD also required a historic brick Round House located on the NMPC Property to be moved and preserved.

In July 2006, additional impacted subsurface soil and groundwater were identified on an adjacent property known as the former Spa Steel Property, located west of a barrier wall erected to contain contamination on the NMPC Property.

Several investigations were performed at the Spa Steel Property. To contain contamination on a section of this Property, a sheetpile wall and an impermeable cap were constructed in April 2008.

EPA's Environmental Response Team evaluated the extent of impacts south of the former Spa Steel Property in July 2006. NMPC performed subsequent investigations from February 2008 through November 2009 to evaluate the extent of soil and groundwater impacts. A feasibility study was prepared to evaluate cleanup alternatives and was finalized in July 2012. Following submittal of the *Feasibility Study Report* (ARCADIS, 2012) (the "FS Report"), the EPA designated the newly discovered impacted area as the OU 2 Project

Area of the NMPC Site. As designated by the March 29, 2013 ROD, the OU 2 Project Area includes contaminated subsurface soil and groundwater in an approximately 0.5 acre area that consists of a section of Excelsior Avenue, a section of a paved parking lot for a commercial business owned by The Mill, LLC, and a small green space that includes the Old Red Spring Well and an associated pavilion.

1.3 OU 2 Project Area Characterization

This section summarizes the characterization of the OU 2 Project Area and describes remedial investigations associated with the OU 2 Project Area.

1.3.1 Site Characterization

The OU 2 Project Area was the subject of five environmental investigations and other studies from 2006 through 2012. These investigations are identified below:

- July 2006 Investigation conducted by the EPA to assess the presence and extent of MGP-related residuals within subsurface soils in the area south of the Spa Steel Property.

- February/March 2008 Supplemental Site Investigation (SSI) conducted by NMPC to further defines the nature and extent of MGP-related impacts to the south and southwest of the NMPC Property.

- May 2009 Groundwater investigations conducted by NMPC to support an evaluation of monitored natural attenuation (MNA) as a potential remedial alternative to address MGP-related impacts to groundwater at the Site.

- October/November 2009 Site Investigation conducted by NMPC to further defines the nature and extent of MGP-related impacts to the south and southwest of the NMPC Property, primarily in the direction of the commercial property to the west of the Old Red Spring Area.

- January 2012 Additional soil borings completed by NMPC to characterize soil below Excelsior Avenue and confirm the quantity of visual impacts previously observed in the Old Red Spring Area.

During these investigations, approximately 56 soil borings were drilled, 22 monitoring/recovery wells were installed, and 170 samples of environmental media were collected and analyzed. The comprehensive results of these investigations are presented in the March 2011 FS Report, as revised by the July 2012 FS Report.

A brief discussion of the site geology and hydrogeology is provided below.

1.3.1.1 Geology

Subsurface investigations have identified five principle geologic units of interest at the Site. In order of increasing depth from the ground surface, these geologic units are presented below:

- Approximately 8 to 12 feet of fill
- Approximately 6 to 8 feet of peat/clayey silt
- Approximately 3 to 8 feet of fine to coarse sand
- Approximately 50 feet of silty clay
- Approximately 50 feet of till underlain by Canajoharie Shale.

Silty clay is generally encountered between 15 to 25 feet below ground surface (bgs); however, the surface of this unit appears to rise to the east, where it is encountered at approximately 8 to 10 feet bgs. Based on the results of historical investigations at the NMPC Property and Spa Steel Property, the underlying clay confining unit is greater than 50 feet in thickness. Based on the extent of impacts, the silty clay unit has served as a confining layer, inhibiting MGP-related impacts from migrating deeper.

1.3.1.2 Hydrogeology

As identified during the previous investigations, saturated conditions are first encountered within the fill layer. Monitoring wells were generally installed within the overburden immediately above the clay confining layer from depths of approximately 4- to 24-feet bgs. The water-level data indicate that the water table beneath the Site generally occurs at a depth of approximately 5 to 10 feet bgs. The direction of groundwater flow in the OU 2 Project Area is generally to the southeast as indicated by a November 19, 2009 water table contour map presented FS Report.

The Old Red Spring Well located in the OU 2 Project Area pumps water from a separate deep aquifer which has not been impacted by Site-related contamination. Further details related to the Old Red Spring Area and laboratory analysis of water collected from the well are presented in the FS Report.

1.3.2 Previous Remedial Actions

Remedial actions have been performed at the Site in accordance with the EPA OU 1 ROD, issued September 29, 1995 (EPA, 1995) and the September 2001 ESD. A summary of the remedial activities completed at the Site pursuant to the OU 1 ROD is presented in the *Draft Remedial Action Final Closeout Report – Remedial Action Implementation for the Former Manufactured Gas Plant Site, Saratoga Springs, New York* (Blasland, Bouck & Lee, Inc. [BBL], 2004). For a complete summary of the remedial activities at the Spa Steel Property, refer to the *Construction Certification Report – Spa Steel Products Property, Saratoga Springs, New York* (ARCADIS, 2009). The remedial actions are briefly summarized below.

1.3.2.1 Niagara Mohawk Power Corporation Property Remedial Action

Remedial activities were performed at the NMPC Property from 2001 through 2002 and included:

- Installing a sub-grade sheet pile barrier wall around the perimeter of the NMPC Property.
- Excavating and transporting MGP-source material and select surface soils off-site for treatment/disposal.
- Installing a perimeter stormwater diversion/management system.
- Constructing a permanent groundwater management/treatment system.
- Installing an asphaltic cap at the NMPC Property.

1.3.2.2 Former Skating Rink Area Remedial Action

Remedial activities were performed at the Former Skating Rink Area and included:

- Demolition and removal of the former skating rink building.

- Surface and subsurface soil excavation and removal.
- Backfill of excavation areas and long term groundwater monitoring.

1.3.2.3 Spring Run Creek Remedial Action

Spring Run Creek Sediment Excavation and Removal and Wetlands Mitigation Remedial activities that were performed at the Spring Run Creek Area included:

- Sediment excavation and removal.
- Backfill of excavated areas and wetlands mitigation.

1.3.2.4 36-Inch-Diameter Brick Storm Sewer

Remedial activities for the 36-inch diameter brick storm sewer included the abandonment/ rehabilitation of approximately 5,500 linear foot of the storm sewer.

1.3.2.5 Spa Steel Property Remedial Action

Remedial activities at the Spa Steel Property were performed from November 2007 through April 2008 as a follow-up to previous remedial activities completed at the adjacent NMPC Property. The remedial activities included:

- Installing a sub-grade sheet pile barrier wall within a portion of the property.
- Installing an impermeable cap covering the area enclosed by the sheet pile barrier.

1.4 Nature and Extent of Remaining Impacts

As indicated in the FS Report, the nature and extent of impacts associated with the Site were assessed by multiple investigations. The nature and extent of impacts in surface soil, subsurface soil, and groundwater at the OU 2 Project Area are discussed below.

1.4.1 Surface Soil

The nature and extent of MGP-related impacts to surface soil at the OU 2 Project Area were characterized by the previous investigations. Surface soil samples were collected from locations SS-06-02 (0.5 feet bgs) and SS-06-06 (1.5 feet bgs), which are shown on Figure

4. Only the surface soil sample from location SS-06-02 (just north of Excelsior Avenue) contained polycyclic aromatic hydrocarbons (PAHs) at concentrations slightly greater than the soil cleanup objectives (SCOs) for restricted-residential use specified in Part 375-6 of Title 6 of the New York Codes, Rules, and Regulations (6 NYCRR Part 375).

1.4.2 Subsurface Soil

The nature and extent of MGP-related impacts to subsurface soil at the OU 2 Project Area were characterized by the previous investigations. Coal tar dense non-aqueous phase liquid (DNAPL) was observed in relatively small quantities (i.e., blebs, sheens), over relatively thin (i.e., 0.1 to 2-foot) intervals, and in discontinuous areas throughout the OU 2 Project Area. DNAPL is generally encountered at depths between 14 to 18 feet bgs, but has been observed at a depth as shallow as 11 feet bgs (soil boring NG-31, completed within Excelsior Avenue) and as deep as 23 feet bgs (soil borings NG-14 and NG-28, which correspond to a local low point in the confining silty clay unit). DNAPL-saturated material has not been observed in the OU 2 Project Area.

The source of DNAPL, in the form of coal tar, is the upgradient former MGP facility on the NMPC Property located northeast of the OU 2 Project Area. DNAPL from the NMPC Property vertically descended from historical sources and then entered the OU 2 Project Area horizontally along the surface of the silty clay confining unit. The distribution of DNAPL is generally consistent with the undulations in the clay surface.

DNAPL was observed in monitoring wells MW-EPA-05 and MW-EPA-08 (located in the middle of the Old Red Spring Area, as shown on Figure 4) on July 26, 2006, immediately following installation of the wells. The DNAPL was removed and has not returned. DNAPL has not been identified in any remaining monitoring wells.

Soil samples collected from 11 soil borings contained volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs) at concentrations greater than the 6 NYCRR Part 375 SCOs for unrestricted use and/or restricted use for groundwater protection. As shown on Figure 4, soil samples collected from locations containing DNAPL generally contained constituents of concern (COCs) at concentrations greater than 6 NYCRR Part 375 unrestricted use SCOs. Additionally, soil samples collected from soil borings in the southern portion of the OU 2 Project Area (i.e., near High Rock Avenue) also contained benzene at concentrations slightly exceeding the 6 NYCRR Part 375 unrestricted use SCO.

1.4.3 Groundwater

The nature and extent of MGP-related impacts to groundwater at the Site were characterized by the previous investigations. Dissolved-phase COCs were identified in shallow overburden groundwater at concentrations exceeding the Federal Maximum Contaminants Levels (federal MCLs) and the NYSDEC Class GA groundwater standards specified in the NYSDEC's Division of Water, Technical and Operational Guidance Series (TOGS) 1.1.1 document titled *Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations* (NYSDEC, 2004), herein referred to as NYSDEC Class GA standards and guidance values.

Groundwater samples collected in May 2009 from five monitoring wells (MW-EPA-02, MW-EPA-04, MW-EPA-05, MW-EPA-07, and MW-EPA-08, as shown on Figure 5) contained one or more COCs at concentrations that exceeded the NYSDEC Class GA standards or guidance values and/or federal MCLs. Dissolved-phase COCs have not been detected in groundwater samples collected from monitoring wells located downgradient (south) from the OU 2 Project Area (MW-EPA-09 and MW-EPA-10), east of the OU 2 Project Area (MW-SS-08-05), and west of the OU 2 Project Area (MW-EPA-06, MW-SS-09-06, and MW-SS-09-07). Groundwater analytical results for samples from these additional wells are also shown on Figure 5.

Results for periodic groundwater sampling confirm that dissolved phase COCs have not been detected in the Old Red Spring Well, which extracts groundwater from a deep aquifer located within shale bedrock at depths greater than 150 feet bgs.

1.5 Applicable or Relevant and Appropriate Requirements, To Be Considered Criteria, and Other Guidelines

The OU 2 ROD developed remedial action objectives (RAOs) based on Applicable or Relevant and Appropriate Requirements (ARARs), To Be Considered (TBC) criteria, and other guidelines, which will also be used to in developing remedial plans for soil and groundwater cleanup. The OU 2 ROD has identified New York State's SCOs at 6 NYCRR Section 375-6.3(b) for unrestricted use as an ARAR, TBC, or other guideline to address contaminated surface and subsurface soil in the portion of the Old Red Spring Area not targeted for ISS.

The above-referenced criteria and guidelines are relevant to the design and implementation of remedial activities at the Site and were selected in the OU 2 ROD. ARARs, TBC criteria, and other guidelines, including SCGs, are categorized into chemical-, action-, and location-specific classifications and those potentially applicable to the design and implementation of the final remedy at the Site are presented in Table 1.

1.6 Remedial Action Objectives

Remedial action objectives (RAOs) established for the OU 2 Project Area of the Site are defined in the OU 2 ROD. RAOs are specific goals to protect human health and the environment. The RAOs presented in the ROD consist of the following:

Remedial Action Objectives	
RAO 1	Eliminate the migration of contaminants within the subsurface soils and further into groundwater
RAO 2	Remove, treat or contain principal threat waste
RAO 3	Protect human health by preventing exposure to contaminated soil, groundwater, and soil vapor
RAO 4	Restore shallow groundwater to levels that meet state and federal standards within a reasonable time

1.7 Selected Remedy Overview

The EPA-selected remedy proposed in the OU 2 ROD generally includes the following components:

- Treating DNAPL-impacted soil via in-situ solidification/stabilization (ISS) in the Old Red Spring Area of the Operable Unit 2 Project Area. This remedy component includes removing the top five feet of surface soil to account for the increase in volume of the solidified material and to allow room for two feet of clean backfill.

- Removing surface soil (i.e., up to two feet below grade) in areas not targeted for ISS within the Old Red Spring Area and restoring the area with imported clean fill underlain by a demarcation layer.

- Enhancing biodegradation of impacted subsurface soil and groundwater in the Old Red Spring Area by the application of amendments, such as organic nutrients, oxygen releasing compounds, and/or chemical products.

- Plugging and abandoning the existing Old Red Spring water well and installing a replacement well with a double casing.

- Installing a containment barrier wall and a subsurface mat to encapsulate DNAPL impacted soil under a section of Excelsior Avenue.

- Conducting long-term groundwater monitoring, including periodic sampling of monitoring wells and analysis for VOCs, SVOCs, and metals.

- Implementing institutional controls (ICs) at the properties in Operable Unit 2, which would include the development of environmental easements/restrictive covenants to be filed in the property records of Saratoga County.

- Developing a Site Management Plan (SMP) to ensure the effectiveness of the engineering and institutional controls, as well as the long-term groundwater monitoring, periodic reviews and certifications.

- Restoring disturbed areas (including vegetated surfaces, parking lots, roadways, sidewalks, curbs, etc.) following the completion of remedial construction activities by replacing them to their original pre-construction condition and topographic contours.

- Conducting a periodic review and certification, at a frequency not exceeding five years, of institutional and engineering controls, until the EPA provides notification in writing that this certification is no longer needed.

- Considering green remediation and sustainability efforts in the design and implementation of the remedy to the extent practicable, including: (1) using renewable energy sources; (2) reducing greenhouse gas emissions; (3) encouraging low carbon technologies; and (4) recycling and reusing clean materials.

2. Project Management

NMPC, EPA, NYSDEC, NYSDOH, and ARCADIS will participate jointly in the implementation of the PDI activities described in this document. NMPC has the ultimate responsibility for implementing the activities described in this work plan. The PDI activities will be implemented by ARCADIS in general compliance with this work plan. Key personnel for NMPC, EPA, NYSDEC, NYSDOH, ARCADIS, and PDI subcontractors are identified below in Table 2-1.

Table 2-1 – Key Personnel

Name/Affiliation	Address	Phone/Fax/E-mail
NMPC		
Mr. William R. Jones, PE Lead Senior Environmental Engineer	300 Erie Boulevard West Syracuse, NY 13202	T: 315.428.5690 F: 315.460.9624 Willam.R.Jones@us.ngrid.com
USEPA		
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NYSDEC		
Mr. David A. Crosby Chief - Remedial Section B	625 Broadway 11th Floor Albany, NY 12233-7014	T: 518.402.9662 F: 518.402.9679 dacrosby@gw.dec.state.ny.us
NYSDOH		
Ms. Scarlett Messier, PHS Public Health Specialist	Empire State Plaza Corning Tower, Room 1787 Albany, NY 12237	T: 518.402.7860 F: 518.402.7859 sem10@health.state.ny.us
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Mr. Terry W. Young, PE Engineer of Record	6723 Towpath Road, Box 66 Syracuse, NY 13214-0066	T: 315.671.9478 F: 315.449.4111 Terry.Young2@arcadis-us.com
Mr. John C. Brussel, PE Project Manager	6723 Towpath Road, Box 66 Syracuse, NY 13214-0066	T: 315.671.9441 F: 315.449.4111 John.Brussel@arcadis-us.com
Mr. Matthew S. Hysell, PE Task Manager	6723 Towpath Road, Box 66 Syracuse, NY 13214-0066	T: 315.671.9189 F: 315.449.4111 Matt.Hysell@arcadis-us.com
PDI Subcontractors (subcontractors to ARCADIS)		
Surveyor Driller & Test Pit Excavation Analytical/Geotechnical Laboratories Private Utility Locator Video Inspection/Reconnaissance	Following approval of the RDWP, ARCADIS will identify subcontractors to implement the PDI activities.	

3. Pre-Design Investigation

This section describes the PDIs to be conducted at the OU 2 Project Area during the Remedial Design phase of the project. 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 – Site Survey
- PDI Task 2 – Subsurface Utility Location
- PDI Task 3 – Subsurface Soil Investigation
- PDI Task 4 – Groundwater Investigation
- PDI Task 5 – Groundwater Modeling
- PDI Task 6 – Old Red Spring Evaluation
- PDI Task 7 – Ecological Survey

Methodologies and protocols to be followed during the completion of the PDI activities are presented in the *Sampling Analysis and Monitoring Plan* (SAMP) (BBL, 2001). Analytical procedures and requirements to be followed for the laboratory analysis of samples collected during investigation activities are presented in the Quality Assurance Project Plan (QAPP; ARCADIS, 2014), which was prepared in accordance with the with the Intergovernmental Data Quality Task Force; Uniform Federal Policy for Quality Assurance Project Plans; EPA-505-B-04-900A and DoD: DTIC ADA 427785; March 2005. This QAPP supersedes the previous (2001) QAPP prepared for the Superfund Site.

Health and safety protocols to be followed by field personnel during investigation activities are presented in the Health and Safety Plan (HASP) (ARCADIS, 2012), which will be updated as needed.

A description of each task associated with the PDI is presented below.

3.1 PDI Task 1 – Site Survey

Field survey activities will be performed as part of the PDI by a New York State- licensed Land Surveyor. The survey activities will be performed to accomplish the following:

- Locate and stake property boundaries of the OU 2 Project Area and adjacent properties to the north and west.

- Mark the proposed horizontal limits of the ISS treatment area, barrier wall alignment, and subsurface mat area (for visual reference during implementation of the PDI field investigation activities).

- Establish 20 feet by 20 feet square grids needed for conducting the geophysical survey.

- Document locations of overhead and subsurface utilities (in and around the proposed soil remedial activities), as identified and marked in the field by the utility locators and personnel performing a geophysical survey (for later use during the utility location efforts and inclusion on Contract Drawings to be prepared as part of the Remedial Design).

- Document locations of subsurface structures/anomalies as identified by the geophysical survey and subsurface investigation (for later use during the utility location efforts and inclusion on Contract Drawings, as needed).

- Field-identify and mark proposed PDI soil boring locations based on coordinates obtained from mapping (to allow soil borings to be positioned in relation to the anticipated remedial limits, as shown on Figure 6).

- Prepare topographic mapping to show ground surface elevation contours (1-foot contours) in and around the proposed remedial limits (for later evaluation during Remedial Design and use on Contract Drawings). This will also include verifying existing site mapping shows correct locations for fence lines, roadways/sidewalks, and other site features.

- Document elevations and locations of subsurface utilities that are verified through intrusive field verification techniques (hand excavation, test pits, vacuum excavation, etc.).

- Prepare draft drawings and/or other boundary descriptions of the areas within which institutional controls will be required to be included with the draft environmental easements/restrictive covenants to be filed in the property records of Saratoga County in recordable format for approval by EPA.

Most of the survey work will be performed prior to the implementation of intrusive field investigation activities. Follow-up survey work will be performed, as needed, to document final soil boring locations (if adjustments to the proposed locations are made based on field conditions encountered during the PDI) and to document subsurface utilities and structures/anomalies. The 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 efforts.

3.2 PDI Task 2 – Subsurface Utility Location

Subsurface utility location will be a critical PDI activity necessary to support the design and implementation of the remedial activities. Utilities known to be in the OU 2 Project Area include natural gas lines, overhead and underground electric lines, communications cables, storm sewer lines, 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 detailed utility plans for the OU 2 Project Area.

- Performing a detailed visual Site inspection to identify utilities present in the area in comparison to the Site survey and Site utility plans.

- Contacting Dig Safely New York to identify and mark the location of underground utilities at and in the immediate vicinity of the proposed remedial limits.

- Subcontracting a private utility locating service to identify and mark the location of underground utilities at and in the immediate vicinity of the proposed remedial limits.

- Obtaining and reviewing utility providers' utility location figures.

- Performing a geophysical survey using electromagnetic (EM) and ground penetrating radar (GPR) techniques to identify and mark the location of underground utilities at and in the immediate vicinity of the proposed remedial limits.

Once the non-intrusive verification of utility locations has been exhausted, subsurface utility locations, orientation, elevations, size, materials of construction, and condition (to the extent feasible) within the remedial areas will be field-verified using techniques such as:

- Closed-circuit television (CCTV) inspection.
- Entry into the utility (if accessible).
- Exposing the utility at various locations along the length of the utility within or in the vicinity of the OU 2 Project Area via test pits, hand excavation, or vacuum excavation.

CCTV inspection will be performed for active storm sewers in the OU 2 Project Area. The Old Red Brick Sewer was previously abandoned (bulkheads were installed at several locations to isolate this former sewer) and will not undergo CCTV inspection.

The above-referenced techniques will help to assess: (1) the potential presence of cracks, gaps, or broken pipe to evaluate the potential for the pipes to be affected by remedial activities in close proximity (e.g., nearby injection of grout for subsurface mat or barrier wall construction); and (2) the physical location/alignment of the pipes (e.g., to understand potential bends or changes in pipe direction, or to identify pipe-to-pipe connections that do not occur within the manholes, so that the pipes can be avoided by anticipated future ISS mixing activities).

Data gathered during the subsurface utility investigation will be used to evaluate and select appropriate construction methods to minimize the risk of: (1) direct contact with the utilities by heavy construction equipment (to avoid unintentional breakage); and (2) injected grout entry into the sewers (to avoid potentially blocking or impeding flow in the sewers).

It should be noted, that during the utility location efforts, additional techniques to field verify the location(s) of utilities (that are not outlined in this section of the RDWP) may be identified and implemented.

3.3 PDI Task 3 – Subsurface Soil Investigation

As presented in the ROD and summarized in the FS Report, soil impacts at the OU 2 Project Area 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. Soil borings will be drilled at a total of seven locations

(locations GT-01 through GT-07, as shown on Figure 6) during the PDI to achieve the following objectives:

- Further evaluate subsurface conditions and lithology, including the presence and extent of fill in the proposed subsurface mat area and the clay confining layer depth along the barrier wall alignment.

- Evaluate handling requirements for soil to be removed as part of the remedy (currently anticipated to be 5 feet bgs in ISS areas and 2 feet bgs in remaining areas).

- Collect soil from within the proposed ISS limits (i.e., 5 to 24 feet bgs), subsurface mat area, and barrier wall alignment to support bench-scale treatability studies.

- Evaluate geotechnical properties of soil within and below the proposed ISS, barrier wall, and subsurface mat areas to support the remedial design.

The soil investigation will be accomplished by drilling soil borings as discussed below. Prior to drilling, several measures will be taken to clear utilities, including: (1) performing a one-call utility mark out; (2) performing an EM/GPR survey; and (3) using hand or manual excavation methods (e.g., hand augering, vacuum excavation) at proposed soil boring locations. The soil boring locations will be adjusted, as needed, based on the locations of subsurface utilities and/or structures as discussed in Subsection 2.2 and based on subsurface conditions encountered in the field.

The soil borings drilled during the PDI program will be completed after 5 feet of continuous clay is encountered. Based on available data, clay is anticipated to be encountered at depths ranging from approximately 16 feet bgs in the eastern part of Excelsior Avenue to 25 feet bgs within the ISS area just northeast of the parking lot. Therefore, the borings are anticipated to be drilled to depths of approximately 21 to 30 feet bgs. Real-time field data will be used to determine the actual depth of each soil boring.

The borings will be completed using hollow stem auger (HSA) drilling methods. Continuous soil sampling will be performed using:

- A 2-inch diameter split-soon sampler at boring locations GT-01 through GT-03 (along the barrier wall alignment and/or near the subsurface mat area).

- A 3-inch diameter split-spoon sampler at boring locations GT-04 through GT-07 (in the ISS area).

The 3-inch diameter split-spoon sampler will be used to maximize soil volume obtained for bench-scale testing. Standard penetration test (SPT) data will be obtained at each boring location in accordance with American Society for Testing and Materials (ASTM) D1586. Relatively undisturbed samples of the clay confining unit will also be collected as described below. Soil recovered from each sample interval during drilling will be described and logged by field personnel for color, texture, moisture content, and presence/absence of NAPL. Selected soil samples collected from the borings will be submitted for laboratory testing as described below. If additional soil volume is required for the treatability studies, split-spoon samples may be supplemented with soil from: (1) auger cuttings; or (2) additional soil borings completed adjacent to the above-identified boring locations. It is anticipated that the additional soil borings, if needed, will be blind-drilled and material will not be logged.

Upon completion, the borings will be tremie-grouted to the surface using a cement-bentonite grout. Soil cuttings and other investigation-derived wastes (e.g., plastic sheeting, decontamination washwaters, etc.) will be containerized in 55-gallon drums for offsite disposal based on the characterization sampling described below.

Further explanation of the soil investigation activities is presented below organized by the goals of the investigation activities.

3.3.1 Evaluate Pre-ISS Excavation Soil Handling Requirements

It is envisioned that the top 2 feet of soil from the ISS and surrounding area will be removed and transported for offsite disposal prior to starting ISS. Soil from this area will ultimately be replaced by a 2-foot thick layer of imported clean fill during site restoration. In addition, soil from approximately 2 feet to 5 feet bgs within the ISS area will be excavated in preparation for ISS (to accommodate the soil volume increase/bulking that will occur during ISS). Based on extensive existing soil characterization analytical data for soil below 2 feet bgs, this subsurface soil will be staged for re-use as subsurface fill (above the ISS monolith and below the 2-foot thick layer of imported clean fill). Excavated soil that will require off-site disposal will be characterized prior to off-site shipment, as required by the proposed disposal facility(ies).

Additional data is needed as part of the PDI to characterize the top 2 feet of soil to be removed from the ISS and surrounding area (estimated to be approximately 1,000 CY) for direct-loading and transportation to an offsite disposal facility. Based on the previous experience, it is assumed that the potential disposal facilities will require the collection and analysis of characterization samples at a frequency of approximately one sample per 500 CY (to supplement the existing surface soil analytical data). Two composite soil samples

(samples WC-1 and WC-2) will be collected as part of the PDI to characterize the 2 feet of soil from the ISS and surrounding area. Each composite sample will be formed using discrete grab subsamples from five soil sampling locations, as follows:

- *Sample WC-1:* Soil from the 0- to 2-foot depth interval of borings GT-02, GT-04, and GT-05 and from two 2-foot deep randomly-selected hand-auger boring locations east of the ISS area.

- *Sample WC-2:* Soil from the 0- to 2-foot depth interval of borings GT-06 and GT-07 and from three 2-foot deep randomly-selected hand-auger boring locations south of the ISS area.

Each composite characterization sample will be submitted for laboratory analysis for Toxicity Characteristic Leaching Procedure (TCLP) SVOCs, TCLP metals, TCLP pesticides, TCLP herbicides, ignitability, corrosivity, reactivity, pH, and polychlorinated biphenyls (PCBs). One of the subsamples used to form each composite sample will be submitted for laboratory analysis for VOCs. An analytical sampling summary, which identifies proposed soil sampling locations/intervals and corresponding analyses, is presented in Table 2.

3.3.2 Obtain Soil for Bench-Scale Treatability Testing

Up to 5 gallons of representative soil will be collected from each proposed soil boring for use during the bench-scale treatability studies, as identified below.

- *Subsurface Mat/Barrier Wall Area (GT-01 through GT-03)* – Material obtained from a depth of approximately 11 feet bgs to the top of the clay confining layer at these three boring locations will be composited at the treatability laboratory for use in the subsurface mat and barrier wall treatability studies.

- *ISS Area (GT-04 through GT-07)* – Material obtained from these four boring locations will be composited into one or two homogenates at the treatability laboratory for the ISS treatability study. Soil will be collected from a depth of 5 feet bgs to the clay confining layer (up to 25 feet bgs) and will include the most heavily-impacted material encountered at each soil boring location. Previous investigations indicate that the DNAPL-impacted material, which primarily consists of blebs and stringers, is generally encountered within narrow bands (typically only a couple millimeters to a couple centimeters thick), generally not extending more than 3 feet above the clay surface. This approach will allow for collection of a “DNAPL-rich” soil sample from the areas where DNAPL has been encountered.

The "composite" samples for the homogenate(s) will be submitted to a qualified geotechnical laboratory for laboratory analysis prior to undergoing treatability testing. Each 5-gallon container of soil will be securely packaged and shipped by express delivery courier to the geotechnical laboratory. The composited soil samples will be used in the bench-scale treatability studies to:

- Develop and test multiple mix designs using various reagents (e.g., Portland cement, ground-granulated blast furnace slag cement, bentonite) for ISS.
- Develop and test multiple mix designs using various reagents (e.g., Portland cement, bentonite) for jet grouting the proposed barrier wall and subsurface mat area.

The final mix designs for ISS, jet grouting, and mat construction will be presented in the Remedial Design.

A total of 5 gallons of tap/potable water will also be collected from an onsite source (e.g., fire hydrant) for use during the treatability studies. In addition, 5 gallons of site groundwater will be collected and sent to the treatability laboratory for use in developing the mix designs.

3.3.3 Obtain Soil for Geotechnical Laboratory Analysis

In addition to collecting soil samples for bench-scale ISS testing, several split-spoon and undisturbed soil samples (Shelby tubes) will be collected to provide in-situ geotechnical soil properties for use during the treatability studies, remedial design, and remedial implementation. The geotechnical data will be used to:

- Provide a basis for comparison of pre- and post-remediation soil properties.
- Evaluate potential performance issues associated with differential settlement and stability for the barrier wall, subsurface mat, and utilities/roadway.
- Develop/confirm performance criteria for design components and develop specifications and design criteria to be used during design and construction.

Shelby tubes will be collected from the clay confining layer at various depths from up to three locations within the treatment/containment areas in accordance with ASTM D1587. Shelby tubes will be submitted to a geotechnical laboratory and may be analyzed for select parameters, including:

Analysis	Purpose
Grain size (ASTM D422)	Index properties of soils for treatability studies/remedial design and remedial implementation.
Moisture content (ASTM D2216)	
Atterberg limits (ASTM D4318)	
Bulk density (ASTM D2937)	In-situ unit weight of soils for treatability studies/remedial design and remedial implementation.
Permeability (ASTM 5084)	Establish the permeability of the overburden and clay materials to develop specifications for the ISS and slurry mixes and to provide data for pre- and post-construction comparisons.
Consolidation (ASTM D2435)	Strength and time-rate consolidation properties for evaluation of ISS, barrier wall, and subsurface mat stability/settlement.
Shear Strength (ASTM D2850)	

Geotechnical testing parameters and sample depths may be revised based on field conditions. Results from the above analyses will be used to further evaluate the geotechnical properties of soils from other locations based on the visual characterization and standard penetration test data.

3.4 PDI Task 4 – Groundwater Investigation

A groundwater investigation will be conducted as part of the PDI to accomplish the following:

- Collect groundwater samples for laboratory analysis to provide data for the enhanced groundwater bioremediation desktop evaluation and remedial design.

- Collect hydrogeologic information for the soil and groundwater remedial designs. A description of each of the groundwater investigation activities is presented below.

3.4.1 Enhanced Groundwater Bioremediation Characterization Sampling

Results from the Supplemental Remedial Investigation (ARCADIS, 2008) indicate that the aquifer beneath the Site is a naturally aerobic environment capable of degrading COCs in soil and groundwater. Several environmental factors, including soil pH, microbial community composition, bioavailability of nutrients and COCs, and temperature influence the efficacy of aerobic biodegradation. To provide additional information for the enhanced groundwater bioremediation design, additional PDI groundwater investigation activities will be performed to evaluate oxygen demand under natural site conditions. Groundwater characterization sampling activities are anticipated to be performed after completion of the soil remedial activities.

Groundwater will be collected from four existing monitoring wells (MW-EPA-4, MW- EPA-07, MW-SS-08-08, and MW-SS-09-07) hydraulically downgradient of soil remedial areas, as shown on Figure 6. Samples will be collected from the monitoring wells using low-flow groundwater sampling procedures. Field parameter measurements of temperature, pH, specific conductivity, dissolved oxygen (DO), turbidity, and oxidation-reduction potential will be obtained during sampling using a water quality meter and flow through measurement cell (e.g., YSI 6-series Multi- Parameter Instrument, Horiba U-10, or U-22 Water Quality Monitoring System). Field parameter measurements may be collected at additional monitoring wells hydraulically downgradient of the proposed remedial areas (e.g., MW-SS-09-06, MW-EPA-09), based on field parameter measurements collected at the above-identified monitoring wells. Each groundwater sample will be submitted for laboratory analysis of the following:

- Benzene, toluene, ethylbenzene, and xylenes (BTEX) and naphthalene by EPA SW-846 Method 8260.

- Biological oxygen demand (BOD) by Standard Method (SM) 5210B.

- Chemical oxygen demand (COD) by EPA Method 410.4.

Sampling groundwater from the monitoring wells will provide data required to evaluate potential enhanced groundwater bioremediation treatment technologies and the oxygen demand required to degrade dissolved phase impacts at the Site.

3.4.2 Groundwater Hydrogeologic Evaluation

To further evaluate the hydrogeologic conditions at the site, a synoptic round of groundwater level measurements will be obtained from each existing accessible monitoring well located at the site using an electronic interface probe. The presence and thickness of DNAPL, if any, will also be documented. If DNAPL is encountered, it will be removed via manual bailing.

Hydraulic conductivity testing will also be performed at each existing accessible monitoring well. Drawdown testing will be performed by pumping groundwater and periodically measuring the drawdown with an electronic interface probe over time. Results of the groundwater level gauging and drawdown testing will be used to: (1) evaluate existing hydrogeologic conditions; (2) assess potential groundwater dewatering rates required during remedial activities; and (3) prepare a groundwater flow model.

3.5 PDI Task 5 – Groundwater Modeling

To evaluate groundwater flux and velocity through the proposed soil and groundwater treatment areas and provide information for the Remedial Design, a groundwater flow model will be developed to reflect:

- Site-specific hydrogeologic information
- The low permeability of the proposed solidified mass to be created during the remedial action

The model will be used for a preliminary evaluation of groundwater flow conditions anticipated to result from implementation of the soil remedy.

3.6 PDI Task 6 – Old Red Spring Evaluation

Prior to implementing intrusive PDI activities, information related to the Old Red Spring Well will be obtained and reviewed (e.g., as-built construction details, well boring/completion logs) to identify well details for decommissioning and re-installation of the well associated with remedial activities. A follow-up well inspection will be performed with a down-hole camera to further assess construction information and document the well's condition.

3.7 PDI Task 7 – Ecological Survey

An ecological survey of the site will be performed by an ecologist. The ecologist will visit the OU 2 Project Area to: (1) document existing plant species (e.g., trees and shrubs) for use during site restoration; and (2) evaluate the potential presence of threatened/ endangered species (if any) at or in the vicinity of the site. Results of the ecological survey will be presented in the PDI Summary Letter.

3.8 PDI Summary Letter Report

The results from the PDI will be documented in a PDI Summary Letter Report. Those results, along with existing site information, will support the development of a basis of design for the Remedial Design. The PDI Summary Letter Report will include the following:

- A summary of the PDI work activities and results, including field observations, sampling results, preliminary hydrogeologic evaluation results, Old Red Spring Well evaluation, ecological evaluation results, changes made in response to field conditions, problems encountered and resolutions, and other pertinent information to document that the site activities were performed pursuant to this RDWP.

- Updated figures showing the surveyed locations of aboveground and underground utilities in and around the proposed remedial areas and surveyed locations of soil borings completed as part of the PDI.

- An analytical sample summary that identifies final sampling locations and corresponding laboratory analyses.

- Tables presenting geotechnical sample results and pre-excavation in-situ soil characterization analytical results.

- Soil boring logs.

- An updated schedule for preparing the Remedial Design.

Laboratory analytical data reports and data validation reports will be attached to the letter report in electronic format (i.e., placed on a CD).

4. Bench-Scale Treatability Studies & Desktop Evaluation

This section presents a description of the bench-scale treatability studies to be performed for OU 2 Project Area soil and the enhanced groundwater bioremediation desktop evaluation for groundwater in the OU 2 Project Area. A description of the treatability studies and desktop evaluation is presented below.

4.1 Soil Treatability Studies

A summary of the ISS treatability study is presented below, followed by a description of the subsurface mat and barrier wall treatability studies.

4.1.1 ISS Treatability Study

An ISS treatability study will be conducted during the PDI to determine the mix requirements and other parameters associated with the ISS. As discussed in Subsection 2.3.3, samples of representative site soil will be submitted to the treatability laboratory for use in bench-scale testing. The objective of the bench-scale testing is to identify mix designs for ISS that will successfully immobilize site-related constituents in impacted materials and to effectively meet remedial objectives. Specifically, the mix designs will be evaluated based on the following primary criteria:

- Strength – The minimum 28-day unconfined compressive strength (UCS) of the treated soil matrix will be approximately 50 pounds per square inch (psi). The maximum allowable UCS of the treated soil will be determined during the Remedial Design. The final UCS determined by the treatability study will be presented in the Remedial Design. The proposed minimum strength is anticipated to be sufficient for the anticipated restoration (i.e., grassy areas) and the adjacent roadway (i.e., Excelsior Avenue). The roadway will need to withstand wheel loadings without settlement or deterioration.

- Hydraulic Conductivity – The maximum hydraulic conductivity of the treated soil matrix following addition of mixing reagents will be approximately 1 x 10-6 centimeters per second (cm/sec). The reduced pore space and corresponding reduced hydraulic conductivity of the treated soil matrix will result in lower mobility of pore-filling liquids (water, DNAPL) and reduced potential for leaching.

Upon receipt at the laboratory, the soil samples will initially be visually characterized within their original containers. The samples will then be homogenized by the laboratory to prepare representative samples for the treatability study. One or two homogenates may be prepared based on material type and extent of impacts. The treatability laboratory will characterize the untreated soil for the following chemical and physical parameters:

- pH (Hach Test Kit)
- Grain Size (ASTM D422)
- Atterberg Limits (ASTM D4318)
- Classification (ASTM D2487)
- Loss on Ignition (ASTM D2974)
- Moisture Content (ASTM D2216)

Following physical characterization of the soil, the geotechnical laboratory will prepare grout mixtures that will be analyzed for the following:

- Viscosity, Density, pH, Temperature (API RP 13B)
- Grout Bleed (ASTM C940)
- Set Time (ASTM D403/C953)

The grout mixtures may contain a combination of water, Portland cement, bentonite, and/or blast furnace slag. After testing the soil and grout, the treatability laboratory will perform a two-phase bench-scale testing program which will consist of mixing the soil with grout (using various mix designs) and other additives (if required) to develop a mixture that achieves the ISS objectives. During Phase 1 of the treatability study, approximately six ISS mix designs will be developed. Following mixing, each soil/grout mixture will be tested for the following physical properties:

- Slump and Density (ASTM D143 Modified)
- pH and Temperature (API RP 13B)
- Moisture Content (ASTM D 2216/2937)
- Penetration Resistance (after 1, 3, and 5 days of curing) (ASTM D1558)

- Unconfined Compressive Strength (UCS) (ASTM D1633)

The treatability laboratory will perform the first four tests listed above near the start of the treatability study.

Each soil/grout mixture will be analyzed for UCS at a geotechnical laboratory after curing for 7 and 28 days. As indicated above, the UCS criteria will be between 50 psi and an upper bound (to be determined during the Remedial Design). Soil/grout mixtures meeting UCS criteria after 28 days of curing will subsequently be tested for hydraulic conductivity via ASTM D5084. Select soil/grout mixtures meeting the hydraulic conductivity criteria (i.e., less than or equal to 1 x 10-6 cm/sec) will be selected for monolith leaching using a 'hybrid' method that combines: (1) repeated sequential leaching of a molded monolith with a set ratio of monolith surface area to extracting solution volume (American Nuclear Society [ANS] 16.1-1986); with (2) a traditional extractor demonstrated for use on VOCs as designed for TCLP testing (e.g., EPA SW-846 Method 1311). The Standard Operating Procedure (SOP) for the 'hybrid' monolith leaching method is included in Appendix A. An explanation and the rationale for selecting the procedures proposed in the SOP are provided in an October 18, 2013 letter from National Grid to the EPA (included in Appendix B of this RDWP) that responds to the EPA's and NYSDEC's comments on the "draft" RDWP submitted in June 2013. The leachability goal for the ISS treatability study is for concentrations in leachate obtained from the solidified soil to be less than or equal to the groundwater quality standards.

Once results from the initial mix process are evaluated, optimization of the mix designs may occur. If necessary, Phase 2 testing will mimic the Phase 1 testing described above. Once complete, it is anticipated that one mix design will be developed for ISS treatment based on technical performance and economics of implementation.

As each round of tests is completed (or when data is available), the geotechnical laboratory will provide results reports. Reports will summarize mix ingredients, results of the various tests, observations and estimated material costs. The results from each round of testing will be reviewed before revised mixtures are selected for subsequent rounds of testing and optimization, if needed. A treatability study report will be prepared documenting the results.

Following submittal of the representative soil samples to the geotechnical laboratory, it is anticipated that the bench-scale testing will require approximately 12 weeks to complete.

4.1.2 Subsurface Mat Treatability Study

An initial desktop study of the potential methods for subsurface mat construction, including jet grouting and chemical/permeation grouting, will be performed. If necessary based on the proposed mat construction method identified during the desktop evaluation, a treatability study will be performed with various reagents (including Portland cement and bentonite) to prepare a specification to be included in the Remedial Design.

Treatability performance requirements will be developed based on geotechnical properties of the existing fill and underlying soils identified at the site, as discussed in Subsection 2.3.4. Subsurface mat treatability testing will be similar to the testing identified in Subsection 3.1.1 for strength and permeability. Once the treatability study is completed, it is anticipated that one mix design and method for constructing the proposed subsurface mat will be developed. The geotechnical laboratory will prepare a report summarizing testing results following each round of tests (or when data is available). Reports will provide a summary of mix ingredients, results of various testing, observations, and estimated material costs. The results from each round of testing will be reviewed before revised mixtures are selected for subsequent rounds of testing and optimization, if necessary. Results of the subsurface mat treatability study will be included in the treatability study report.

4.1.3 Barrier Wall Treatability Study

Due to the presence of multiple utilities beneath Excelsior Avenue, the proposed barrier wall is anticipated to be constructed via jet grouting. The barrier wall design will be based on knowledge of site-specific geotechnical sampling results from the PDI, previous site investigations, and experience on previous slurry/jet grout wall projects. Geotechnical parameters of the existing overburden and subsurface clay confining layer (e.g., permeability) will be used to identify the proposed barrier wall performance requirements.

Selected reagents (e.g., bentonite, attapulgite, Portland cement) and dosages will be evaluated to achieve a reduction in hydraulic conductivity across the barrier wall. Barrier wall treatability testing for the grout/slurry mixes will be similar to the testing identified in Subsection 3.1.1. The laboratory will provide a report summarizing the results of each anticipated barrier wall mix following each round of tests (or when data is available). Reports will include a summary of mix ingredients, results of various testing, observations, and estimated material costs. One mix design will be selected and presented in the Remedial Design based on technical performance and economics of implementation.

4.2 Enhanced Groundwater Bioremediation Desktop Evaluation

Some Site-related COCs (i.e., BTEX and naphthalene) are known to be degraded by aerobic microorganisms. The primary technique for implementing the enhancing aerobic microorganisms is the addition of oxygen-releasing material (ORM) to degrade these COCs in subsurface saturated soils and groundwater. Several ORM are available (e.g., calcium peroxide, calcium hydroxide, magnesium hydroxide, calcium carbonate, hydrogen peroxide) and the characteristics vary depending on the material. ORMs release a fixed amount of oxygen into the surrounding environment at a specific rate. Most ORMs release oxygen over period of one year; however, this can vary depending on the oxygen demand of the aquifer, microorganisms, and the COC mass.

Following the PDI groundwater investigation, analytical results will be evaluated. Stoichiometric calculations of COC groundwater concentrations will provide the estimated oxygen necessary to degrade COCs. BOD and COD results will also be evaluated to identify the oxygen demand of microorganisms to degrade organic compounds and organic/inorganic compounds in the subsurface, respectively. Based on the total oxygen demand of the aquifer, an optimal ORM can be selected for the site. Additional details related to the ORM will be provided in the Remedial Design.

5. Remedial Design Activities

This section presents a description of the key remedial activities to be conducted for the OU 2 Project Area. Work activities associated with preparing the Remedial Design will be conducted under the following principal design tasks:

- Design Task 1 – Soil Excavation and Handling
- Design Task 2 – In-Situ Soil Solidification
- Design Task 3 – Subsurface Barrier Wall Construction
- Design Task 4 – Subsurface Mat Construction
- Design Task 5 – Enhanced Groundwater Bioremediation
- Design Task 6 – Waste Management
- Design Task 7 – 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, water management, noise/ vapor/dust suppression, air monitoring, characterization/verification sampling, equipment decontamination, site restoration, etc.) will be detailed in the Remedial Design.

For purposes of this work plan, these tasks are presented and discussed below as if one Remedial Design would be prepared for the OU 2 Project Area. However, based on the need to further evaluate potential changes to groundwater conditions following the soil remedial action, separate Remedial Designs are anticipated to be prepared for the soil and groundwater remedial measures at the OU 2 Project Area.

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

5.1 Design Task 1 – Soil Excavation and Handling

As indicated in the ROD and based on available information, an estimated 2,000 CY of shallow soil will be removed from the proposed ISS treatment area (0 to approximately

5 feet bgs), barrier wall alignment, and remaining work area (0 to approximately 2 feet bgs) to: (1) allow for soil bulking that will occur when ISS is implemented; (2) identify and protect subsurface utilities in Excelsior Avenue; and/or (3) provide a depth sufficient for equipment to enter the excavation and construct the subsurface mat. The soil removal volume and depth are subject to change based on the results of the PDI. The approximate horizontal limits of the proposed excavation area are shown on Figure 6. Before soil removal is performed, existing asphalt pavement, sub-base materials, and concrete curbing within Excelsior Avenue will be removed. These materials will be staged onsite for potential re-use as fill material and/or transported offsite 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 offsite disposal.

Various subsurface utilities are anticipated to be encountered within the proposed excavation area. Certain utilities may need to be left in-place and protected for subsequent ISS around the utilities. It may be possible to excavate and re-locate other utilities to facilitate subsequent ISS. The proposed handling of utilities will be further evaluated during the Remedial Design based on the findings of the PDI.

The top 2 feet of soil removed from the ISS and surrounding area will be transported for proper offsite disposal. Soil excavated between a depth of 2 and 5 feet bgs from the OU 2 Project Area that exhibits no visible NAPL, staining, or obvious odors will be stockpiled for potential re-use as subsurface fill. Samples of the stockpiled soil will be collected in accordance with the provisions in Section 5.4(e)10 of DER-10. As required by DER-10, the samples will be analyzed for VOCs, SVOCs, inorganic constituents, PCBs, and pesticides. In order for the soil to be deemed acceptable for subsurface re-use, the analytical results must be less than the SCOs for groundwater protection as presented in 6 NYCRR Part 375-6.8(b). The soil deemed acceptable for re-use will be placed below a demarcation layer that will be covered with at least 2 feet of imported clean backfill meeting restricted-residential use SCOs and groundwater protection SCOs. If the soil excavated between 2 and 5 feet bgs does not meet re-use criteria or otherwise exhibits unacceptable characteristics, then it will be transported for offsite treatment/ disposal.

Based on the proposed excavation depths and soil conditions in the OU 2 Project Area, a sidewall support system (e.g., consisting of sloping, benching, sheetpile) may be needed 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 Code of Federal Regulations (CFR) Part 1926 Subpart P. The design of this system, if needed, will be included in the Remedial Design and will consider measures needed (if any) to address the stability of Excelsior Avenue roadway adjacent to the excavation.

5.2 Design Task 2 – In-Situ Soil Solidification

The largest component of the remedy includes the ISS treatment of approximately 3,200 CY of soil (approximately 550 CY of which is impacted by DNAPL). This involves encapsulating DNAPL in soil by forming a solid material and restricting constituent migration by decreasing the surface area exposed to leaching and/or by coating the impacted soil with low-permeability materials. Solidification is accomplished by mechanical processes and by a chemical reaction between the soil/waste and binding (solidifying) reagents. Solidification of fine waste particles is referred to as microencapsulation, while solidification of a large block or container of waste is referred to as macroencapsulation.

The horizontal and vertical limits of ISS, as presented in the ROD, are shown on Figure 6. ISS within the above-described area will address DNAPL-containing subsurface soil at the site.

ISS would be performed by mixing binding reagents (a fluid grout containing a combination of water, Portland cement, bentonite, organo-clay, and/or blast furnace slag, as determined by the treatability study) into a column of soil. ISS will be accomplished by using a combination of auger mixing, bucket mixing, and/or jet grouting, as indicated below:

- *Auger Mixing* – This involves using a large crane or excavator-mounted drill to turn a special mixing tool into the soil while the fluid grout is pumped through the tool and mixed into the soil. The resulting material is generally a homogeneous mixture of soil and grout that hardens to become a weakly-cemented material. The mixing tool will be selected by the remedial Contractor, but is anticipated to be between 6 and 12 feet in diameter. In order to create continuous zones of treatment, the columns of mixed soil and cement are overlapped to provide continuity. This method could be supplemented by bucket mixing or jet grouting around obstacles/underground utilities where the augers would not otherwise achieve the needed solidification.

- *Bucket Mixing* – This involves using the bucket on an excavator to manually mix the fluid grout into the soil. A long-stick excavator would likely be required to achieve the anticipated mixing depths of 19 to 24 feet bgs at this Site. Mixing would be performed by mechanically turning the soil with the excavator bucket until the grout is evenly distributed throughout the soil and a solidified mass (monolith) is created. This method may be more suitable than auger mixing for working around obstacles/obstructions (such as subsurface construction and demolition debris) that would limit auger mixing.

- *Jet Grouting* – This involves injecting a fluid cement-bentonite grout into a column of soil using high pressure. Jet grouting would be used to form a panel of solidified soil in the vicinity of subsurface obstructions (e.g., utilities) to immobilize the soil without the need for excavation.

Excess materials will be generated during ISS treatment as a result of volume expansion (bulking) of soil when solidified by bucket/auger mixing or jet-grouting. The excess materials will consist of a mixture of soil, groundwater, and grout. The excess material volume is estimated to be 15 to 25% of the soil volume treated by the mixing tool method or 100% of the soil volume treated by the jet-grouting method. The volume expansion due to the ISS treatment will be evaluated during the Remedial Design based on the results of the treatability study. The excess materials generated by ISS will generally be managed within the limits of the excavation performed in preparation for ISS. However, based on the actual volume expansion, some of the excess materials may need to be transported for offsite disposal.

Quality assurance/quality control (QA/QC) sampling and analysis will be performed in connection with the ISS to verify that performance criteria are met for the solidified soil. If performance criteria are not specifically met in some locations, one of more of the following actions may be taken: (1) columns may be re-mixed; (2) additional solidifying agents may be added; or (3) other measures may be taken, as appropriate. The QA/QC sampling frequency and parameters, which are currently anticipated to be unconfined compressive strength and hydraulic conductivity, will be presented in the Remedial Design. Based on the information presented below, leaching is not anticipated to be specified in the Remedial Design as a QA/QC parameter:

- Previous investigation data indicate that COCs would not be found in leachate generated by TCLP sample extraction at concentrations exceeding regulatory limits (based on levels identified in samples submitted for analysis on a totals basis).

- Leaching will be further evaluated in conjunction with strength and hydraulic conductivity testing during the treatability study. It is expected that leaching goals will be achieved whenever strength and hydraulic conductivity goals are achieved. Assuming the treatability study demonstrates this is the case, strength and hydraulic conductivity will serve as a surrogate for leaching in the QA/QC program for full-scale ISS implementation.

5.3 Design Task 3 – Subsurface Barrier Wall Construction

A barrier wall surrounding the proposed subsurface mat will be installed within Excelsior Avenue as shown in Figure 6. The barrier wall will significantly decrease the flow of impacted groundwater from this area by forming a wall of low permeability material. Solidification of the proposed barrier wall is accomplished by mechanical processes and by a chemical reaction between the soil and binding (solidifying) reagents.

The final vertical limits of the proposed barrier wall will be determined during the Remedial Design based on the results of the PDI activities described under Subsection 2.3. Solidification will be performed by vertical jet grouting by mixing binding reagents (a fluid grout containing a combination of water, Portland cement, bentonite, and/or blast furnace slag as determined by the treatability study) into vertical columns along the alignment of the proposed barrier wall.

Excess materials will be generated during the barrier wall construction as a result of soil volume expansion (bulking) when solidifying by jet-grouting. Jet grout/slurry wall construction activities will displace approximately 100% of the existing soil along the proposed barrier wall alignment. The excess material will consist of a mixture of soil, groundwater, and grout. The volume of excess material from construction of the barrier wall will be evaluated during the Remedial Design based on the results of the treatability study, depth of the wall, and locations of existing utilities. Based on the actual volume of grout, the excess materials may need to be transported for offsite disposal as discussed in Subsection 4.1.

QA/QC sampling and analysis will be performed in connection with the jet grouting to verify that performance criteria are met for the solidified grout. If performance criteria are not specifically met in some locations, one or more of the following actions may be taken: (1) columns may be re-mixed; (2) additional solidifying agents may be added; or (3) other measures may be taken, as appropriate. The QA/QC sampling frequency and parameters, which are currently anticipated to be unconfined compressive strength and hydraulic conductivity, will be presented in the Remedial Design.

5.4 Design Task 4 – Subsurface Mat Construction

A horizontal subsurface barrier mat will be constructed beneath Excelsior Avenue between existing utilities and deeper potentially-impacted materials. The anticipated horizontal limits of the subsurface mat are shown on Figure 6. The final vertical limits of the proposed subsurface mat will be identified during the PDI and Remedial Design.

The subsurface mat installation method will be identified in the Remedial Design based on results of the PDI and treatability study activities, but is expected to be installed via horizontal jet grouting by mixing binding reagents (a fluid grout containing a combination of water, Portland cement, bentonite, and/or blast furnace slag as determined by the treatability study) into horizontal columns of soil or by installing horizontal perforated polyvinyl chloride (PVC) pipe and injecting the mixed binding reagents to permeate surrounding soils and harden in place.

Excess materials will be generated during subsurface mat construction as a result of soil volume expansion (bulking) when solidifying by jet-grouting. Jet grout/slurry wall construction activities will displace approximately 100% of the existing soil within the proposed subsurface mat area. The excess material will consist of a mixture of soil, groundwater, and grout. The volume of excess material from construction of the subsurface mat will be evaluated during the Remedial Design based on the results of the treatability study, physical characteristics of the underlying existing fill and soils, and locations of existing utilities. Based on the actual volume of grout, the excess materials may need to be transported for offsite disposal as discussed in Subsection 4.1.

QA/QC sampling and analysis will be performed in connection with the jet grouting to verify that performance criteria are met for the solidified soil. If performance criteria are not specifically met in some locations, one or more of the following actions may be taken: (1) columns may be re-mixed; (2) additional solidifying agents may be added; (3) other measure may be taken, as appropriate. The QA/QC sampling frequency and parameters, which are currently anticipated to be unconfined compressive strength and hydraulic conductivity, will be presented in the Remedial Design.

5.5 Design Task 5 – Enhanced Groundwater Bioremediation

In-situ groundwater treatment using bioremediation techniques will be implemented hydraulically side-gradient and downgradient from the soil remedial limits to degrade COCs in subsurface saturated soils and groundwater. The bioremediation techniques and mechanisms for delivering microbial enhancements will be determined based on the results of the enhanced groundwater bioremediation desktop evaluation. In addition to the desktop evaluation, potential changes to groundwater conditions and COC concentrations will be evaluated following soil remedial activities. As a result, the design of the groundwater component of this remedy will be prepared as a separate design deliverable package.

The design basis for this component of the remedy will include the following criteria:

- Eliminate or reduce (to the extent practicable) impacted groundwater migration downgradient from the site that does not attain New York State Groundwater Quality Standards for site-related COCs.
- Minimize disruption to property owners during the implementation of the groundwater remedy.
- Provide a treatment that is safe for construction personnel and the community.
- Provide a cost-effective system over the estimated operational timeframe, which will be assessed during the Remedial Design.

Based on the results of the enhanced groundwater bioremediation desktop evaluation, the groundwater remedial design is anticipated to involve drilling soil borings and backfilling with an ORM/grout mixture within the proposed groundwater treatment area. The design will include provisions for the subsequent groundwater monitoring, optimization of the treatment, and additional ORM application, if needed. The results of the enhanced groundwater bioremediation desktop evaluation will be used to determine the following design parameters:

- Soil boring spacing.
- Groundwater temperature and chemical and biological characteristics.
- ORM type.
- ORM delivery system.
- Anticipated degradation rates and activity characterization.
- Groundwater flow velocity, direction, and factors affecting flow.

- Zone of influence for ORM application.

The enhanced groundwater bioremediation desktop evaluation will provide the necessary information for the development of the Remedial Design. The Remedial Design will provide the information and details necessary for the successful construction and implementation of the enhanced groundwater bioremediation treatment system.

5.6 Design Task 6 – Waste Management

A section of the Remedial Design will be devoted to waste management and will address 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

5.7 Design Task 7 – Backfilling and Site Restoration

Following soil remedial activities, the paved portions of Excelsior Avenue, landscaping, and lawn areas that will be removed to facilitate soil remedial activities will be restored to their original condition, to the extent practical (e.g., if existing trees cannot be transplanted back to the area, new trees will be provided).

Fill removed from the excavation area that meets re-use criteria (analytical and geotechnical) will be placed on top of the solidified monolith. A visible demarcation layer will be placed at the interface of the re-use soil and imported clean fill placed to restore the area. In accordance with 6 NYCRR Part 375-6.7(d)(1)(ii)(b), imported soil backfill brought onsite for use as a soil cover or backfill must meet the lower of the restricted-residential use SCOs and the groundwater protection SCOs presented in 6 NYCRR Part 375-6.8(b). However, gravel, rock, or stone backfill that consists of virgin material from a permitted mine or quarry may be imported to the site without chemical testing (i.e., for use as backfill beneath pavement, buildings or as part of the final site cover) provided that it contains less than 10% by weight material that would pass through a size 80 sieve, and NYSDEC provides approval of the material source. In areas to be restored with grass, the thickness of the imported clean fill will be at least 2 feet.

Fill will also be placed, as needed, to achieve the base elevation required for the pavement cross-section. It is anticipated that the pavement cross-section will consist of several inches of dense-graded aggregate/stone sub-base materials and several inches of asphalt base, binder, and top course. The proposed replacement pavement cross-section (to be presented in the Remedial Design) will be determined based on review of as-built drawings from the construction of Excelsior Avenue and the paved parking lot (at the adjacent property), observations from soil borings completed during the proposed PDI, and city/owner specifications. Final restoration will include paving, installing concrete/granite curbs, placing topsoil in landscaped area, hydroseeding, and re-planting trees and shrubs.

6. Permits and Approvals

This section describes the permits and approvals to be obtained for the PDI phase of the project. Permits and approvals required for PDI activities are primarily anticipated to be associated with performing subsurface investigation within Excelsior Avenue and the associated right-of-way. Access agreements with the adjacent commercial property to the west and within the Spa Steel Property will also be confirmed and/or renewed, as necessary.

Regulatory and permitting requirements associated with implementing the soil remedial activities will be identified in the Remedial Design.

7. Remedial Design Documents

As indicated in Section 4, separate Remedial Designs will be prepared for soil and groundwater remedies for the OU 2 Project Area. The Remedial design will be submitted in phases and will include an Intermediate (60% Design), Pre-Final (90% Design), and Final Design (100% Design). The schedule for preparing the Remedial Designs is further discussed in Section 7.

The Intermediate Design will include the following: (1) design criteria; (2) results of the PDI and treatability studies; (3) results of additional field sampling and pre-design work, if any; (4) project delivery strategy; (5) preliminary drawings; and (6) a listing of anticipated specifications.

The Pre-Final and Final Remedial Design documents to be prepared for the soil remedy are described below. Consistent with the requirements set forth in DER-10 and the CD, it is anticipated that the soil Remedial Design will include the following information:

- 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 work performed and results obtained for the PDI and treatability studies.
- The basis of design for the proposed Remedial Design, including information and design calculations used to develop the design and construction components of the project.
- A detailed description of the selected remedy organized by design task (e.g., installation of erosion and sedimentation controls, soil excavation, excavation sidewall support, waste management, ISS, barrier wall and subsurface mat construction, site restoration, and decontamination).
- A description of Site controls to protect 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 activities described in the Remedial Design.

- 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, ARCADIS name, date prepared, sheet index and EPA project identification.

  - Existing Site Conditions – to include pertinent property data including owners of record for all properties adjacent to the OU 2 Project Area (as necessary); site survey including the distance and bearing of property lines that identify and define the project site; 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; 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.

  - Site Remediation Plan – to include minimum requirements for temporary erosion and sedimentation controls, Site facilities (parking areas, decontamination area, equipment/material lay down area), limits of the excavation, ISS treatment area, barrier wall alignment, subsurface mat area, 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.

  - 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, ISS, barrier wall construction, subsurface mat construction, water management, backfill, and support facilities.

- A description of operation, maintenance, and monitoring (OM&M) activities to be undertaken after the EPA has approved construction of the Remedial Design, including the number of years during which such activities will be performed.

- Construction Quality Assurance Project Plan for sampling, analysis, testing, and monitoring to be performed during remedial construction.

- A Community Air Monitoring Plan (CAMP) in accordance with the New York State Department of Health (NYSDOH) generic CAMP to identify the perimeter air monitoring requirements during the implementation of remedial construction activities.

- A HASP for the protection of construction workers implementing the remedial construction activities. This plan shall be prepared in accordance with 29 CFR 1910 by a certified health and safety professional.

- A Citizen Participation Plan (CPP) that incorporates appropriate activities outlined in the NYSDEC document titled “DER-23 / Citizen Participation Handbook for Remedial Programs” (DER-23), dated January 2010, and the EPA document titled “Superfund Community Involvement Handbook” (EPA 540-K05-003, Revision 4), dated April 2005.

- Preliminary remedial action schedule, which presents the anticipated schedule for implementing the final remedy.

- A description of the certification report to be prepared after the remedy has been implemented.

The Remedial Design will include finalized (i.e., biddable quality) versions of the text, specifications, drawings, and plans. As required by the CD, the Remedial Design will be stamped and signed by a Professional Engineer (PE) registered in the State of New York. EPA/NYSDOH comments (if any) will be addressed in a comment-response letter or a subsequent submittal of the Remedial Design, if needed.

The Remedial Design for the groundwater remedy will incorporate, by reference, various components of the soil Remedial Design. The approach for the Remedial Design for enhanced groundwater bioremediation will be further described in the Post-ISS Groundwater Summary Letter Report to be prepared following implementation of post-ISS groundwater monitoring.

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8. Remedial Design Schedule

This section presents the anticipated schedule for implementing the proposed PDI and treatability studies and preparing the Remedial Design for the Site. Work identified for the completion of these activities and the estimated milestone dates are as follows:

Activity	Milestones
RDWP	
• Submit "Draft" RDWP to EPA	June 19, 2013
• NYSDEC Review/Comments on RDWP	August 2, 2013
• EPA Review/Comments on RDWP	September 18, 2013
• Issue Letter Responding to EPA/NYSDEC Comments	October 18, 2013
• Submit QAPP to EPA	January 17, 2014
• EPA Approval of Response to NYSDEC Comments on RDWP	February 14, 2014
• EPA Provides Redline Markup of RDWP for NMPC Review	
• Accept EPA Changes, as Appropriate and Further Revise RDWP (Using EPA Markup Version) to Address NYSDEC Comments	March 30, 2014
• Revise/Finalize RDWP	1 week (following approval of Redline Markup)
• EPA Review/Approval of RDWP	TBD
New Consent Decree for Remedial Design/Remedial Action	
• EPA and NMPC Execute New Consent Decree	TBD
PDI / Treatability Studies (following EPA approval of the RDWP and execution of new Consent Decree)	
• Access Agreements	TBD
• EM/GPR Survey & Other Utility Verification Activities	7 months following securing access agreements and EPA approval of the RDWP
• Site Survey	
• Subsurface Soil Investigation	
• Groundwater Investigation	
• Laboratory Analysis	
• Groundwater Modeling	
• Enhanced Groundwater Bioremediation Desktop Evaluation	
• Soil Treatability Studies	
• Data Evaluation/PDI Report Preparation	

Activity	Milestones
Soil Remedial Design (submittals for EPA/NYSDEC Review)	
• Intermediate (60% Design)	6 months following completion of the PDI and preparation of the PDI summary letter
• Pre-Final (90% Design)	4 months following receipt of EPA/NYSDEC comments on 60% Design
• Final (100% Design)	2 months following receipt of EPA/NYSDEC comments on 90% Design

The project schedule is subject to change based on EPA timing for review/approval of this RDWP, execution and entry of a new Consent Decree for the OU 2 Project Area Remedial Design/Remedial Action, and review/approval of 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. In addition, the results of the initial PDI activities may dictate the need for supplemental PDI activities, which would lengthen the overall project schedule. The soil treatability studies and utility investigation activities may require additional time to complete to achieve project objectives, which could also lengthen the project schedule. NMPC will notify the EPA regarding delays that impact the schedule for completing the PDI, treatability studies, and design-related activities.

9. Post-Construction Activities

This section describes the anticipated activities to be completed following completion of the soil remedial action. Proposed post-construction activities and primarily related to the groundwater remedial action, including post-ISS groundwater monitoring and analysis, updating/refining the groundwater model to include post-ISS Site data, and preparation of the groundwater remedial design. Additional details related to the post- construction activities will be included in the Remedial Design.

10. References

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Tables

TABLE 1
APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS,
TO BE CONSIDERED CRITERIA, AND OTHER GUIDELINES

NIAGARA MOHAWK POWER CORPORATION
SUPERFUND SITE - OPERABLE UNIT 2 SITE
SARATOGA SPRINGS, NEW YORK
REMEDIAL DESIGN WORK PLAN

Regulation/Authority	Citation	Requirement Synopsis
Chemical-Specific ARARs, TBCs, and Other Guidelines		
Clean Water Act [Federal Water Pollution Control Act, as amended]	33 U.S.C. §§1251-1387; 40 CFR. Part 131	Authority for States to specify appropriate uses for bodies of water to achieve and protect. States may adopt sub-categories of use and to set appropriate criteria to reflect varying needs, including protecting aquatic life and/or human health depending on designated water use.
Clean Water Act (CWA) [Federal Water Pollution Control Act, as amended]	33 U.S.C. §§1251-1387; see CWA Sections 301, 304, 307, and 501(a); 40 CFR 136	Guidelines for establishing test procedures for the analysis of pollutants.
National Primary Drinking Water Standards	42 U.S.C. §§300f, 300g-1 through 330g-6, 300j-4 and j-9; 40 CFR Part 141, Subpart F	Establishes maximum contaminant levels (MCLs) which are health- based standards for public water supply systems.
RCRA-Regulated Levels for Toxic Characteristics Leaching Procedure (TCLP) Constituents	42 U.S.C. §§ 6905, 6912, 6921-6922; 40 CFR Part 261	These regulations specify the TCLP constituent levels for identification of hazardous wastes that exhibit the characteristic of toxicity.
Universal Treatment Standards/Land Disposal Restrictions (UTS/LDRs), Solid Waste Disposal Act, as amended	42 U.S.C.§§6905, 6912(a), 6921, 6924; 40 CFR Part 268	Identifies hazardous wastes for which land disposal is restricted and provides a set of numerical constituent concentration criteria at which hazardous waste is restricted from land disposal (without treatment).
NYSDEC Soil Cleanup Objectives	New York State Environmental Conservation Law (ECL), Article 27; 6 NYCRR Sections 375- 6.3(b) and 375-6.8(a)	NYSDEC Remedial Program Soil Cleanup Objectives are calculated values which were considered in developing the unrestricted use of soil cleanup objectives. Unrestricted use, as set forth in 375-1.8(g)(1)(i) and 375-6.3(b), is achieved when a remedial program for soil meets the unrestricted use soil cleanup objectives in
NYSDEC Ambient Water Quality Standards and Guidance Values	ECL, Article 17; 6 NYCRR Parts 700-706; Division of Water Technical and Operational Guidance Series (TOGS) 1.1.1 (6/98);	Provides a compilation of ambient water quality standards and guidance values for toxic and non-conventional pollutants (except for coliforms and dissolved oxygen) for use when there are no standards or regulatory effluent limitations in 6 NYCRR §703.5.
Identification and Listing of Hazardous Wastes	ECL Article 27; 6 NYCRR Part 371	Outlines criteria for determining if a solid waste is a hazardous waste and is subject to regulation under 6 NYCRR Parts 371-376.
New York State Surface Water and Groundwater Quality Standards	ECL §§3-0301[2][m], 15-0313, 17-0301, 17-0809; 6 NYCRR Part 703	Establishes water quality standards for surface water and groundwater.

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Location-Specific ARARs, TBCs, and Other Guidelines		
National Historic Preservation Act	16 U.S.C. §§470-470x-6; 36 C.F.R. Part 800	Establishes that response actions must take into account effect on properties currently listed or eligible for inclusion on the National Registry of Historic Places. Requires federal agencies to take into account the effects of their undertakings on historic properties and afford the council a reasonable opportunity to comment on such undertakings. This will include consultation with state and local governments, and private organizations as necessary.
New York Preservation of Historic Structures or Artifacts. NY Parks, Recreation and Historic Preservation Law (PRHPL)	NY PRHPL Sections §§3.09 (8), 14.09 (1), (2), 9 NYADMIN §428.1; 9 NYCRR §428.1	Requirements for preservation of historical/ archeological structures and/or artifacts.
Action-Specific ARARs, TBCs, and Other Guidelines		
Occupational Safety and Health Act (OSHA) - General Industry Standards	29 USC §553 and 42 USC§126; 29 CFR §1910.120	These regulations specify the 8-hour time-weighted average concentration for worker exposure to various compounds. Training requirements for workers at hazardous waste operations are specified in 29 CFR §1910.120.
OSHA – Safety and Health Standards	40 U.S.C. §333; 29 U.S.C. §§653, 655, 657; 29 CFR Part 1926	These regulations specify the type of safety equipment and procedures to be followed during site remediation.
OSHA – Recordkeeping, Reporting and Related Regulations	29 U.S.C. §§657, 658, 660, 669, 673; 29 CFR Part 1904	These regulations outline recordkeeping and reporting requirements for an employer under OSHA.
RCRA – Preparedness and Prevention	42 U.S.C. §§6905, 6912(a), 6924, and 6925; 40 CFR §§264.30 - 264.31	Outlines requirements for safety equipment and spill control when treating, handling and/or storing hazardous wastes.
RCRA – Contingency Plan and Emergency Procedures	42 U.S.C. §§6905, 6912(a), 6924, and 6925; 40 CFR §§ 264.50 - 264.56	Provides emergency procedures to be used following explosions, fires, etc. when storing hazardous wastes.
Superfund Green Remediation Strategy	www.epa.gov/superfund/greenremediation/sf-gr-strategy.pdf	Provides USEPA's strategy to clean up hazardous waste sites in ways that use natural resources and energy efficiently and reduces negative impacts on human health and the environment.
RCRA 90-Day Accumulation Rule for Hazardous Waste	42 U.S.C.§§ 6906, 6912, 6922-6925, 6937, and 6938; 40 CFR Part 262	Allows generators of hazardous waste to store and treat hazardous waste at the generation site for up to 90 days in tanks, containers and containment buildings without having to obtain a RCRA hazardous waste permit.

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Regulation/Authority	Citation	Requirement Synopsis
Action-Specific ARARs, TBCs, and Other Guidelines (con't)		
Standards Applicable to Transporters of Applicable Hazardous Waste – RCRA	42 U.S.C.§§ 6906, 6912, 6922-6925, 6937, and 6938; 40 CFR Part 263	Establishes the responsibility of off-site transporters of hazardous waste in the handling, transportation and management of the waste. Requires manifesting, recordkeeping and immediate action in the event of a discharge.
RCRA – General Standards	42 U.S.C. §§6905, 6912(a), 6924, and 6925; 40 CFR Part 264	General performance standards requiring minimization of need for further maintenance and control; minimization or elimination of post-closure escape of hazardous waste, hazardous constituents, leachate, contaminated runoff, or hazardous waste decomposition products. Also requires decontamination or disposal of contaminated equipment, structures and soils.
U.S. Department of Transportation (USDOT) Rules for Transportation of Hazardous Materials	49 CFR Parts 107 and 171.1-172.558	Outlines procedures for the packaging, labeling, manifesting and transporting of hazardous materials.
Clean Air Act-National Ambient Air Quality Standards	42 U.S.C. §§7401-7671q; 40 CFR Parts 50-52, 60, and 40	Establishes ambient air quality standards for protection of public health.
RCRA Hazardous Waste Permit Program	42 U.S.C. §6925; 40 CFR Part 270	Covers the basic permitting, application, monitoring and reporting requirements for off-site hazardous waste management facilities
Green Remediation	DER-31	Provides concepts and techniques of green remediation and guidance on how to apply them to remedial programs under DER.
New York Hazardous Waste Management System - General	ECL, Article 27; 6 NYCRR Part 370	Provides definitions of terms and general instructions for the Part 370 series of hazardous waste management.
Identification and Listing of Hazardous Wastes	ECL, Article 27; 6 NYCRR Part 371	Outlines criteria for determining if a solid waste is a hazardous waste and is subject to regulation under 6 NYCRR Parts 371-376.
Hazardous Waste Manifest System and Related Standards for Generators, Transporters, and Facilities	ECL, Article 27; 6 NYCRR Part 372	Provides guidelines relating to the use of the manifest system and its recordkeeping requirements. It applies to generators, transporters and facilities in New York State.
New York Regulations for Transportation of Hazardous Waste	ECL, Article 27; 6 NYCRR Part 372.3 a-d	Outlines procedures for the packaging, labeling, manifesting and transporting of hazardous waste.
Waste Transporter Permits	ECL, Article 27, Titles 3, 9, and 15; 6 NYCRR Part 364	Governs the collection, transport and delivery of regulated waste within New York State.

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Action-Specific ARARs, TBCs, and Other Guidelines (con't)		
New York Regulations for Hazardous Waste Management Facilities	ECL, Article 27; 6 NYCRR Part 373.1.1 - 373.1.8	Provides requirements and procedures for obtaining a permit to operate a hazardous waste treatment, storage and disposal facility. Also lists contents and conditions of permits.
Management of Soil and Sediment Contaminated With Coal Tar From Former Manufactured Gas Plants	NYSDEC Program Policy – TAGM 4061	Purpose of the guidance is to facilitate the permanent treatment of soil contaminated with coal tar from the sites of former MGPs.
Land Disposal of a Hazardous Waste	6 NYCRR Part 376	Restricts land disposal of hazardous wastes that exceed specific criteria.
NYSDEC Guidance on the Management of Coal Tar Waste and Coal Tar Contaminated Soils and Sediment from Former Manufactured Gas Plants	DER-4; TAGM 4061(2002)	Outlines the criteria for conditionally excluding coal tar waste and impacted soils from former MGPs which exhibit the hazardous characteristic of toxicity for benzene (D018) from the hazardous waste requirements of 6 NYCRR §§370-374 and 376 when destined for thermal treatment.

Notes:
1. CFR = Code of Federal Regulations
2. DER = Division of Environmental Remediation
3. MGP = manufactured gas plant
4. NYCRR = New York Codes, Rules, and Regulations
5. NYSDEC = New York State Department of Environmental Conservation
6. RCRA = Resource Conservation Recovery Act
7. TAGM = Technical and Administrative Guidance Memorandum
8. U.S.C. = United States Code
9. USEPA = United States Environmental Protection Agency

TABLE 2
PROPOSED PRE-DESIGN INVESTIGATION SAMPLING AND GAUGING SUMMARY

NIAGARA MOHAWK POWER CORPORATION
SUPERFUND SITE - OPERABLE UNIT 2
SARATOGA SPRINGS, NEW YORK
REMEDIAL DESIGN WORK PLAN

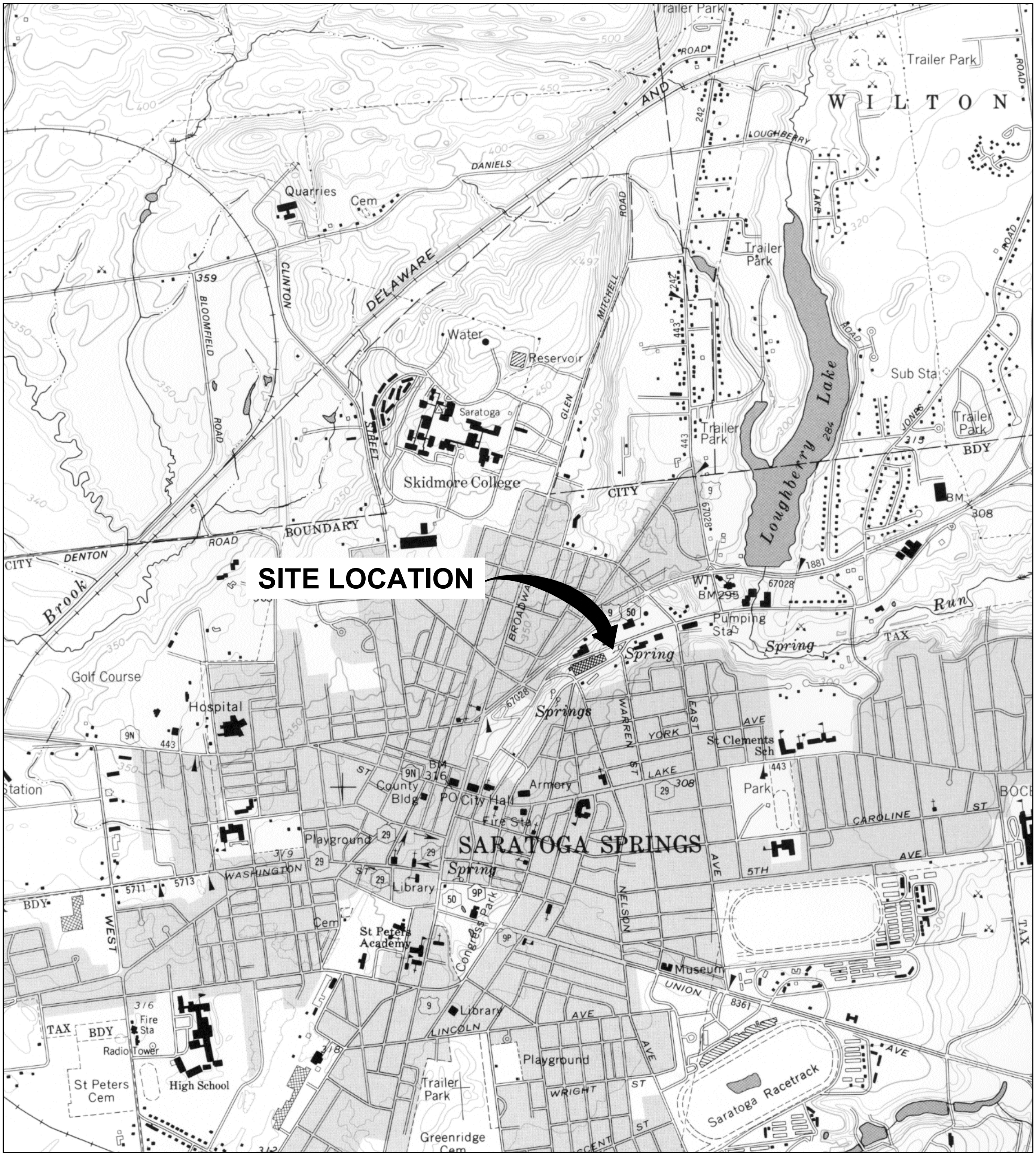
Location	Depth (feet bgs)	Soil Volume for Treatability Study			TCLP Parameters	I/C/R	PCBs	Shelby Tube Parameters	BTEX & Naphthalene	BOD & COD	Synoptic Water Level Gauging, DNAPL Gauging/ Removal, Conductivity Testing
		ISS	Barrier Wall	Subsurface Mat							
Soil Borings											
GT-01	11 - Top of Clay		X	X							
GT-02	11 - Top of Clay		X	X				X[A]			
GT-03	11 - Top of Clay		X	X							
GT-04	5 - Top of Clay	X									
GT-05	5 - Top of Clay	X						X[B]			
GT-06	5 - Top of Clay	X									
GT-07	5 - Top of Clay	X									
WC-1	0 - 2				X	X	X				
WC-2	0 - 2				X	X	X				
Monitoring Wells											
LTMP-12	- -										X
MW-SS-08-05	- -										X
MW-SS-08-08	- -								X	X	X
MW-SS-09-06	- -										X
MW-SS-09-07	- -								X	X	X
SS-06-01 / MW-EPA-01	- -										X
SS-06-03 / MW-EPA-02	- -										X
SS-06-04 / MW-EPA-03	- -										X
SS-06-07 / MW-EPA-04	- -								X	X	X
SS-06-08 / MW-EPA-05	- -										X
SS-06-09 / MW-EPA-06	- -										X
SS-06-12 / MW-EPA-07	- -								X	X	X
SS-06-14 / MW-EPA-08	- -										X
SS-06-16 / MW-EPA-09	- -										X
SS-06-18 / MW-EPA-10	- -										X
GW-IDW	- -					X			X		

TABLE 2
PROPOSED PDI SAMPLING AND GAUGING SUMMARY

NIAGARA MOHAWK POWER CORPORATION
SUPERFUND SITE - OPERABLE UNIT 2 SITE
SARATOGA SPRINGS, NEW YORK
REMEDIAL DESIGN WORK PLAN

Notes:
1. PDI = pre-design investigation.
2. bgs = below ground surface.
3. ISS = in-situ soil solidification.
4. TCLP = Toxicity Characteristic Leaching Procedure.
5. PCBs = polychlorinated biphenyls.
6. I/C/R = ignitiability, corrosivity, and reactivity.
7. BTEX = benzene, toluene, ethylbenzene, and xylenes.
8. BOD = biological oxygen demand.
9. COD = chemical oxygen demand.
10. DNAPL = dense non-aqueous phase liquid.
11. TCLP Parameters = VOCs, SVOCs, Metals, Pesticides, and Herbicides.
12. TOC = top of clay.
13. [A] = Up to 2 Shelby tube samples will be collected from GT-01 through GT-03.
14. **[B]** = 1 Shelby tube samples will be collected from GT-04 through GT-07.
15. Samples will be submitted for laboratory analysis of one or more of the following:
    - Toxic Characteristic Leaching Procedure (TCLP) extraction by USEPA SW-846 Method 1311 and analysis for:
        - VOCs using USEPA SW-846 Method 8260.
        - Semi Volatile Organic Compounds (SVOCs) using USEPA SW-846 Method 8270.
        - Metals using USEPA SW-846 Method 6010 and 7471.
        - Pesticides using USEPA SW-846 Method 8081.
        - Herbicides using USEPA SW-846 Method 8151.
    - PCBs using USEPA SW-846 Method 8082.
    - I/C/R by:
        - Ignitability using USEPA Method 1030.
        - pH by USEPA Method 9045.
        - Reactive cyanide using USEPA Method 9012.
        - Reactive sulfide using USEPA Method 9034.
    - Shelby tube by ASTM D1587 and:
        - Grain size by ASTM D-422.
        - Bulk density by ASTM D2937
        - Moisture content by ASTM D2216
        - Atterberg limits by ASTM D4318
        - Consolidation by ASTM D2435
        - Permeability by ASTM D5084
        - Shear strength by ASTM D2850 and D4767
    - BOD by Standard Method 5210B.
    - COD by USEPA Method 410.4.
16. - - = A depth is not applicable for the sample.
17. A check-mark (**X**) indicates analysis will be conducted.

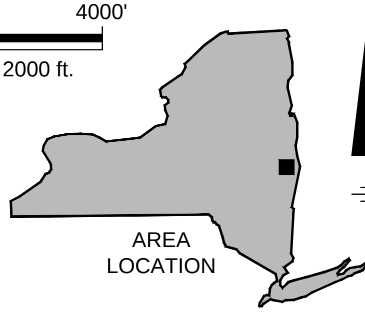
Figures



REFERENCE: BASE MAP USGS 7.5. MIN. TOPO. QUAD., SARATOGA SPRINGS, NY, 1983.

0 2000' 4000'

Approximate Scale: 1 in. = 2000 ft.



NIAGARA MOHAWK POWER CORPORATION
SUPERFUND SITE - OPERABLE UNIT 2
SARATOGA SPRINGS, NEW YORK

REMEDIAL DESIGN WORK PLAN

SITE LOCATION MAP

ARCADIS

FIGURE
1

CITY: SYRACUSE, NY DIV/GROUP: ENV/IEST/IM-DV DB: P. LISTER PM/TM/TR: M. HYSELL LYR: ON=*;OFF=*REF* PAGESETUP: C-PA-PDF PLOTSTYLETABLE: PLTFULL.CTB PLOTTED: 3/10/2014 10:26 AM BY: LISTER, PAUL
G:\ENVCAD\SYRACUSE\ACT\B0036641\0001\00001\DWG\36641N01.DWG LAYOUT: 1 SAVED: 3/10/2014 10:25 AM ACADVER: 18.1S (LMS TECH)
XREFS: 36641PA IMAGES: 36641X01.TIF PROJECTNAME: ----

LEGEND:

AREA BOUNDARY

0 200 400 Feet

GRAPHIC SCALE

NOTES:

1. 2010 IMAGERY PROVIDED BY BING IMAGERY SERVICE LICENSED THROUGH ESRI SOFTWARE.
2. NMPC - NIAGARA MOHAWK POWER CORPORATION
3. OU - OPERABLE UNIT

NIAGARA MOHAWK POWER CORPORATION
SUPERFUND SITE - OPERABLE UNIT 2
SARATOGA SPRINGS, NEW YORK

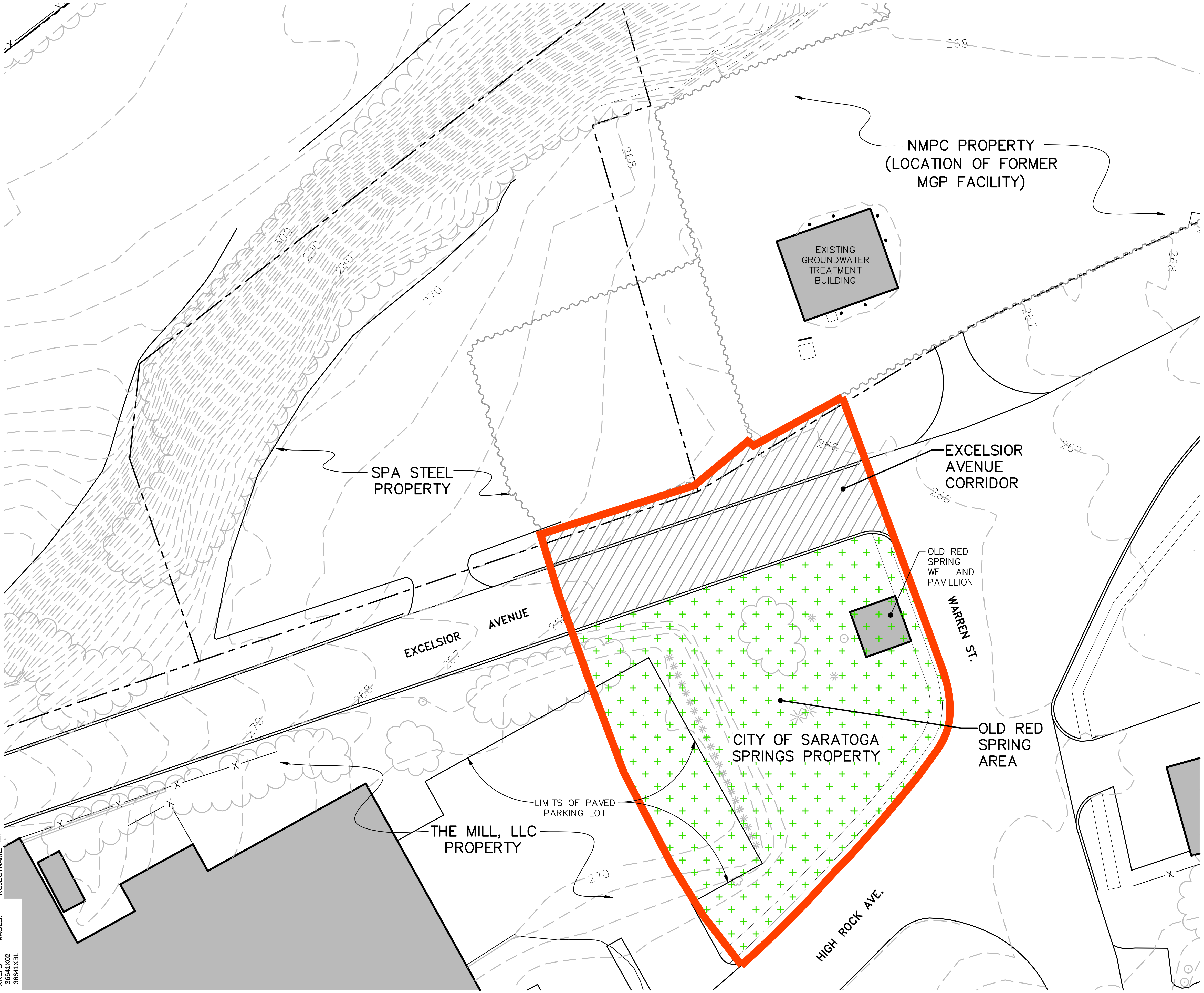
REMEDIAL DESIGN WORK PLAN

AERIAL PHOTOGRAPH

ARCADIS

FIGURE **2**

City:SYR Div/Group: SWG Created By: Jayme Rapp Last Saved By: jrapp
Nat Grid Saratoga Springs (36614.0.256)
Q:\NationalGrid\SaratogaSpringsMGP\RemedialDesignWorkPlan\mxd\SiteMap.mxd 3/10/2014 1:45:36 PM



LEGEND:

- PROPERTY LINE (APPROXIMATE)
- CHAINLINK FENCE
- GROUND SURFACE CONTOUR (ONE–FOOT INTERVAL)
- EXISTING SUBGRADE SHEET PILE BARRIER WALL
- TREE/BRUSH LINE
- TREE/BUSH
- BUILDING/STRUCTURE
- OLD RED SPRING AREA
- EXCELSIOR AVENUE CORRIDOR
- OPERABLE UNIT 2

NOTES:

1. BASE MAPPING WAS COMPILED FROM A COMBINATION OF STEREOPHOTOGRAMMETRIC METHODS; AERIAL PHOTOGRAPHY FLOWN ON 8/96 AND 11/98 BY LOCKWOOD MAPPING COMPANY; AS–BUILT RECORD DRAWINGS FOR COMPLETED REMEDIATION ACTIVITIES AT THE SPA STEEL PRODUCTS PROPERTY; AND FIELD SURVEY METHODS ON 5/96, PROVIDED BY NIAGARA MOHAWK, SURVEY REFERENCE FILE NO. 3435, FILE INDEX 21.0–S2.18–M49, AND A NEW SURVEY FILE NO. 01135–1.DWG RECEIVED 8/19/02.
2. PROPERTY INFORMATION TAKEN FROM "CITY OF SARATOGA SPRINGS, SARATOGA COUNTY, N.Y. TAX MAPS" NUMBERED 153.00(OD), 166.00(OD), 165.36(ID), 166.00(ID), 166.05(ID), 166.11(ID), 166.21(ID), 166.29(ID), 166.30(ID), 166.31(ID), 166.37(ID), 166.38(ID), AND 166.39(ID).
3. NMPC = NIAGARA MOHAWK POWER CORPORATION.
4. MGP = MANUFACTURED GAS PLANT.
5. ELEVATIONS ARE BASED ON NAVD 88 USING STATION G396, ELEVATION 306.010 FEET.

0 40' 80'
GRAPHIC SCALE

NIAGARA MOHAWK POWER CORPORATION
SUPERFUND SITE - OPERABLE UNIT 2
SARATOGA SPRINGS, NEW YORK

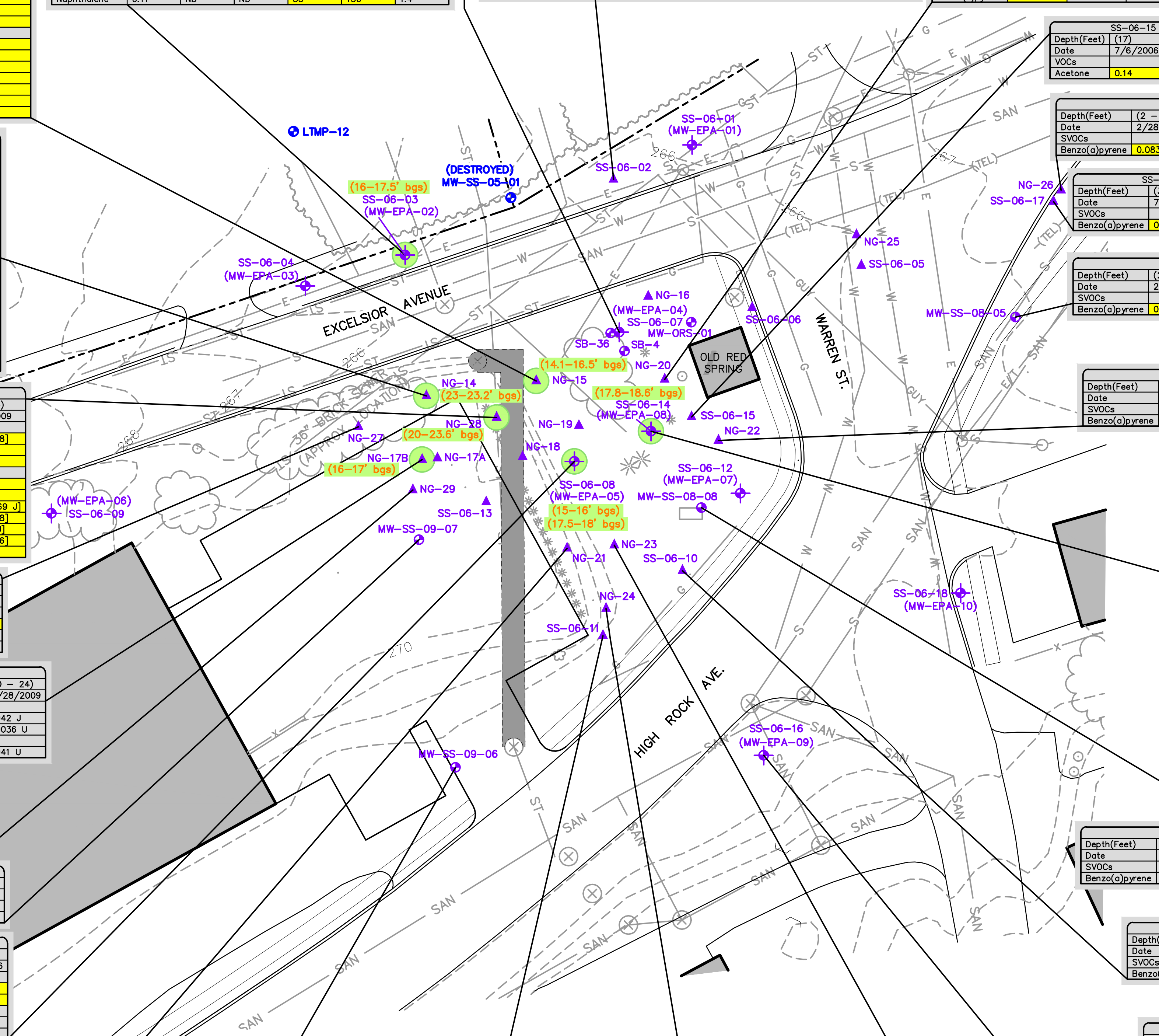
REMEDIAL DESIGN WORK PLAN

OU-2 PROJECT AREA AND SURROUNDING AREAS

ARCADIS

FIGURE
3

CITY: SYRACUSE NY DIV/GROUP: ENVCAD DB: R. BASSETT, R.ALLEN, E. KRAHMER LD: (Opt.) PIC: T. YOUNG PM/TM: J. BRUSSEL TR: M. HYSELL LYR: ON=*;OFF=*REF* BY: KRAHMER, ERIC
G:\ENVCAD\SYRACUSE\ACT\B0036641\0001\00001\DWG\36641C03.DWG LAYOUT: 4 SAVED: 5/6/2014 2:38 PM ACADVER: 18.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: PLTFULL.CTB PLOTTED: 5/7/2014 5:22 PM
IMAGES: PROJECTNAME: ----
XREFS: 36641X02 36641X01 36641XBL_OU2



SS-06-07				
Depth(Feet)	(9.5)	(14)	(15)	(15.5)
Date	7/6/2006	7/6/2006	7/6/2006	7/6/2006
VOCs				
Benzene	ND	ND	ND	0.29

SS-06-02						
Depth(Feet)	(0.5)	(2)	(7.5)	(11.5)	(17)	(17.5)
Date	7/6/2006	7/6/2006	7/6/2006	7/6/2006	7/6/2006	7/6/2006
VOCs						
1,2,4–Trimethylbenzene	ND	ND	ND	85	1.2	1.9
2–Butanone	ND	ND	0.0019	0.68	ND	ND
Acetone	ND	ND	ND	2.6	ND	ND
Benzene	ND	ND	ND	1.3	2.4	ND
Ethylbenzene	ND	ND	ND	ND	3.0	2.8
n–Propylbenzene	ND	ND	ND	4.8	ND	ND
Xylenes (total)	ND	ND	ND	0.52	1.6	2.3
SVOCs						
Benzo(a)pyrene	2.3	0.41	ND	ND	ND	ND
Benzo(k)fluoranthene	1.9	0.40	ND	ND	ND	ND
Chrysene	3.0	0.44	ND	ND	ND	ND
Naphthalene	1.9	ND	ND	11	19	69

SS-06-03						
Depth(Feet)	(2.5)	(3)	(6.5)	(16)	(17.5)	(18)
Date	7/6/2006	7/6/2006	7/6/2006	7/6/2006	7/6/2006	7/6/2006
VOCs						
Benzene	ND	ND	ND	0.23	ND	ND
Ethylbenzene	ND	ND	ND	1.5	7.5	ND
Xylenes (total)	ND	ND	ND	1.1	3.4	ND
SVOCs						
Benzo(a)pyrene	0.31	ND	ND	ND	ND	0.11
Naphthalene	0.11	ND	ND	35	150	1.4

NG-15				
Depth(Feet)	(2 – 4)	(6 – 8)	(8 – 12)	(12 – 16.5)
Date	10/26/2009	10/26/2009	10/28/2009	10/28/2009
VOCs				
2–Butanone	0.011 U	0.012 U	0.45 J	1.4 U
Acetone	0.011 U	0.012 UB	0.97 J	1.4 U
Benzene	0.0011 U	0.0012 U	0.20	0.56
Ethylbenzene	0.0011 U	0.0012 U	0.15 U	7.1
Xylenes (total)	0.0034 U	0.0036 U	0.45 U	6.0
SVOCs				
Benzo(a)anthracene	0.29	0.040 U	0.051 U	3.1
Benzo(a)pyrene	0.27	0.040 U	0.051 U	2.3
Benzo(b)fluoranthene	0.40	0.040 U	0.051 U	1.6
Benzo(k)fluoranthene	0.18	0.040 U	0.051 U	0.98
Chrysene	0.29 J	0.40 U	0.51 U	2.9
Indeno(1,2,3–cd)pyrene	0.23	0.040 U	0.051 U	0.92
Naphthalene	0.38 U	0.40 U	0.51 U	40

NG-20				
Depth(Feet)	(2 – 4)	(6 – 8)	(12 – 14)	(17 – 19)
Date	2/26/2008	2/26/2008	2/26/2008	2/26/2008
VOCs				
Acetone	0.0056 U	0.066 J	0.056 UJ [0.012 UJ]	0.056 J
SVOCs				
Benzo(a)pyrene	0.19	0.040 U	0.048 U [0.044 U]	0.043 U

SS-06-15		
Depth(Feet)	(17)	(17.5)
Date	7/6/2006	7/6/2006
VOCs		
Acetone	0.14	ND

NG-26				
Depth(Feet)	(2 – 4)	(6 – 8)	(12 – 14)	(18 – 20)
Date	2/28/2008	2/28/2008	2/28/2008	2/28/2008
SVOCs				
Benzo(a)pyrene	0.083	0.046 U	0.043 U	0.046 U

SS-06-17		
Depth(Feet)	(3)	(3.5)
Date	7/6/2006	7/6/2006
SVOCs		
Benzo(a)pyrene	0.23	ND

MW-SS-08-05				
Depth(Feet)	(2 – 4)	(6 – 8)	(9.5 – 11.5)	(18 – 20)
Date	2/28/2008	2/28/2008	2/28/2008	2/28/2008
SVOCs				
Benzo(a)pyrene	0.32	0.043 U	0.043 U	0.044 U

NG-22				
Depth(Feet)	(2 – 4)	(6 – 8)	(12 – 14)	(17 – 19)
Date	2/26/2008	2/26/2008	2/26/2008	2/26/2008
SVOCs				
Benzo(a)pyrene	0.10	0.041 U	0.050 U	0.044 U

NG-14				
Depth(Feet)	(2 – 4)	(6 – 8)	(12 – 14)	(21 – 23)
Date	2/27/2008	2/27/2008	2/27/2008	2/27/2008
VOCs				
Acetone	0.0056 UJ	0.0059 UJ	0.077 J	0.64 U
Benzene	0.0011 U	0.0012 U	0.0010 J	0.36
Ethylbenzene	0.0045 U	0.0048 U	0.0062 U	4.7
Toluene	0.0056 U	0.0059 U	0.0078 U	1.1
Xylenes (total)	0.0056 U	0.0059 U	0.0078 U	8.9
SVOCs				
Acenaphthene	0.37 U	0.015 J	0.54 U	83
Benzo(a)anthracene	0.046	0.36	0.054 U	22
Benzo(a)pyrene	0.037 J	0.39	0.054 U	17
Benzo(b)fluoranthene	0.027 J	0.36	0.054 U	5.5
Benzo(k)fluoranthene	0.037 J	0.53	0.054 U	11
Chrysene	0.052 J	0.43	0.54 U	21
Dibenzo(a,h)anthracene	0.037 U	0.053	0.054 U	1.5
Fluorene	0.37 U	0.40 U	0.54 U	45
Indeno(1,2,3–cd)pyrene	0.023 J	0.14	0.054 U	5.7
Naphthalene	0.37 U	0.028 J	0.54 U	180
Phenanthrene	0.065 J	0.36 J	0.54 U	140

NG-28				
Depth(Feet)	(2 – 4)	(6 – 7.5)	(12 – 16)	(20 – 24)
Date	10/26/2009	10/26/2009	10/28/2009	10/28/2009
VOCs				
Benzene	0.0011 U	0.0011 U	0.0017 U	0.72 [0.58]
Ethylbenzene	0.0011 U	0.0011 U	0.0045	4.8 [2.6]
Xylenes (total)	0.0032 U	0.0034 U	0.0015 J	4.3 [2.3]
SVOCs				
Benzo(a)anthracene	0.036 U	0.086	0.13	3.1 [1.5]
Benzo(a)pyrene	0.036 U	0.097	0.11	2.7 [1.1]
Benzo(b)fluoranthene	0.036 U	0.17	0.14	1.7 J [0.69 J]
Benzo(k)fluoranthene	0.036 U	0.049	0.076	0.93 [0.38]
Chrysene	0.36 U	0.12 J	0.13 J	3.1 [1.4 J]
Indeno(1,2,3–cd)pyrene	0.036 U	0.095	0.077	0.82 [0.36]
Naphthalene	0.36 U	0.39 U	0.56 U	39 [13]

NG-27				
Depth(Feet)	(2 – 4)	(6 – 8)	(12 – 14)	(21 – 23)
Date	2/29/2008	2/29/2008	2/29/2008	2/29/2008
VOCs				
Acetone	0.013 UJ	0.0054 UJ	0.019 UJ	0.068 J [0.023 UJ]
SVOCs				
Benzo(a)pyrene	0.036 U	0.19	0.037 U	0.048 U [0.041 U]

NG-17					
Depth(Feet)	(2 – 4)	(6 – 8)	(12 – 16)	(16 – 20)	(20 – 24)
Date	10/27/2009	10/27/2009	10/28/2009	10/28/2009	10/28/2009
VOCs					
Acetone	0.012 UB	0.012 U	0.12	1.6 U	0.042 J
Xylenes (total)	0.0037 U	0.0035 U	0.0042 U	0.46 J	0.0036 U
SVOCs					
Benzo(a)pyrene	0.041 U	0.13	0.049 U	0.090	0.041 U

NG-29				
Depth(Feet)	(2 – 4)	(5 – 9)	(13 – 17)	(21 – 23)
Date	10/28/2009	10/28/2009	10/28/2009	10/28/2009
VOCs				
Acetone	0.013 U	0.012 U	0.088 J	0.027
SVOCs				
Benzo(a)pyrene	0.046 U	0.035 J	0.16	0.039 U

MW-SS-09-07				
Depth(Feet)	(2 – 4)	(6 – 8)	(12 – 14)	(18 – 22)
Date	10/27/2009	10/27/2009	10/27/2009	10/27/2009
VOCs				
Acetone	0.011 UB [0.012 UB]	0.020 UB	0.10	0.047 UB

SS-06-08				
Depth(Feet)	(15.5)	(16)	(17)	(17.5)
Date	7/6/2006	7/6/2006	7/6/2006	7/6/2006
VOCs				
Ethylbenzene	ND	0.79 [ND]	ND	120
Xylenes (total)	ND	0.51 [ND]	ND	78
SVOCs				
Acenaphthene	ND	ND [ND]	71	ND
Benzo(a)pyrene	ND	ND [ND]	130	ND
Benzo(b)fluoranthene	ND	ND [ND]	7.8	ND
Benzo(k)fluoranthene	ND	ND [ND]	5.6	ND
Chrysene	ND	ND [ND]	18	ND
Fluorene	ND	ND [ND]	51	ND
Indeno(1,2,3–cd)pyrene	ND	ND [ND]	4.5	ND
Naphthalene	1.1	19 [490]	160	2000
Phenanthrene	0.19	ND [ND]	160	ND

SS-06-14		
Depth(Feet)	(8)	(17.5)
Date	7/6/2006	7/6/2006
VOCs		
1,2,4–Trimethylbenzene	120	ND
1,3,5–Trimethylbenzene	24	ND
Benzene	28	ND
Ethylbenzene	300	ND
Toluene	120	ND
Xylenes (total)	280	ND
SVOCs		
Acenaphthene	ND	400
Acenaphthylene	ND	430
Anthracene	ND	330
Benzo(a)anthracene	ND	130
Benzo(a)pyrene	ND	120
Benzo(b)fluoranthene	ND	49
Benzo(k)fluoranthene	ND	62
Chrysene	ND	150
Dibenzofuran	ND	30
Fluoranthene	ND	330
Fluorene	ND	350
Indeno(1,2,3–cd)pyrene	ND	34
Naphthalene	5400	2000
Phenanthrene	ND	1100
Pyrene	ND	490

MW-SS-08-08				
Depth(Feet)	(6 – 8)	(8)	(12 – 14)	(17 – 19)
Date	2/27/2008	2/27/2008	2/27/2008	2/27/2008
SVOCs				
Benzo(a)pyrene	0.041 U	0.24	0.043 U	0.043 U

SS-06-10			
Depth(Feet)	(2)	(16)	(16.5)
Date	7/6/2006	7/6/2006	7/6/2006
SVOCs			
Benzo(a)pyrene	ND	0.13	ND

SS-06-16		
Depth(Feet)	(14.5)	(15.5)
Date	7/6/2006	7/6/2006
VOCs		
Acetone	0.18	ND
SVOCs		
Benzo(a)pyrene	ND	0.13

NG-21				
Depth(Feet)	(2 – 4)	(6 – 8)	(13 – 17)	(17 – 21)
Date	10/27/2009	10/27/2009	10/28/2009	10/28/2009
VOCs				
Acetone	0.011 U	0.011 UB	0.11	1.2 U
Benzene	0.0011 U	0.0011 U	0.0026	0.15
Xylenes (total)	0.0032 U	0.0032 U	0.0049	0.36 J

MW-SS-09-06				
Depth(Feet)	(2 – 4)	(6 – 8)	(12 – 16)	(16 – 20)
Date	10/27/2009	10/27/2009	10/27/2009	10/27/2009
VOCs				
Acetone	0.017 UB	0.011 UB	0.79 J	0.089 UB
SVOCs				
Benzo(a)pyrene	0.065	0.039 U	0.042 U	0.041 U

SS-06-11		
Depth(Feet)	(17)	(17.5)
Date	7/6/2006	7/6/2006
VOCs		
Acetone	ND	0.056
Benzene	ND	0.26

NG-24				
Depth(Feet)	(2 – 4)	(6 – 8)	(14 – 16)	(18 – 20)
Date	2/27/2008	2/27/2008	2/27/2008	2/27/2008
VOCs				
Acetone	0.0075 UJ	0.0095 UJ	0.085 J	0.095 J
Benzene	0.0011 U	0.0011 U	0.0052	0.067
SVOCs				
Benzo(a)pyrene	0.030 J	0.038 U	0.047 U	0.043 U

NG-23				
Depth(Feet)	(2 – 4)	(6 – 6.5)	(6.5 – 8)	(8 – 12)
Date	10/26/2009	10/26/2009	10/28/2009	10/28/2009
VOCs				
Acetone	0.013 U	0.013 U	0.13	0.17
Benzene	0.0013 U	0.0013 U	0.0029	0.069
SVOCs				
Benzo(a)pyrene	0.16	0.045 U	0.082 U	0.083 U

LEGEND:

- PROPERTY LINE (APPROXIMATE)
- CHAINLINK FENCE
- GROUND SURFACE CONTOUR (ONE–FOOT INTERVAL)
- EXISTING SUBGRADE SHEET PILE BARRIER WALL
- TREE/BRUSH LINE
- TREE/BUSH
- BUILDING/STRUCTURE
- ASSUMED MANHOLE AND BOX CULVERT
- CATCH BASIN
- MANHOLE
- UTILITY POLE
- W — WATER LINE (APPROXIMATE)
- G — GAS LINE (APPROXIMATE)
- S — SANITARY SEWER (APPROXIMATE)
- ST — STORM SEWER (APPROXIMATE)
- OH — OVERHEAD UTILITY LINE (APPROXIMATE)
- SOIL BORING LOCATION
- MONITORING WELL LOCATION
- SOIL BORING/MONITORING WELL LOCATION
- TAR–LIKE MATERIAL AND/OR NAPL OBSERVED AT GIVEN INTERVAL (FEET BGS)

NOTES:

1. BASE MAPPING WAS COMPILED FROM A COMBINATION OF STEREOPHOTOGRAMMETRIC METHODS; AERIAL PHOTOGRAPHY FLOWN ON 8/96 AND 11/98 BY LOCKWOOD MAPPING COMPANY; AS–BUILT RECORD DRAWINGS FOR COMPLETED REMEDIATION ACTIVITIES AT THE SPA STEEL PRODUCTS PROPERTY; AND FIELD SURVEY METHODS ON 5/96, PROVIDED BY NIAGARA MOHAWK, SURVEY REFERENCE FILE NO. 3435, FILE INDEX 21.0–S2.18–M49, AND A NEW SURVEY FILE NO. 01135–1.DWG RECEIVED 8/19/02.
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3. EXISTING UTILITY INFORMATION PROVIDED BY NIAGARA MOHAWK POWER CORPORATION, TAKEN FROM MAPPING DEVELOPED BY S.Y. KIM LAND SURVEYOR, P.C. PROJECT NO. 730135, JOB NO. 43–219–97, DATED JANUARY 12, 1998.
4. CONCENTRATIONS GIVEN IN MILLIGRAMS PER KILOGRAM (mg/kg) OR PARTS PER MILLION (ppm).
5. SHADED VALUES EXCEED NYSDEC PART 375, UNRESTRICTED SOIL CLEANUP OBJECTIVES.
   ND = NOT DETECTED.
   U = NOT DETECTED ABOVE GIVEN VALUE.
   J = ESTIMATED CONCENTRATION.
   [ ] = DUPLICATE SAMPLE.
   B = ANALYTE WAS ALSO DETECTED IN THE METHOD BLANK.

0 50' 100'
GRAPHIC SCALE

NIAGARA MOHAWK POWER CORPORATION
SUPERFUND SITE - OPERABLE UNIT 2
SARATOGA SPRINGS, NEW YORK
REMEDIAL DESIGN WORK PLAN

PART 375-UNRESTRICTED SOIL EXCEEDANCES

ARCADIS

FIGURE
4

MW-EPA-02			
Date	7/27/2006	3/26/2008	5/21/2009
VOCs			
Benzene	4.2	3.8	2.9
Ethylbenzene	1.7	4.0 U	8.5
SVOCs			
Naphthalene	12	0.94 U	200

MW-EPA-03	
Date	7/28/2006
VOCs and SVOCs	No Exceedances

LTMW-12	
Date	5/22/2009
VOCs and SVOCs	No Exceedances

MW-SS-05-01	
Date	7/28/2006
VOCs	
Benzene	5800
Ethylbenzene	810
Toluene	400
Xylenes (total)	690 J
SVOCs	
1,1'-Biphenyl	19
Phenol	20
Naphthalene	2500

MW-EPA-04			
Date	7/27/2006	3/26/2008	5/21/2009
VOCs			
Benzene	1500	910	2300
Ethylbenzene	61	140	85
Methylene chloride	28 J	15 U	25 U
Toluene	50 U	5.6 J	6.2 J
Xylenes (total)	51 J	76	46 J
SVOCs			
Acenaphthene	9.5 U	22 J	23
Naphthalene	270	820	420
Phenol	17	50 U	4.0 J

MW-EPA-01			
Date	7/28/2006	3/26/2008	5/20/2009
VOCs and SVOCs	No Exceedances		

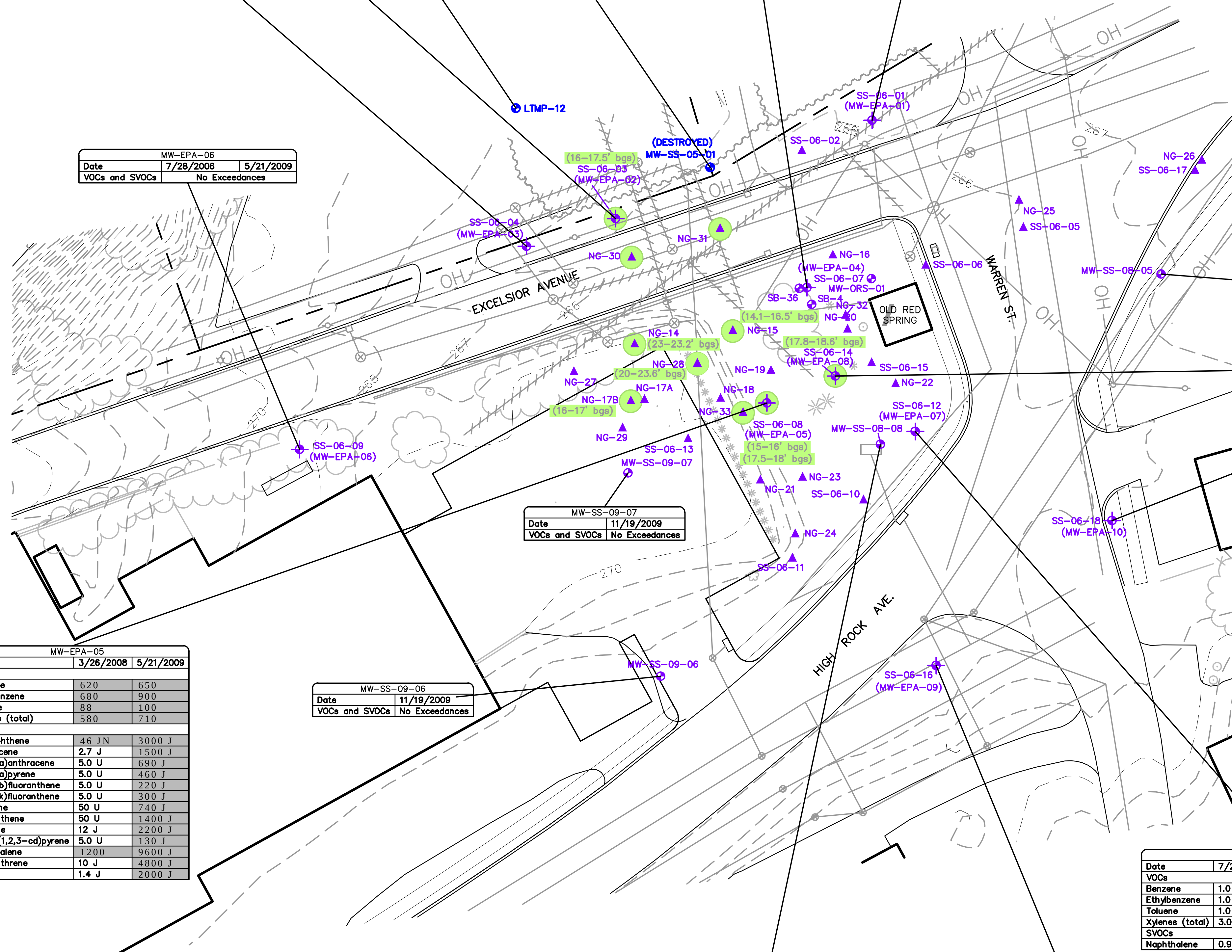
MW-EPA-06		
Date	7/28/2006	5/21/2009
VOCs and SVOCs	No Exceedances	

Groundwater Quality Standards and Guidance Values		
Consituent	NYSDEC TOGs 1.1.1	USEPA MCLs
VOCs		
Benzene	1	5
Ethylbenzene	5	700
Methylene chloride	5	5
Toluene	5	1000
Xylenes (total)	5	10000
SVOCs		
1,1'-Biphenyl	5	--
Acenaphthene	20	--
Anthracene	50	--
Benzo(a)anthracene	0.002	--
Benzo(a)pyrene	ND	0.2
Benzo(b)fluoranthene	0.002	--
Benzo(k)fluoranthene	0.002	--
Chrysene	0.002	--
Fluoranthene	50	--
Fluorene	50	--
Indeno(1,2,3-cd)pyrene	0.002	--
Naphthalene	10	--
Phenanthrene	50	--
Phenol	1	--
Pyrene	50	--

MW-08-05	
Date	5/22/2009
VOCs and SVOCs	No Exceedances

MW-EPA-08	
Date	5/22/2009
VOCs	
Benzene	630
Ethylbenzene	920
Toluene	460
Xylenes (total)	1100
SVOCs	
Acenaphthene	160 J
Fluorene	66 J
Naphthalene	3500 J

MW-EPA-10			
Date	7/26/2006	3/27/2008	5/20/2009
PAHs			
Chrysene	0.030 J	0.19 U	NA



MW-SS-09-07	
Date	11/19/2009
VOCs and SVOCs	No Exceedances

MW-EPA-05		
Date	3/26/2008	5/21/2009
VOCs		
Benzene	620	650
Ethylbenzene	680	900
Toluene	88	100
Xylenes (total)	580	710
SVOCs		
Acenaphthene	46 JN	3000 J
Anthracene	2.7 J	1500 J
Benzo(a)anthracene	5.0 U	690 J
Benzo(a)pyrene	5.0 U	460 J
Benzo(b)fluoranthene	5.0 U	220 J
Benzo(k)fluoranthene	5.0 U	300 J
Chrysene	50 U	740 J
Fluoranthene	50 U	1400 J
Fluorene	12 J	2200 J
Indeno(1,2,3-cd)pyrene	5.0 U	130 J
Naphthalene	1200	9600 J
Phenanthrene	10 J	4800 J
Pyrene	1.4 J	2000 J

MW-SS-09-06	
Date	11/19/2009
VOCs and SVOCs	No Exceedances

MW-EPA-07			
Date	7/27/2006	3/26/2008	5/22/2009
VOCs			
Benzene	1.0 U [1.0 U]	140	130 J [47 J]
Ethylbenzene	1.0 U [1.0 U]	200	150 J [48 J]
Toluene	1.0 U [1.0 U]	230	75 J [25 J]
Xylenes (total)	3.0 U [3.0 U]	190	150 J [47 J]
SVOCs			
Naphthalene	0.95 U [0.95 U]	130	750 [950 J]

MW-08-08			
Date	3/26/2008	5/21/2009	5/22/2009
VOCs and SVOCs	No Exceedances		

MW-EPA-09			
Date	7/28/2006	3/27/2008	5/20/2009
VOCs and SVOCs	No Exceedances		

LEGEND:

- SOIL BORING LOCATION
- MONITORING WELL LOCATION
- SOIL BORING/MONITORING WELL LOCATION
- TAR-LIKE MATERIAL AND/OR NAPL OBSERVED AT GIVEN INTERVAL (FEET BGS)
- SHADED VALUES EXCEED THE CORRESPONDING NYSDEC CLASS GA GROUNDWATER STANDARD (TOGS 1.1.1, JUNE 1998) AND/OR FEDERAL MAXIMUM CONTAMINANTS LEVEL.
- PROPERTY LINE (APPROXIMATE)
- CHAINLINK FENCE
- GROUND SURFACE CONTOUR (ONE-FOOT INTERVAL)
- EXISTING SUBGRADE SHEET PILE BARRIER WALL
- TREE/BRUSH LINE
- TREE/BUSH
- BUILDING/STRUCTURE
- CATCH BASIN
- MANHOLE
- UTILITY POLE
- WATER LINE (APPROXIMATE)
- GAS LINE (APPROXIMATE)
- SANITARY SEWER (APPROXIMATE)
- STORM SEWER (APPROXIMATE)
- OVERHEAD UTILITY LINE (APPROXIMATE)
- UNDERGROUND ELECTRIC LINE (APPROXIMATE)
- UNDERGROUND TELEPHONE LINE (APPROXIMATE)
- ABANDONED UTILITY

NOTES:

1. BASE MAPPING WAS COMPILED FROM A COMBINATION OF STEREOPHOTOGRAMMETRIC METHODS; AERIAL PHOTOGRAPHY FLOWN ON 8/96 AND 11/98 BY LOCKWOOD MAPPING COMPANY; AS-BUILT RECORD DRAWINGS FOR COMPLETED REMEDIATION ACTIVITIES AT THE SPA STEEL PRODUCTS PROPERTY; AND FIELD SURVEY METHODS ON 5/96, PROVIDED BY NIAGARA MOHAWK, SURVEY REFERENCE FILE NO. 3435, FILE INDEX 21.0-S2.18-M49, AND A NEW SURVEY FILE NO. 01135-1.DWG RECEIVED 8/19/02.
2. PROPERTY INFORMATION TAKEN FROM "CITY OF SARATOGA SPRINGS, SARATOGA COUNTY, N.Y. TAX MAPS" NUMBERED 153.00(OD), 166.00(OD), 165.36(ID), 166.00(ID), 166.05(ID), 166.11(ID), 166.21(ID), 166.29(ID), 166.30(ID), 166.31(ID), 166.37(ID), 166.38(ID), AND 166.39(ID).
3. EXISTING UTILITY INFORMATION PROVIDED BY NIAGARA MOHAWK POWER CORPORATION, TAKEN FROM MAPPING DEVELOPED BY S.Y. KIM LAND SURVEYOR, P.C. PROJECT NO. 730135, JOB NO. 43-219-97, DATED JANUARY 12, 1998.
4. CONCENTRATIONS GIVEN IN MICROGRAMS PER LITER (ug/L) OR PARTS PER MILLION (ppm).
5. DATA MODIFIERS ARE DEFINED AS FOLLOWS:
   J = INDICATES AN ESTIMATED VALUE.
   U = THE COMPOUND WAS ANALYZED FOR BUT NOT DETECTED. THE ASSOCIATED VALUE IS THE COMPOUND QUANTITATION LIMIT.
   [ ] = DUPLICATE SAMPLE
   ND = NOT DETECTED
6. FOR CONSTITUENTS ANALYZED USING BOTH USEPA METHOD 8270C AND METHOD 8310, THE GREATEST CONCENTRATION REPORTED FROM EITHER METHOD IS DISPLAYED IN THIS FIGURE, UNLESS BOTH METHODS REPORTED A NON-DETECT VALUE, IN WHICH CASE, THE NON-DETECT FROM THE SAMPLE THAT OBTAINED THE LOWEST DETECTION LIMIT IS DISPLAYED IN THIS FIGURE.

0 50' 100'

GRAPHIC SCALE

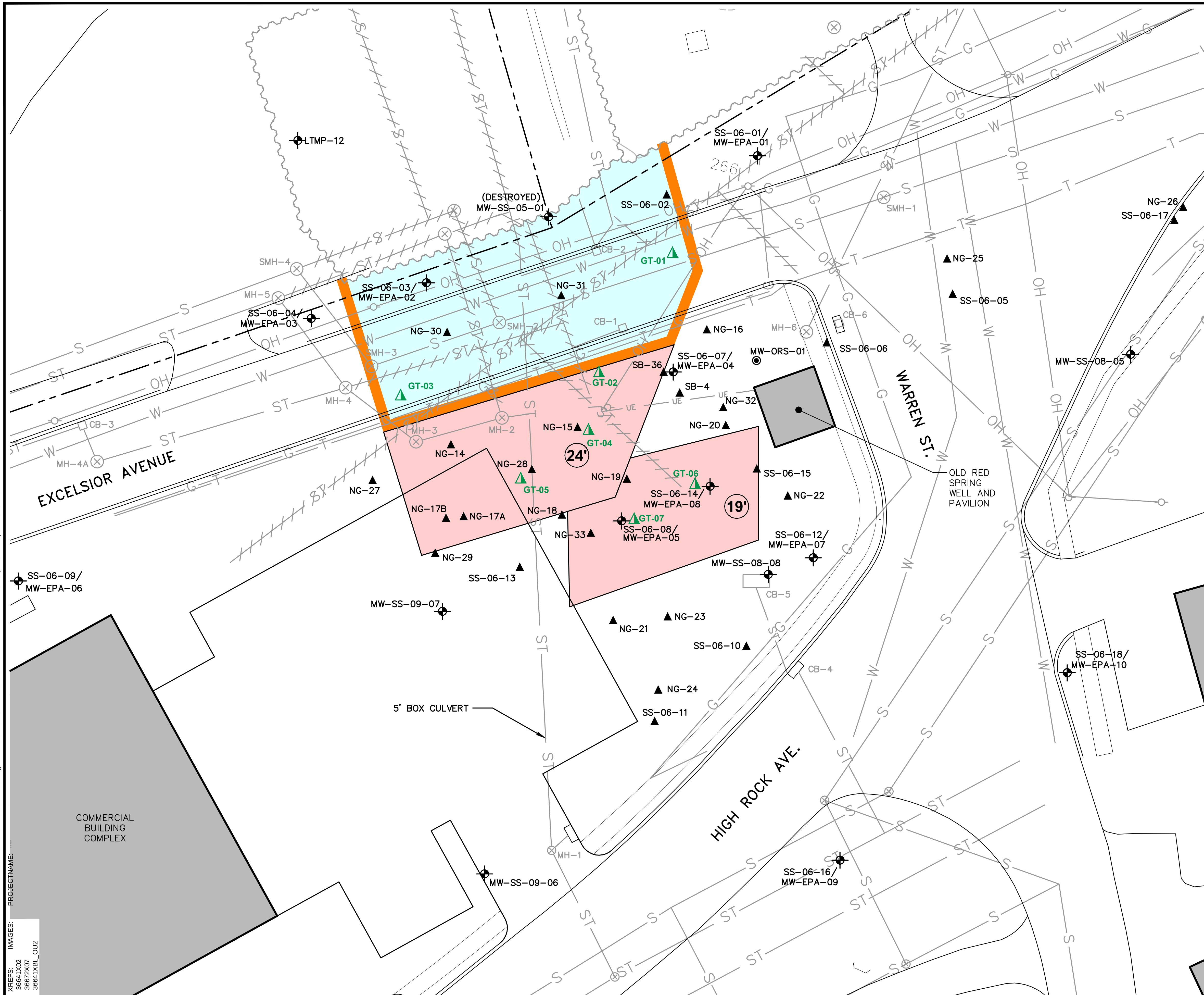
NIAGARA MOHAWK POWER CORPORATION
SUPERFUND SITE - OPERABLE UNIT 2
SARATOGA SPRINGS, NEW YORK

REMEDIAL DESIGN WORK PLAN

GROUNDWATER VOC AND SVOC EXCEEDANCES

ARCADIS

FIGURE 5



LEGEND:

- PROPOSED PDI SOIL BORING LOCATION
- SOIL BORING LOCATION
- SUPPLY WELL LOCATION
- MONITORING WELL LOCATION
- PROPOSED BARRIER WALL
- PROPOSED SUBSURFACE MAT
- PROPOSED ISS TREATMENT
- 19' DEPTH OF PROPOSED ISS TREATMENT
- PROPERTY LINE (APPROXIMATE)
- EXISTING SUBGRADE SHEET PILE BARRIER WALL
- BUILDING/STRUCTURE
- CB-1 CATCH BASIN
- SMH-1 SANITARY SEWER MANHOLE
- MH-1 STORM SEWER MANHOLE
- UTILITY POLE
- W WATER LINE (APPROXIMATE)
- G GAS LINE (APPROXIMATE)
- S SANITARY SEWER (APPROXIMATE)
- ST STORM SEWER (APPROXIMATE)
- OH OVERHEAD UTILITY LINE (APPROXIMATE)
- UE UNDERGROUND ELECTRIC LINE (APPROXIMATE)
- T UNDERGROUND TELEPHONE LINE (APPROXIMATE)
- ABANDONED UTILITY

NOTES:

1. BASE MAPPING WAS COMPILED FROM A COMBINATION OF STEREOPHOTOGRAMMETRIC METHODS; AERIAL PHOTOGRAPHY FLOWN ON 8/96 AND 11/98 BY LOCKWOOD MAPPING COMPANY; AS-BUILT RECORD DRAWINGS FOR COMPLETED REMEDIATION ACTIVITIES AT THE SPA STEEL PRODUCTS PROPERTY; AND FIELD SURVEY METHODS ON 5/96, PROVIDED BY NIAGARA MOHAWK, SURVEY REFERENCE FILE NO. 3435, FILE INDEX 21.0-S2.18-M49, AND A NEW SURVEY FILE NO. 01135-1.DWG RECEIVED 8/19/02.
2. PROPERTY INFORMATION FROM "CITY OF SARATOGA SPRINGS, SARATOGA COUNTY, N.Y. TAX MAPS" NUMBERED 153.00(OD), 166.00(OD), 165.36(ID), 166.00(ID), 166.05(ID), 166.11(ID), 166.21(ID), 166.29(ID), 166.30(ID), 166.31(ID), 166.37(ID), 166.38(ID), AND 166.39(ID).
3. EXISTING UTILITY INFORMATION TAKEN FROM MAPPING DEVELOPED BY S.Y. KIM LAND SURVEYOR, P.C. PROJECT NO. 730135, JOB NO. 43-219-97, DATED JANUARY 12, 1998 (PROVIDED BY NATIONAL GRID) AND FROM CITY OF SARATOGA SPRINGS DRAWINGS 6C-16, DATED SEPTEMBER 1, 2002 AND "AS-BUILT UTILITY INSTALLATION PLAN", DATED DECEMBER 6, 2007.
4. LOCATIONS OF BORINGS NG-30, NG-31, NG-32, AND NG-33 ARE APPROXIMATE.
5. PDI = PRE-DESIGN INVESTIGATION.
6. ISS = IN-SITU SOIL SOLIDIFICATION.

0 30' 60'
GRAPHIC SCALE

NIAGARA MOHAWK POWER CORPORATION
SUPERFUND SITE - OPERABLE UNIT 2
SARATOGA SPRINGS, NEW YORK
REMEDIAL DESIGN WORK PLAN

PROPOSED PDI SOIL BORING LOCATIONS

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FIGURE 6

CITY: SYRACUSE, NY DIV/GROUP: ENV/IEST/IM-DV DB: R. BASSETT, E. KRAHMER PM/TM/TR: M.HYSELL LYR: ON=*;OFF=*REF*
G:\ENVCAD\SYRACUSE\ACT\B0036641\0001\00001\DWG\36641B03.dwg LAYOUT: 6 SAVED: 5/7/2014 5:24 PM ACADVER: 18.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: PLTFULL.CTB PLOTTED: 5/7/2014 5:26 PM BY: KRAHMER, ERIC
XREFS: 36641X02 36672X07 36641XBL_OU2 IMAGES: PROJECTNAME: ----

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Appendix A

Standard Operating Procedure for Monolith Leaching

ARCADIS Standard Operating Procedure
Monolith Leaching Method

Overview

This leaching test is a quasi-dynamic procedure intended for application to solidified samples of soils impacted with organic and/or inorganic constituents of concern (COCs). The solidified samples constitute "monoliths" and are created through the addition of various (often pozzolanic) admixtures. The geotechnical characteristics of monoliths including unconfined compressive strength (ASTM D-1633) and permeability (ASTM D-5084-03) are initially tested. Selected monoliths with acceptable geotechnical characteristics are then leached using this procedure to document reduction in contaminant transport. During the implementation of the method, monoliths are immersed in an aqueous based extraction fluid, which is replaced at 24 hour intervals and analyzed for COCs. A cumulative amount of COCs is then documented over the total immersion time period.

Semivolatile Organic Compound and Metals Extraction

Monolith - cast cylinder (2-inch x 4-inch mold) Surface Area = 202.5 cm^2

Per Method 1312, the leaching vessel will be constructed of unreactive materials and designed for the extraction of organic chemicals and metals. The solidified monolithic sample will be placed in the test vessel. The monolith will be extracted in deionized water. The extraction liquid volume will be 2 Liters **(10 times the monolith's surface area as adopted from ANS 16.1)**. The monolith must be immersed such that >98% of the specimen is in contact with the leachate at all times.

The leaching vessel will sit quiescently in the dark at ambient temperature for 24 hours. After the 24 hour leaching interval, the aqueous contents of the leaching vessel will be poured off, preserved and stored according to USEPA Method 8270 or USEPA Method 6010. This step may be repeated on individual monolith samples with regular analysis of the leachate according to USEPA Method 8270 as determined by site-specific conditions until either: leachate concentrations are below regulatory criteria; or thirty tests have been completed.

Note – this extraction can also provide analytical sample volume for many other USEPA analytical methods for non-volatile analytes. For alternate, nonvolatile analytes, extraction procedures would remain the same and extraction fluid preservation would follow guidelines and hold times in the appropriate USEPA methodologies.

Volatile Organic Compound Extraction

Monolith - cast cylinder (reduced 50cc tube – diameter 2.5cm, height cut to 5.1cm along the lines marked on the cylinders) Surface Area = 50.0 cm^2

Per Method 1312, the leaching vessel will be constructed of unreactive materials and designed for the extraction of organic chemicals. The solidified monolithic sample will be placed in the test vessel. The monolith will be extracted in deionized water. The extraction fluid volume will be 500 ml **(10 times the monolith's surface area as adopted from ANS 16.1)** to create a zero head space condition.

The leaching vessel will sit quiescently in the dark at ambient temperature for 24 hours. After the 24 hour leaching interval, the aqueous contents of the leaching vessel will be poured off, preserved and stored according to USEPA Method 8260. This step may be repeated on individual monolith samples with regular analysis of the leachate according to USEPA Method 8260 as determined by site-specific conditions until either: leachate concentrations are below regulatory criteria; or thirty tests have been completed.

Selection of Extraction Fluid

Extraction fluid is selected according the USEPA Method 1312 SPLP Section 5.4.

References

USEPA Method 1312 - Synthetic Precipitation Leaching Procedure

Standard drafted by the American Nuclear Society Standards Committee [ANSI/ANS] 16.1-1986

ARCADIS

Appendix B

October 18, 2013 National Grid Letter (Response to EPA and NYSDEC Comments on the “Draft” Remedial Design Work Plan)

nationalgrid

William R. Jones
Lead Senior Environmental Engineer
Environmental Department

October 18, 2013

Ms. Maria Jon
EPA Region II
Emergency and Remedial Response Division
New York Remediation Branch
290 Broadway, 20th Floor
New York, NY 10007-1866

Re: Niagara Mohawk Power Corporation
Saratoga Springs Former MGP Site
Saratoga Springs, New York
EPA ID #NYD980664361
Operable Unit 2 – Old Red Spring Subarea
"Draft" Remedial Design Work Plan – Response to EPA and NYSDEC Comments

Dear Ms. Jon:

This letter responds to the United States Environmental Protection Agency's (EPA's) and New York State Department of Environmental Conservation's (NYSDEC's) comments on the *"Draft" Remedial Design Work Plan* (ARCADIS, June 2013) ("the RDWP") for the Saratoga Springs former manufactured gas plant (MGP) – Operable Unit 2 site (the site). The comments are provided in your September 18, 2013 e-mail correspondence to Niagara Mohawk Power Corporation (NMPC), which included an August 2, 2013 comment letter from the NYSDEC as an attachment.

For ease of presentation, each EPA and NYSDEC comment provided in the above-identified correspondence is presented below, followed by NMPC's response.

RESPONSE TO EPA COMMENTS

Comment 1

Regarding Appendix A of the RDWP, ARCADIS Standard Operating Procedure for Monolith Leaching Method, please provide an explanation and rationale for selecting the procedures proposed by ARCADIS in this document. Please also list whether this ARCADIS standard complies with any standards set forth by regulatory agencies and/or professional associations and cite the titles of the standards that the ARCADIS standard complies with. Also indicate whether ARCARDIS has tested these procedures during treatability studies and its experience.

Response 1

The ARCADIS Standard Operating Procedure (SOP) for monolith leaching is a hybrid version of the following methods:

- American Nuclear Society (ANS) Method 16.1 titled, "Measurement of the Leachability of Solidified Low-Level Radioactive Wastes by a Short-Term Test Procedure" (ANS 2003); and

- EPA Method 1312 titled, “Synthetic Precipitation Leaching Procedure” (SPLP).

The Interstate Technology & Regulatory Council (ITRC) document titled “Development of Performance Specifications for Solidification/Stabilization” (ITRC, July 2011) specifically identifies modified ANS Method 16.1 as an appropriate flux-based test for monolithic materials. As indicated in the ITRC document, ANS Method 16.1 is very similar to EPA’s Leaching Environmental Assessment Framework (LEAF) Method 1315 titled “Mass Transfer of Constituents in Monolithic or Compacted Granular Materials Using a Semi-Dynamic Tank Leaching Procedure”, with only minor variations in the schedule of leachant collection. However, concerns about the appropriateness of modified ANS Method 16.1 for evaluating volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs) have been addressed in the ARCADIS SOP by leaching monoliths inside a zero headspace extraction (ZHE) vessel for VOCs and a 2-Liter amber borosilicate glass jar for SVOCs per EPA Method 1312.

As indicated in part by its title, ANS 16.1 was originally developed for use in estimating the flux of solidified low-level radioactive wastes prior to disposal. This method has been modified to estimate post-in-situ soil solidification (ISS) flux rates because it uses monolithic, solidified samples, which are representative of post-treatment conditions at ISS sites. EPA Method 1312, while traditionally used to estimate contaminant flux from a soil sample into groundwater, requires a reduction in sample size prior to testing. This size reduction is not representative in estimating contaminant flux from a solidified monolith, where only a fraction of the total surface area is exposed to groundwater. In order to more representatively estimate the post-solidification contaminant flux, this hybrid method borrows the following aspects from ANS Method 16.1 and EPA Method 1312:

Method	Method Aspects Incorporated into ARCADIS SOP
ANS Method 16.1	• Leachant volume to monolith surface area ratio of 10:1. Per ANS 16.1: *“A ratio of leachant volume to specimen external-geometry surface area of 10 cm is usually sufficient to minimize leachant composition changes during reasonably short leaching intervals, while providing sufficient concentration of extracted species for analysis.”*
	• Time-dependent, multi-point testing of contaminant flux
	• Sequential leaching cycles, preventing suppressed leaching rates if contaminant concentrations were allowed to build up
EPA Method 1312	• Use of a ZHE vessel to preclude the development of a headspace when investigating the leaching behavior of VOCs

Under the ARCADIS SOP, a molded/cured monolith is cut to adjust the ratio of monolith surface area to the extracting solution volume. The monolith is sized to provide adequate sample for subsequent analysis. The sized monolith is inserted into the SPLP extractor along with the extracting liquid (i.e., deionized water). The extractor is sealed and sits quiescently for 24 hours. The leached liquid is removed, analyzed or discarded (based on the analytical testing schedule), and replaced with un-impacted deionized water to start another 24-hour cycle.

The hybrid approach outlined in the ARCADIS SOP has been approved by regulatory agencies to evaluate ISS monolith leaching during treatability study testing for the following MGP sites in New York State:

- Hiawatha Boulevard former MGP site (Syracuse, NY)
- North Albany former MGP site (Albany, NY)
- Laurel Street former MGP site (Poughkeepsie, NY)
- Port Jervis former MGP site (Port Jervis, NY)
- McMaster Street former MGP site (Auburn, NY)
- Clark Street former MGP site (Auburn, NY)

♦ ♦ ♦

Comment 2

EPA is requesting that the Quality Assurance Project Plan (QAPP) (BBL, 2001) be updated and prepared in accordance with the ***Intergovernmental Data Quality Task Force; Uniform Federal Policy for Quality Assurance Project Plans; EPA-505-B-04-900A and DoD: DTIC ADA 427785; March 2005****. This guidance consists of three parts, Part 1: UFP-QAPP Manual; Part 2A (Original): UFP-QAPP Manual and Part 2B, Quality Assurance/Quality Control Compendium: Minimum QA/QC Activities. Part 2A (Revised) Optimized UFP-QAPP Worksheets; March 2012 could be used instead of the original worksheets.*

Response 2

Acknowledged. A QAPP will be prepared in accordance with the above-identified guidance. The main focus of the QAPP will be: (1) the performance testing to be conducted in connection with the ISS, barrier wall, and subsurface mat treatability studies (e.g., monolith leaching and leachate analysis); and (2) the sampling/ analysis to be conducted during the remedial action to characterize soil (soil proposed for re-use and fill to be imported to the site to provide 2 feet of clean cover) and groundwater. NMPC anticipates that the “draft” QAPP will be submitted to the EPA in November 2013 for review/approval.

♦ ♦ ♦

<u>RESPONSE TO NYSDEC COMMENTS</u>

Comment 1

Appendix A, ARCADIS Standard Operating Procedure Monolith Leaching Procedure: The methodology proposed in the Appendix appears to be similar to the EPA Leaching environmental Assessment Framework (LEAF) test methods Method 1315 "Mass Transfer Rates of Constituents in Monolithic or Compacted Granular Materials using a Semi-dynamic Tank Leaching Procedure". Is the method proposed consistent with the EPA LEAF Method? If so, it is the Department's understanding that the EPA method is not recommended for VOCs and SVOCs. Please clarify.

Further, the Department has been using the following EPRI methodology on other MGP sites in New York, see

- *Leaching Assessment Methods for Evaluating the Effectiveness of In Situ Stabilization of Soil Material at Former MGP Sites, EPRI, Palo Alto, CA: 2009 Product ID 1014062.*

Is the Arcadis method consistent with the EPRI approach? Please compare.

More importantly, the Department believes this should be done during design to formulate a mix that achieves both geotechnical and chemical goals, not as a construction QC test. The Department assumes that is the case here.

Response 1

The ARCADIS SOP is similar to EPA Method 1315 in certain respects for leachability testing of solidified soil. However, the SOP modifies several portions of EPA Method 1315 to meet the requirements of the treatability study. The modifications stem from concerns related to the need for the treatability study to evaluate the fate/transport/leaching behavior of organic constituents (VOCs and SVOCs) as a function of admixture selection and dosing. Paragraphs 1.1 and 1.4 of Method 1315 state the following:

- "This method is designed to provide the mass transfer rates (release rates) of inorganic analytes contained in a monolithic or compacted granular material, under diffusion-controlled release conditions, as a function of leaching time."

- "This method is not applicable to characterize the release of volatile or semi-volatile organic analytes with the exception of general dissolved organic carbon."

In keeping with its focus on inorganic analytes, Method 1315 specifies a leaching vessel composed of high density polyethylene, polycarbonate, polypropylene, or polyvinyl chloride. These types of plastics are known to adsorb and be permeable to the types of organic constituents at the site. Constituent sorption to the leaching vessel or volatilization through leaching vessel walls may bias results during the analytical stages of the project. The hybrid method described under the response to EPA Comment 1 addresses this concern.

In response to the second part of the NYSDEC's comment, NMPC acknowledges that the ARCADIS SOP and the Electric Power Research Institute (EPRI) approach both involve monolithic leaching methods. However, the ARCADIS SOP and the EPRI methodology differ in the following respects:

	Key Differences	
Aspect	**EPRI Methodology**	**ARCADIS SOP**
Target vs. Non-Target Analytes	Analyzes for several "non target" analytes such as anions, dissolved organic carbon, and total suspended solids	Limits analysis to constituents of concern
Frequency of Analyses	Conducts periodic analysis at gradually increasing time increments up to 15 months (i.e. the time between analyses increases as the study continues from hours up to months)	Conducts evenly-spaced analyses on leachate from selected 24 hour cycles (i.e., analysis on leachate from Day 1, 5, 10, 15, etc. of leaching) out to a specified number of cycles

Aspect	Key Differences	
	EPRI Methodology	**ARCADIS SOP**
VOCs vs. SVOCs	Focuses on SVOCs (polycyclic aromatic hydrocarbons)	Analyzes for both VOCs and SVOCs
Monolith Position in Reactor	Uses a patent-pending test vessel and a stainless steel monolith holder to suspend the monolith in the test vessel (Integrated Device for Environmental Assessment and Leaching)	Specifies that the monolith rests on the bottom of the test vessel

Finally, NMPC agrees that monolith leaching should be performed during the treatability study to formulate a mix that achieves both geotechnical and chemical goals, not as a construction QC test during the remedial action. NMPC does not anticipate performing monolith leaching during full-scale remediation. QC will be accomplished primarily by testing for unconfined compressive strength and permeability.

♦ ♦ ♦

Comment 2

Page 16, first paragraph after bullets reads: "Each composite characterization sample will be submitted for laboratory analysis for Toxicity Characteristic Leaching Procedure (TCLP) VOCs, TCLP SVOCs... "

- *Please ensure that samples to be analyzed for VOCs are discrete (not composite) samples. Effort should be made for minimal disturbance of the sample (not homogenized).*

Response 2

Acknowledged. The RDWP will be revised to indicate that discrete grab soil samples will be collected for TCLP VOC analysis.

♦ ♦ ♦

Comment 3

Page 32, Section 5.4, second paragraph reads: "...jet grouting by mixing binding reagents (a fluid grout containing a combination of water, Portland cement, bentonite, fly ash, and/or blast furnace slag... "

- *Is fly ash or blast furnace slag appropriate for this use? What would be done to ensure additional contamination is not being introduced to the site here?*

Response 3

Fly ash will not be used in the treatability studies or the full-scale remedial action. It is the byproduct of electric power generation that varies from source to source and may not be appropriate as a binding reagent.

As more fully explained below, blast furnace slag cement (BFS) is an appropriate binding reagent and will be used in the treatability study and potentially in full-scale remedial action. BFS is the co-product of iron production, a controlled process that results in a uniform composition from source to source. BFS is commonly used as a replacement for Portland cement in normal concrete. According to the Slag Cement Association, BFS replaces as much as 50% in normal concrete and up to 80% in specialty concrete applications. The American Society of Testing and Materials (ASTM) "Definition of Terms Relating to Concrete and Concrete Materials" (ASTM C125) identifies BFS as "the non-metallic product consisting essentially of silicates and alumino silicates of calcium and other bases, that is developed in a molten condition simultaneously with iron in a blast furnace." BFS components are identified on the attached Material Safety Data Sheet (MSDS).

Ground-granulated BFS will be used in the grout mix designs of the treatability studies because it offers several advantages that improve the performance of the proposed soil remedy, as listed below:

- Increases the unconfined compressive strength and lowers the permeability of solidified soils (strength and permeability are the key performance goals for ISS).
- Reduces the required water content of the grout to reach a given consistency (less water consumption means a "greener" alternative).
- Has a slow set-time relative to Portland cement (this provides for greater workability).
- Provides environmental benefits (can be procured locally and is consistent with "green remediation" practices because it is a beneficial use of a co-product from iron production).
- Has previously been used successfully in grout mixtures at five of the six sites identified in the response to EPA Comment 1 (note that BFS was not used at the Laurel Street former MGP site).
- May reduce the total cost of amendments.

♦ ♦ ♦

Comment 4

An investigation of the brick sewer to ensure that ISS activities do not damage the structure is required.

Response 4

The Old Red Brick Sewer was previously abandoned during remediation of Operable Unit OU1 and is no longer an active sewer. Bulkheads were constructed at several locations to isolate this former sewer. Several active and critically-important sewers are present within the OU2 area, including the following (refer to Figure 3 of the RDWP for the sewer locations):

1. A concrete/stone box culvert storm sewer that extends from manhole MH-1 (just north of High Rock Avenue) approximately 175 northward to beneath Excelsior Avenue.

2. Two storm sewer pipes that convey flow from catch basins CB-1 and CB-2 (located along the south and north sides of Excelsior Avenue) to the above-referenced concrete/stone box culvert.

3. A series of high-density polyethylene (HDPE) storm sewers that convey flow through manholes MH-2, MH-3, and MH-4 to the above-referenced concrete/stone box culvert.

4. A sanitary sewer that extends from west to east below the centerline of Excelsior Avenue.

Both the active and inactive sewers will be located using non-intrusive methods (i.e., DigSafely NY, electromagnetic/ground penetrating radar survey, private utility location). The above-identified *active* storm and sanitary sewers will be further investigated during the PDI by the following activities:

- Performing a closed-circuit television inspection of the sewer pipes to assess: (1) the construction materials and conditions of the pipes (e.g., presence of cracks, gaps, or broken pipe to evaluate the potential for the pipes to be affected by remedial activities in close proximity, including nearby injection of grout for subsurface mat or barrier wall construction); and (2) the physical location/alignment of the pipes (e.g., to understand potential bends or changes in pipe direction, or to identify pipe-to-pipe connections that do not occur within the manholes, so that the pipes can be avoided by anticipated future ISS mixing activities).

- Excavating test pits and vacuum excavating boreholes at selected locations to further assess the location, construction materials, and/or condition of the sewers. One or more of these pits/boreholes may be installed to uncover the top of the Old Red Brick Sewer to verify its location.

The primary objective of the subsurface utility investigation is to gather data needed for evaluating and selecting appropriate construction methods to avoid damage to the sewers. Construction methods will be selected that minimize the risk of: (1) direct contact with the sewers by heavy construction equipment (to avoid unintentional breakage); and (2) injected grout entry into the sewers (to avoid potentially blocking or impeding flow in the sewers).

♦ ♦ ♦

Comment 5

Section 5.1: Any material which is excavated and proposed for re-use on-site (soil or C&D debris) must be sampled, post excavation, and the results compared to the protection of groundwater Soil Cleanup Objective (SCO)s. Should the material be deemed acceptable for reuse, it must be placed below the site cover soil.

Response 5

Acknowledged. Soil excavated below a depth of 2 feet below ground surface (bgs) from the Old Red Spring area that exhibits no visible non-aqueous phase liquid (NAPL), staining, or obvious odors will be stockpiled for potential reuse as subsurface fill. Samples of the stockpiled soil will be collected in accordance with the provisions in Section 5.4(e)10 of the NYSDEC document titled "DER-10/Technical Guidance for Site Investigation and Remediation," (DER-10) issued on May 3, 2010. As required by DER-10, the samples will be analyzed for VOCs, SVOCs, inorganic constituents, polychlorinated biphenyls, and pesticides. In order for the soil to be deemed acceptable for subsurface re-use, the analytical results must be less than the soil cleanup objectives (SCOs) for groundwater protection as presented in Title 6 of the New York Codes, Rules, and Regulations (6 NYCRR) Part 375-6.8(b). The soil deemed acceptable for re-use will be placed below a demarcation layer that will be covered with at least 2 feet of imported clean backfill meeting restricted-residential use SCOs and groundwater protection SCOs.

♦ ♦ ♦

Comment 6

Section 5.7: Imported backfill must meet the SCO for the applicable land use proposed for the site, in this case restricted residential.

Response 6

Acknowledged. In accordance with 6 NYCRR Part 375-6.7(d)(1)(ii)(*b*), imported soil backfill brought onsite for use as a soil cover or backfill must meet the lower of the restricted-residential use SCOs and the groundwater protection SCOs presented in 6 NYCRR Part 375-6.8(b). However, gravel, rock, or stone backfill that consists of virgin material from a permitted mine or quarry may be imported to the site without chemical testing (i.e., for use as backfill beneath pavement, buildings or as part of the final site cover) provided that it contains less than 10% by weight material that would pass through a size 80 sieve, and NYSDEC provides approval of the material source.

♦ ♦ ♦

Upon receipt of EPA's approval of the responses above, the RDWP will be revised to incorporate the changes above. NMPC will submit a "redline" version of the RDWP (showing tracked changes) to facilitate EPA and NYSDEC review/approval. Once the revised document is acceptable to the EPA and NYSDEC, NMPC will submit a final PE-stamped version, which we understand will become part of the Consent Decree for OU2. The finalized RDWP will include this letter and follow-up correspondence as attachments.

Please do not hesitate to call me at (315) 428-5690 if you have any questions or require additional information.

Sincerely,

William R. Jones

William R. Jones, P.E.
Project Manager

Attachments:
Attachment 1 – Ground Granulated Blast Furnace Slag MSDS

Electronic Copies:
Salvatore Badalamenti, EPA (via e-mail)
Cynthia Psoras, EPA (via e-mail)
David A. Crosby, P.E., NYSDEC (via e-mail)
Scarlett McLaughlin, PHS, NYSDOH (via e-mail)
Terry W. Young, P.E., ARCADIS (via e-mail)
John Brussel, P.E., ARCADIS (via e-mail)

ARCADIS

Attachment 1

Ground Granulated Blast Furnace Slag MSDS

Material Safety Data Sheet

Section 1: PRODUCT AND COMPANY INFORMATION

Product Name(s): Slag

Product Identifiers: NewCem®, Litex™ Lightweight Aggregate, True Lite Lightweight Aggregate™, Vitrex™ Pelletized Slag, Ground Granulated Blast Furnace Slag (GGBFS), Blast Furnace Slag, Steel Slag, Granulated Slag, Pelletized Slag, Metallic Slag, Air Cooled Slag, Non-metallic Slag, Slag Cement, Hydraulic Slag Cement, Slag

Manufacturer:
Lafarge North America Inc.
12018 Sunrise Valley Drive, Suite 500
Reston, VA 20191

Information Telephone Number:
703-480-3600 (9am to 5pm EST)

Emergency Telephone Number:
1-800-451-8346 (3E Hotline)

Product Use: Slag is used as a supplementary cementitious material for cement, concrete and concrete products. It is also used in soil stabilization and as filler in asphalt and other products that are widely used in construction.

Note: This MSDS covers many types of slag. Individual composition of hazardous constituents will vary between slag types.

Section 2: COMPOSITION/INFORMATION ON INGREDIENTS

Component	Percent (By Weight)	CAS Number	OSHA PEL -TWA (mg/m^3)	ACGIH TLV-TWA (mg/m^3)	LD_{50} (mouse, intraperitoneal)	LC_{50}
Slag	100	65996-69-2	NA	NA	NA	NA
Calcium Oxide	30-50	1305-78-8	5 (T)	2 (T)	3059 mg/kg	NA
Magnesium Oxide	0-20	1309-48-4	15 (T)	10 (T)	NA	NA
Crystalline Silica	< 1	14808-60-7	[(10) / (%SiO_2+2)] (R); [(30) / (%SiO_2+2)] (T)	0.025 (R)	NA	NA
Particulate Not Otherwise Regulated	-	NA	5 (R); 15 (T)	3 (R); 10 (T)	NA	NA

Note: Exposure limits for components noted with an * contain no asbestos and <1% crystalline silica

Slag is a nonmetallic byproduct from the production of iron. Trace amounts of chemicals may be detected during chemical analysis. For example, slag may contain trace amounts of manganese oxide, titanium oxide, chromium compounds, sulfur compounds, and other trace compounds.

Section 3: HAZARD IDENTIFICATION

WARNING

Irritant: Causes eye, skin and inhalation irritation
Toxic - Harmful by inhalation.
(Contains crystalline silica)

Use proper engineering controls, work practices, and personal protective equipment to prevent exposure to wet or dry product.

Read MSDS for details.

Section 3: HAZARD IDENTIFICATION (continued)

Emergency Overview: Slag is a solid, grey/black or brown/tan, odorless powder. It is not combustible or explosive. A single, short-term exposure to the dry powder presents little or no hazard.

Potential Health Effects:

Eye Contact: Airborne dust may cause immediate or delayed irritation or inflammation. Eye contact with large amounts of dry powder or with wet slag can cause moderate eye irritation. Eye exposures require immediate first aid to prevent significant damage to the eye.

Skin Contact: Slag may cause dry skin, discomfort, irritation, and dermatitis.

Dermatitis: Slag is capable of causing dermatitis by irritation and allergy. Skin affected by dermatitis may include symptoms such as, redness, itching, rash, scaling, and cracking.

Irritant dermatitis is caused by the physical properties of slag including moisture and abrasion.

Allergic contact dermatitis is caused by sensitization to hexavalent chromium (chromate) present in slag. The reaction can range from a mild rash to severe skin ulcers. Persons already sensitized may react to the first contact with slag. Others may develop allergic dermatitis after years of repeated contact with slag.

Inhalation (acute): Breathing dust may cause nose, throat or lung irritation, including choking, depending on the degree of exposure.

Inhalation (chronic): Risk of injury depends on duration and level of exposure.

Silicosis: This product contains crystalline silica. Prolonged or repeated inhalation of respirable crystalline silica from this product can cause silicosis, a seriously disabling and fatal lung disease. See Note to Physicians in Section 4 for further information.

Carcinogenicity: Slag is not listed as a carcinogen by IARC or NTP; however, slag contains trace amounts of crystalline silica and hexavalent chromium which are classified by IARC and NTP as known human carcinogens.

Autoimmune Disease: Some studies show that exposure to respirable crystalline silica (without silicosis) or that the disease silicosis may be associated with the increased incidence of several autoimmune disorders such as scleroderma (thickening of the skin), systemic lupus erythematosus, rheumatoid arthritis and diseases affecting the kidneys.

Tuberculosis: Silicosis increases the risk of tuberculosis.

Renal Disease: Some studies show an increased incidence of chronic kidney disease and end-stage renal disease in workers exposed to respirable crystalline silica.

Ingestion: Do not ingest slag. Ingestion of small quantities of slag is not known to be harmful, large quantities can cause distress to the digestive tract.

Medical Conditions Aggravated by Exposure: Individuals with lung disease (e.g. bronchitis, emphysema, COPD, pulmonary disease) or sensitivity to hexavalent chromium can be aggravated by exposure.

Section 4: FIRST AID MEASURES

Eye Contact: Rinse eyes thoroughly with water for at least 15 minutes, including under lids, to remove all particles. Seek medical attention for abrasions.

Skin Contact: Wash with cool water and a pH neutral soap or a mild skin detergent. Seek medical attention for rash, irritation, dermatitis, and prolonged unprotected exposures to wet slag, cement, cement mixtures or liquids from wet cement.

Inhalation: Move person to fresh air. Seek medical attention for discomfort or if coughing or other symptoms do not subside.

Ingestion: Do not induce vomiting. If conscious, have person drink plenty of water. Seek medical attention or contact poison control center immediately.

Note to Physician: The three types of silicosis include:

- Simple chronic silicosis – which results from long-term exposure (more than 20 years) to low amounts of respirable crystalline silica. Nodules of chronic inflammation and scarring provoked by the respirable crystalline silica form in the lungs and chest lymph nodes. This disease may feature breathlessness and may resemble chronic obstructive pulmonary disease (COPD).
- Accelerated silicosis – occurs after exposure to larger amounts of respirable crystalline silica over a shorter period of time (5-15 years). Inflammation, scarring, and symptoms progress faster in accelerated silicosis than in simple silicosis.
- Acute silicosis – results from short-term exposure to very large amounts of respirable crystalline silica. The lungs become very inflamed and may fill with fluid, causing severe shortness of breath and low blood oxygen levels.

Progressive massive fibrosis may occur in simple or accelerated silicosis, but is more common in the accelerated form. Progressive massive fibrosis results from severe scarring and leads to the destruction of normal lung structures.

Section 5: FIREFIGHTING MEASURES

Flashpoint & Method: Non-combustible

General Hazard: Avoid breathing dust.

Extinguishing Media: Use extinguishing media appropriate for surrounding fire.

Firefighting Equipment: Slag poses no fire-related hazard. A SCBA is recommended to limit exposures to combustion products when fighting any fire.

Combustion Products: None.

Section 6: ACCIDENTAL RELEASE MEASURES

General: Place spilled material into a container. Avoid actions that cause the slag to become airborne. Avoid inhalation of slag and contact with skin. Wear appropriate protective equipment as described in Section 8. Scrape wet slag and place in container. Allow material to dry or solidify before disposal. Do not wash slag down sewage and drainage systems or into bodies of water (e.g. streams).

Waste Disposal Method: Dispose of slag according to Federal, State, Provincial and Local regulations.

Section 7: HANDLING AND STORAGE

General: Handle with care and use appropriate control measures. Keep bulk slag and cement dry until used. When slag is kept wet for long periods of time, the leachate may be discolored and have a sulfurous odor. When this liquid is exposed to oxygen elemental sulfur may precipitate out leaving a solution of calcium thiosulfate.

Engulfment hazard. To prevent burial or suffocation, do not enter a confined space, such as a silo, bin, bulk truck, or other storage container or vessel that stores or contains slag or cement. Slag and cement can buildup or adhere to the walls of a confined space. The slag or cement can release, collapse or fall unexpectedly.

Properly ground all pneumatic conveyance systems. The potential exists for static build-up and static discharge when moving powders through a plastic, non-conductive, or non-grounded pneumatic conveyance system. The static discharge may result in damage to equipment and injury to workers.

Usage: Cutting, crushing or grinding hardened cement, concrete or other crystalline silica-bearing materials will release respirable crystalline silica. Use all appropriate measures of dust control or suppression, and Personal Protective Equipment (PPE) described in Section 8 below.

Housekeeping: Avoid actions that cause the slag to become airborne during clean-up such as dry sweeping or using compressed air. Use HEPA vacuum or thoroughly wet with water to clean-up dust. Use PPE described in Section 8 below.

Storage Temperature: Unlimited. **Storage Pressure:** Unlimited.

Clothing: Promptly remove and launder clothing that is dusty or wet with slag or cement. Thoroughly wash skin after exposure to dust or wet slag or cement.

Section 8: EXPOSURE CONTROLS AND PERSONAL PROTECTION

Engineering Controls: Use local exhaust or general dilution ventilation or other suppression methods to maintain dust levels below exposure limits.

Personal Protective Equipment (PPE):

Respiratory Protection: Under ordinary conditions no respiratory protection is required. Wear a NIOSH approved respirator that is properly fitted and is in good condition when exposed to dust above exposure limits.

Eye Protection: Wear ANSI approved glasses or safety goggles when handling dust or wet slag to prevent contact with eyes. Wearing contact lenses when using slag, under dusty conditions, is not recommended.

Skin Protection: Wear gloves, boot covers and protective clothing impervious to water to prevent skin contact. Do not rely on barrier creams, in place of impervious gloves. Remove clothing and protective equipment that becomes saturated with wet slag or cement and immediately wash exposed areas.

Section 9: PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Solid (powder).	**Evaporation Rate:**	NA.
Appearance:	Gray/black or brown/tan powder.	**pH (in water):**	8-11
Odor:	None.	**Boiling Point:**	>1000° C
Vapor Pressure:	NA.	**Freezing Point:**	None, solid.
Vapor Density:	NA.	**Viscosity:**	None, solid.
Specific Gravity:	2-3	**Solubility in Water:**	Negligible

Section 10: STABILITY AND REACTIVITY

Stability: Stable. Keep dry until use. Slag may react with water resulting in a slight release of heat, depending on the amount of lime (calcium oxide) present. Avoid contact with incompatible materials.

Incompatibility: Slag is incompatible with acids, ammonium salts and aluminum metal. Slag and cement dissolves in hydrofluoric acid, producing corrosive silicon tetrafluoride gas. Slag and cement reacts with water to form silicates and calcium hydroxide. Silicates react with powerful oxidizers such as fluorine, boron trifluoride, chlorine trifluoride, manganese trifluoride, and oxygen difluoride.

Hazardous Polymerization: None.

Hazardous Decomposition: Hydrogen sulfide gas may be released from moist or wet slag when it is heated.

Section 11 and 12: TOXICOLOGICAL AND ECOLOGICAL INFORMATION

For questions regarding toxicological and ecological information refer to contact information in Section 1.

Section 13: DISPOSAL CONSIDERATIONS

Dispose of waste and containers in compliance with applicable Federal, State, Provincial and Local regulations.

Section 14: TRANSPORT INFORMATION

This product is not classified as a Hazardous Material under U.S. DOT or Canadian TDG regulations.

Section 15: REGULATORY INFORMATION

OSHA/MSHA Hazard Communication: This product is considered by OSHA/MSHA to be a hazardous chemical and should be included in the employer's hazard communication program.

CERCLA/SUPERFUND: This product is not listed as a CERCLA hazardous substance.

EPCRA SARA Title III: This product has been reviewed according to the EPA Hazard Categories promulgated under Sections 311 and 312 of the Superfund Amendment and Reauthorization Act of 1986 and is considered a hazardous chemical and a delayed health hazard.

EPRCA SARA Section 313: This product contains none of the substances subject to the reporting requirements of Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR Part 372.

RCRA: If discarded in its purchased form, this product would not be a hazardous waste either by listing or characteristic. However, under RCRA, it is the responsibility of the product user to determine at the time of disposal, whether a material containing the product or derived from the product should be classified as a hazardous waste.

Section 15: REGULATORY INFORMATION (continued)

TSCA: Slag and crystalline silica are exempt from reporting under the inventory update rule.

California Proposition 65: Crystalline silica (airborne particulates of respirable size) and Chromium (hexavalent compounds) are substances known by the State of California to cause cancer.

WHMIS/DSL: Products containing crystalline silica and calcium oxide are classified as D2A, E and are subject to WHMIS requirements.

Section 16: OTHER INFORMATION

Abbreviations:

>	Greater than
ACGIH	American Conference of Governmental Industrial Hygienists
CAS No	Chemical Abstract Service number
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code for Federal Regulations
CL	Ceiling Limit
DOT	U.S. Department of Transportation
EST	Eastern Standard Time
HEPA	High-Efficiency Particulate Air
HMIS	Hazardous Materials Identification System
IARC	International Agency for Research on Cancer
LC_{50}	Lethal Concentration
LD_{50}	Lethal Dose
mg/m^3	Milligrams per cubic meter
MSHA	Mine Safety and Health Administration

NA	Not Applicable
NFPA	National Fire Protection Association
NIOSH	National Institute for Occupational Safety and Health
NTP	National Toxicology Program
OSHA	Occupational Safety and Health Administration
PEL	Permissible Exposure Limit
pH	Negative log of hydrogen ion
PPE	Personal Protective Equipment
R	Respirable Particulate
RCRA	Resource Conservation and Recovery Act
SARA	Superfund Amendments and Reauthorization Act
T	Total Particulate
TDG	Transportation of Dangerous Goods
TLV	Threshold Limit Value
TWA	Time Weighted Average (8 hour)
WHMIS	Workplace Hazardous Materials Information System

This MSDS (Sections 1-16) was revised on March 1, 2011.

An electronic version of this MSDS is available at: www.lafarge-na.com under the Sustainability section.

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