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Alexander B. Grannis
Commissioner

June 30, 2010

John McAuliffe
Honeywell International
301 Plainfield Road, Suite 330
Syracuse, NY 13212

Re: Waste Beds 1-8 Site, Town of Geddes, Onondaga County, New York
Site # 734081, Index # D-7-0002-02-08
Focused Feasibility Study, June 2010

Dear Mr. McAuliffe:

The New York State Department of Environmental Conservation (NYSDEC) has reviewed the revised Focused Feasibility Study (FFS) for the Waste Beds 1 through 8 Site, dated June 2010, This revised FFS, which was submitted pursuant to the Administrative Order on Consent (Index # D-7-0002-02-08) is found to be acceptable for the purpose of proposing a interim remedial measure (IRM)/response action related to the shallow and intermediate groundwater along the lakeshore and other IRMs/response actions necessary to address potential impacts to the Onondaga Lake and Ninemile Creek remedies. The FFS is accepted by the Department with the following limitations and conditions

1.) The June 2010 FFS is accepted conditioned on a copy of this letter being affixed to all copies of the June 2010 FFS that are distributed by Honeywell (including any copies distributed within Honeywell) to its agents and to the public.

2.) Please send/place a copy of the FFS, and this approval letter, in the following document repositories:

Onondaga County Public Library at the Galleries
447 South Salina Street
Syracuse, NY 13204

Atlantic States Legal Foundation
658 West Onondaga Street
Syracuse, NY 13204

The FFS, as limited by and subject to the conditions identified in this letter, is hereby incorporated into the Consent Order.

If you have any questions concerning this letter, you may call me at 518-402-9676.

Sincerely,

Susan Edwards

Susan Edwards, P.E.
Project Manager

ec: D. Crawford, OB &G
A.J. Labuz, Honeywell

Honeywell

Honeywell
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June 8, 2010

Ms. Susan Edwards, P.E.
Project Manager
Remedial Bureau D
New York State Department of Environmental Conservation
625 Broadway, 12th Floor
Albany, New York 12233-7016

Re: Wastebeds 1 – 8 Site, Town of Geddes, Onondaga County, New York
Index # D-7-0002-02-08 – Focused Feasibility Study

Dear Ms. Edwards:

Enclosed are five copies (four paper, one electronic) of the final *Focused Feasibility Study (FFS) Report for Wastebeds 1 through 8*. This document incorporates revisions based on the New York State Department of Environmental Conservation's (Department's) comments on the November 23, 2009 FFS Report as provided in its February 18, 2010 letter. Honeywell's responses to the Department's February 18, 2010 comments were provided in a letter dated May 13, 2010.

Please contact Douglas Crawford of O'Brien & Gere or me if you have any questions or comments.

Sincerely,

John P. McAuliffe by CCC

John P. McAuliffe, P.E.
Program Director, Syracuse

Enc. (5)

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	Mr. Thomas Conklin	O'Brien & Gere
	Mr. Douglas M. Crawford	O'Brien & Gere (1 copy)
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FINAL REPORT

Focused Feasibility Study
Wastebeds 1 through 8
Geddes, New York

Honeywell

June 2010

Job No. 1163/41861

FINAL REPORT

Focused Feasibility Study
Wastebeds 1 through 8
Geddes, New York

Honeywell

Douglas M. Crawford, P.E.
O'Brien & Gere Engineers, Inc.

June 2010

O'BRIEN & GERE

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List of Acronyms

ACO – Administrative Consent Order
ARAR – Applicable or Relevant and Appropriate Requirement
ATV – All terrain Vehicle
BBL - Blasland, Bouck & Lee, Inc. (Arcadis)
BERA – Baseline Ecological Risk Assessment
bgs – Below Ground Surface
BTEX – Benzene, Toluene, Ethylene, (Total) Xylenes
CERCLA – Comprehensive Environmental Response, Compensation and Liability Act
cm/sec – Centimeters per Second
COPC – Chemical of Potential Concern
COPEC - Chemical of Potential Ecological Concern
CPOI – Chemical Parameters of Interest
C&S - Calcerinos & Spina
cy – Cubic Yards
El - Elevation
EPC – Exposure Point Concentration
FFS – Focused Feasibility Study
FRI – Focused Remedial Investigation
FS – Feasibility Study
ft – Feet or Foot
gpm – Gallons per Minute
GRA – General Response Action
GWTP – Groundwater Treatment Plant
HDPE – High Density Polyethylene
HHRA – Human Health Risk Assessment
HI – Hazard Index
HQ – Hazard Quotient
IRM – Interim Remedial Measure
LLDPE – Linear Low Density Polyethylene
mg/kg – Milligrams per Kilogram (parts per million)
MSL – Mean Sea Level
NAPL – Non-Aqueous Phase Liquid
NCP – National Oil and Hazardous Substances Contingency Plan
NMC – Ninemile Creek
NMCSG – Ninemile Creek Sand and Gravel
NYSDEC – New York State Department of Environmental Conservation
OCDWEP – Onondaga County Department of Water Environment Protection
O&M – Operation and Maintenance
OSHA – Occupational Safety and Health Administration
OSWER – Office of Solid Waste and Emergency Response
OU – Operable Unit
PAHs – Polycyclic Aromatic Hydrocarbons
PDI – Pre-Design Investigation
POTW – Publicly Owned Treatment Works
PRAD – Proposed Response Action Document

PSA – Preliminary Site Assessment
PTI – PTI, Inc. (Exponent)
RAD – Remedial Action Document
RAGS – Risk Assessment Guidance for Superfund
RI – Remedial Investigation
ROD – Record of Decision
SMU – Sediment Management Unit
SVOCs – Semi-Volatile Organic Compounds
SRE – Streamlined Risk Evaluation
SYW - Wetland designation code for Wetlands in Syracuse Area
TAMS – TAMS Consultants, Inc.
TBC – To Be Considered
USEPA – United States Environmental Protection Agency
USGS – United States Geological Survey
VOCs – Volatile Organic Compounds
WWTP – Waste Water Treatment Plant
yr - Year

Executive Summary

Background

The Record of Decision (ROD) for the Onondaga Lake Bottom Site (NYSDEC and USEPA July 2005) notes that "the control of contamination migrating from…upland subsites to Onondaga Lake is an integral part of the overall remediation of Onondaga Lake". The ROD also acknowledges the need to coordinate the timing of the remedial work related to the lake bottom with the work that is performed as part of the remedies at the upland sites.

These key elements of the ROD reflect the fact that Onondaga Lake does not exist by itself. It is located at the bottom of an expansive watershed that includes creeks, rivers, wetlands, floodplains and wildlife that are interconnected with the lake. Achieving the goals of the ROD and the community's vision of a restored Onondaga Lake requires a healthy and sustainable watershed.

The Wastebeds 1-8 Site (Site) is located northwest of the City of Syracuse along approximately 2.1 miles of Onondaga Lake's southwest shoreline. It also borders another Onondaga Lake subsite, Ninemile Creek (NMC). The Wastebeds consist primarily of inorganic wastes resulting from the production of soda ash using the Solvay process. Other waste materials associated with a variety of production processes from former Solvay Process, and later Allied Signal, operations were also likely disposed at the Wastebeds along with the Solvay process wastes. These are sources or potential sources of contamination to Onondaga Lake and NMC.

At other Onondaga Lake sites once considered sources of contamination, significant progress is being made to improve the watershed. Restored wetlands at the remediated former LCP site in Geddes support native plant species that are attracting wildlife. A growing "Willow Farm" at the old Solvay Settling Basins supports healthier habitat and holds the promise of becoming a source of renewable energy. Plans are moving forward to remediate Geddes Brook and NMC and re-establish important habitat in those tributaries to Onondaga Lake. Groundwater is being collected along the southwest shoreline and pumped underneath I-690 to the Willis Avenue Groundwater Treatment Plant (GWTP) for treatment. Treated water is being tested to meet state standards before being returned to the lake. These sites represent areas where a lake-sustaining Green Corridor is beginning to emerge.

The interim remedial program of Wastebeds 1-8 outlined in this Focused Feasibility Study (FFS) Report represents an important step toward the overall remediation of the site, and brings the opportunity to expand this Green Corridor by linking and creating restored habitats from lower Geddes Brook to the shores of the lake. The recommended alternative in this FFS Report protects human health and the environment and will support a healthy lake watershed by improving habitat, and creating new opportunities for recreation for the people of Central New York.

To prepare this FFS, Honeywell was assisted by a team of locally and nationally recognized scientists and engineers with expertise in the fields of: habitat restoration, ecological risk assessment, geology, hydrogeology, biology, chemistry, toxicology, civil and environmental engineering, groundwater fate and transport modeling, water treatment, and construction. The technical opinions developed by this team have collectively formed the basis for the conclusions and recommendations in this FFS Report.

This FFS Report documents the development and evaluation of Interim Remedial Measure (IRM) alternatives to address potential impacts to the Onondaga Lake and NMC remedies from the Site and meet the remedial action objectives (RAOs) identified for the IRM. The FFS was conducted pursuant to the Administrative Consent Order (ACO) (D-7-0002-02-08) between the New York State Department of Environmental Conservation (NYSDEC) and Honeywell dated January 22, 2004 and as described in the *Shallow and Intermediate Groundwater FFS Work Plan* (O'Brien & Gere 2008a).

The FFS focused on the following site media to provide for the effectiveness of the NMC Operable Unit (OU)-2 and Onondaga Lake remedies:

- Shallow and intermediate groundwater discharge to Onondaga Lake
- Seep discharge to NMC and Onondaga Lake
- Ninemile Creek Sand and Gravel (NMCSG) unit groundwater discharge to NMC and Onondaga Lake
- Surface water erosion of Solvay waste at the eastern shore to Onondaga Lake
- Wind and wave erosion of Solvay waste along the surf zone of Onondaga Lake
- Solvay waste substrate and sediment in the lower reaches of Ditch A
- Seep discharge from the upper reach of Ditch A to NMC.

The FFS process was initiated in parallel with the site-wide RI/FS such that the remedial elements to address the above aspects of the remedial program for Wastebeds 1-8 are coordinated with the schedules for the Onondaga Lake and NMC OU-2 remedial programs. The RI/FS process will evaluate site-wide remediation, including those remedial elements considered as part of this FFS.

The Site has been investigated during numerous field investigations starting in 1986 and continuing today. The results of these investigations are summarized in the RI Report (O'Brien & Gere 2008b) which is being revised in response to NYSDEC comments (NYSDEC 2008a). Generally, inorganics, volatile organic compounds (VOCs), and semi-volatile organic compounds (SVOCs) were detected in various media at the Site. A revised *Supplemental Remedial Investigation Work Plan* was submitted to NYSDEC on March 13, 2009 (Honeywell 2009d). These supplemental investigations are currently underway and also will be documented in the Revised RI Report. The Site-wide FS will be conducted following the RI.

Additional investigation/treatability study activities were also conducted as part of the FFS process to aid in remedial technology evaluation. The activities included a site survey, geotechnical investigation, material compatibility testing, a groundwater microcosm study, a focused investigation of shallow and intermediate groundwater along the eastern shore, and a seep evaluation. Results of these activities are summarized in this report.

Also of relevance to the FFS is that the eastern shore of the Site has been established as a suitable location for construction of compensatory mitigation wetlands. The mitigation wetlands will consist of an integrated diverse wetland complex on 7.7 acres of the Site's eastern shore. While not part of the IRM discussed in this FFS report, the presence of this wetland complex was considered where relevant in the development of IRM alternatives for the Site.

The shallow and intermediate site groundwater discharging to Onondaga Lake and NMC is a result of recharge from precipitation infiltrating through the wastebeds. There is no offsite source of shallow and intermediate groundwater. Therefore, the general overall remedial strategy for the Site is to both manage shallow and intermediate groundwater that is discharging toward Onondaga Lake and NMC (considered as part of the FFS) and to minimize the recharge of groundwater from infiltration (to be considered in the Site-wide FS). This strategy also includes seeps that have the potential to flow into Onondaga Lake or NMC. An IRM for this Site is intended to be consistent with, and an integral part of the final site-wide remedy, as well as the eastern shore wetland complex, described above.

As part of this FFS, an assessment of reasonably anticipated future land use was completed. As described in Section 2.5, this assessment included information documented in a number of published reports that reflected significant community input. This assessment concluded that the reasonably anticipated future land uses for the site are recreational and ecological. In addition, a streamlined risk evaluation (SRE) was completed. The SRE concluded that groundwater, soils, and seeps considered in this FFS pose potential risks to human health and the environment, based on conservative screening. This evaluation will be advanced through the site-wide risk assessments to be completed as part of the RI/FS process for the Site. The alternatives considered in this FFS will address these potential risks.

The RAOs for this FFS were developed to provide for continued effectiveness of the Onondaga Lake SMU-3 and SMU-4 and NMC OU-2 remedies. The RAOs are to mitigate, to the extent necessary and practicable, and within the context of the IRM, the following:

- Direct contact with and ingestion of exposed Solvay waste and other contaminated soil along the eastern shore
- Discharge of NMCSG unit and eastern shore groundwater to Onondaga Lake and NMC
- Discharge of shallow and intermediate groundwater to Ditch A
- Discharge of and direct contact with selected NMC, eastern and northern shore seep water to Onondaga Lake and NMC
- Erosion of Solvay waste from the eastern shore to Onondaga Lake
- Erosion of Solvay waste along the surf zone of Onondaga Lake SMU-4 and portions of SMU-3 due to wind and wave action
- Erosion of Solvay waste substrate and sediment from the lower reach of Ditch A to Onondaga Lake
- Discharge of seep water from the upper reach of Ditch A to NMC.

Four IRM alternatives were evaluated in detail.

Following review of the evaluations documented in this FFS Report, NYSDEC and USEPA will document the preferred response action in a Proposed Response Action Document (PRAD). Following receipt of public comments on the PRAD, the selected response action will be documented in a Response Action Document (RAD). The proposed and selected response action may be different from that recommended in this FFS Report. The final remedy that results from the site-wide RI/FS process will be documented in a Record of Decision.

The IRM recommended for implementation by Honeywell in this report effectively addresses the remedial objectives and potential risks, and will provide for comprehensive enhancement of the habitat and offer recreational opportunities to the people of Central New York.

1. Introduction

As part of the continuing progress toward achieving the goals of the Wastebeds 1-8 Administrative Consent Order (ACO) and the community's vision for a restored Onondaga Lake, this report documents a Focused Feasibility Study (FFS) that was conducted to develop and evaluate interim remedial measure (IRM) alternatives to address potential impacts from the Wastebeds 1-8 Site to the Onondaga Lake and Ninemile Creek (NMC) Operable Unit (OU)-2remedies and meet the remedial action objectives (RAOs) identified for the IRM. The Wastebeds 1-8 Site (Site) is located in Geddes, New York; a Site location plan is included as **Figure 1**. The FFS was performed on behalf of Honeywell, by a project team consisting of local and nationally recognized experts from various universities, research institutions, and specialty engineering firms to meet Honeywell's overall goal to provide long-lasting protection to the local community and environment, and restore the Onondaga Lake shore to the community.

A Remedial Investigation/Feasibility Study (RI/FS) is being conducted under the ACO. The RI is currently being completed, and an RI Report is being prepared to document field investigations conducted at the site. A baseline human health risk assessment and baseline ecological risk assessment are also being completed. Once these are completed, a site-wide FS will be conducted. The FS will evaluate site-wide remedial alternatives to address potential risks identified through the risk assessments and media of concern identified in the RI. The site-wide remedy will be documented in a Record of Decision for the Site.

The purpose of the FFS was to develop and evaluate IRM alternatives to mitigate groundwater flow, seep discharge, and eastern shore Solvay waste erosion from the Site to Onondaga Lake, and groundwater and seep discharge from the Site to NMC. The FFS was conducted pursuant to the ACO (D-7-0002-02-08) between the New York State Department of Environmental Conservation (NYSDEC) and Honeywell dated January 22, 2004 and as described in the *Shallow and Intermediate Groundwater FFS Work Plan* (O'Brien & Gere 2008a). It was conducted to accelerate the development and evaluation of IRM alternatives to provide for continued effectiveness of the NMC OU-2 and Onondaga Lake remedies so that implementation of the preferred IRM could be conducted in alignment with the schedules for remediation of NMC OU-2 and Onondaga Lake.

This FFS Report documents the process followed during the FFS, provides a summary of the results of field activities and treatability studies conducted in accordance with the FFS Work Plan, and presents the development and evaluation of IRM alternatives.

IRM alternatives were developed and evaluated during the FFS to mitigate potential impacts to the Onondaga Lake and NMC OU-2 remedies. The IRM alternatives focused on the following site media:

- Shallow and intermediate groundwater discharge to Onondaga Lake
- Seep discharge to NMC and Onondaga Lake
- Ninemile Creek Sand and Gravel (NMCSG) unit groundwater discharge to NMC and Onondaga Lake
- Surface water erosion of Solvay waste at the Site's eastern shore to Onondaga Lake
- Wind and wave erosion of Solvay waste along the surf zone of Onondaga Lake
- Solvay waste substrate and sediment in the lower reaches of Ditch A

- Seeps in the upper reach of Ditch A.

The IRM alternatives were also developed considering the requirements for mitigation of open water and wetlands resulting from the remediation of this Site and the Willis Avenue and Wastebed B/Harbor Brook IRMs.

This section provides background information that describes the Site and its history. In addition, background information regarding the setting for this FFS as it relates to the Onondaga Lake Site and NMC Site remedies is provided in this section. **Section 2** of this Report presents a summary of the Site's characteristics. The development of IRM alternatives and the detailed analysis of alternatives are documented in **Sections 3 and 4**, respectively. Honeywell's recommendation as to the alternative that represents the best balance with respect to the evaluation criteria is presented in **Section 5**.

1.1. Site Description

The Site is located on the southwestern shore of Onondaga Lake in Geddes, NY. A Site Plan is included as **Figure 2**. In general, the Site consists of variable terrain with numerous topographic highs and lows that range from approximately 362.9 ft above mean sea level (MSL) at the shore of Onondaga Lake, to 430 ft above MSL, at the highest point. Transportation features bisect the Site and include Interstate 690 (I-690) (which runs between the lakeshore and State Fair Boulevard), New York State Fairgrounds parking lots, access roads for the parking lots, and foot bridges. The irregularly shaped beds extend roughly 2.1 miles along the shore, with a maximum width of 0.5 mile, and cover approximately 315 acres. The Site, in its entirety, and inclusive of the Solvay wastebeds, covers approximately 404 acres.

As presented on **Figure 2**, two wetland areas have been identified and delineated along the eastern shore. These wetlands encompass a total of approximately 0.7 acres and are further described in the *Wetland Delineation and Floodplain Assessment for Wastebeds 1-8* (O'Brien & Gere 2009).

1.2. Site History

The wastebeds were constructed over the Geddes Marsh, which resulted from the lowering of the lake level in 1822 to the same level as the Seneca River (Blasland, Bouck & Lee [BBL] 1989). The wastebeds are composed primarily of Solvay waste consisting of particles of insoluble residues, hydroxides, calcium carbonate, gypsum, sodium chloride (salt), and calcium chloride. These wastes were generated at the former Main Plant as part of soda ash production using the Solvay Process. Soda ash production began in 1884 and continued until 1986. The Solvay waste was hydraulically placed in the wastebeds in slurry form (90 to 95% water and 5 to 10% solid material).

The nature of the material used to construct the perimeter berms is expected to be variable depending on location. It is believed that containment on the shore of the wastebeds consisted of perimeter dams constructed of wooden piles, sheeting, and/or earth. Earthen dams likely consisted of a mixture of urban fill including slag, bricks, gravel, sand, and silt. Remnants of bulkheads that were installed prior to filling the wastebeds, are evident along the lakeshore. Weir box structures were constructed to allow water to decant into the structures and be conveyed using metal pipes through the perimeter berms. These structures were likely constructed of wood timbers. Remnants of collapsed weir boxes and associated pipes have been encountered at various locations at the Site. In some cases, water

continues to seep intermittently from these pipes. Identified weir box remains and associated pipes are shown on **Figure 2**.

Chlorinated benzene production at the Willis Avenue plant occurred between 1918 and 1977. Additional operations reportedly took place at the Willis Avenue plant from 1918 to 1977 including production of hydrochloric acid, caustic soda, caustic potash, and chlorine gas (O'Brien & Gere 1990). The Benzol plant operated from as early as 1903. This plant produced benzene, toluene, xylenes, and naphthalene by the fractional distillation of coke "light oil". The Solvay Process Company operated a coke plant from 1892 through 1923. A phenol production plant operated from 1942 to 1946 (PTI 1992). Materials associated with these operations may have been disposed of in Wastebeds 1-8 with the Solvay waste slurry or by alternative means, although there are no records or reports to indicate this occurred.

Wastebeds 1 through 6 were in use before 1926 and may have been put to use as early as 1916, although no definitive construction date is available (**Figure 2**). NMC was rerouted to the north to permit the construction of Wastebeds 5 and 6. Wastebeds 7 and 8 were not utilized until after 1939 and remained in use with Wastebeds 1-6 until 1943 (BBL 1989).

A dike along Wastebed 7 reportedly failed, and an area along State Fair Boulevard was flooded with Solvay waste on November 25, 1943. This led to the closure of Wastebeds 1-8. The location of each wastebed is presented on **Figure 2**.

Subsequent uses of the Site included construction of I-690 prior to 1958, construction of the I-690 and NYS Route 695 interchange between 1973 and 1978, and the operation of a landfill on a portion of Wastebed 5 by Crucible Specialty Metals (Crucible) from 1973 to 1988 [Calcerinos & Spina (C&S) 1986]. The Crucible Landfill covers an area of approximately 20 acres and contains an estimated volume of 225,100 cubic yards (cy) of non-hazardous and hazardous wastes (C&S 1986). The NYSDEC approved the revised Crucible Landfill closure plan in 1986, and the landfill was closed with a cap in 1988. Long-term monitoring of the Crucible Landfill is performed annually consistent with the landfill closure requirements. The City of Syracuse and Onondaga County utilized a portion of the wastebeds from 1925 to 1978 for sewage sludge disposal, however, the nature, volume, and exact boundaries of this are unknown.

The Site is owned by the State of New York and Onondaga County (C&S 1986). The New York State Fair uses a portion of the Site for parking; however, only the access roads are currently paved. The remainder of the Site is currently vegetated, except for the wastebed slopes along the shore of Onondaga Lake and east of the mouth of NMC where Solvay waste is exposed and minimal vegetation exists. **Figure 2** depicts the approximate property boundaries. The Onondaga County Deed requires that this property be maintained as parkland.

1.3. FFS Background

This FFS Report documents the process followed to develop and evaluate IRM alternatives to address groundwater and seep discharge to Onondaga Lake and NMC and erosion of Solvay waste along the Onondaga Lake shore and from the lower reach of Ditch A. The FFS has been conducted to accelerate the development and evaluation of IRM alternatives to address these aspects of the site, as

necessary, in alignment with the schedules for the remediation of Onondaga Lake and NMC OU-2. Relevant information regarding these programs is provided below.

Components of the Onondaga Lake remedy that are adjacent to the Site are those in-lake remedial elements to be completed in Onondaga Lake Site sediment management unit (SMU)-3 and SMU-4. The locations of SMU-3 and SMU-4 are depicted on **Figure 2**. As described in the July 2005 Record of Decision (NYSDEC and USEPA 2005) these consist of:

- Targeted dredging and capping in SMU-3 and SMU-4
- Habitat enhancement to stabilize calcite deposits and oncolites and promote submerged macrophyte growth along 1.5 miles of SMU-3 shore

An illustrative summary of the proposed remedial approach for SMU-3 and SMU-4 is provided as Exhibit A to this report (NYSDEC and USEPA 2005). A need to limit groundwater upwelling velocities to protect the integrity of the cap may require that groundwater be collected in the vicinity of the SMU-4 cap. The collection system design would be incorporated with the IRM design and would be based on the final in-lake cap design for SMU-4.

Components of the NMC OU-2 remedy that are adjacent to the Site are those in-creek remedial elements to be completed in the lower reach of NMC (reach AB) and in the floodplain along NMC reach AB. The location of NMC reach AB is depicted on **Figure 2**. The remedy for the NMC reach AB as described in the October 1, 2009 *Record of Decision for Operable Unit 2 of the Geddes Brook/Ninemile Creek Site* (NYSDEC 2009a) consists of:

- Sediment removal within the NMC AB Channel
- Restoration of NMC AB Channel by installation of a sand base layer and habitat layer
- Removal of floodplain soil/sediment between the NMC waterline and the 370 ft contour on the shore of the Wastebed 1-8 Site
- Restoration of floodplain between the NMC waterline and the 370 ft contour on the shore of the Wastebed 1-8 Site by placement of a vegetated habitat layer
- Removal of soil/sediment within Wetland SYW-10 at the eastern spit of NMC
- Restoration of excavated area within Wetland SYW-10.

An illustrative summary of the remedial approach for OU-2 is provided as Exhibit B to this report (NYSDEC 2009a).

1.4 Wetland Mitigation

Honeywell and NYSDEC have been working to resolve the actions required to address the mitigation of wetlands along the shore of Onondaga Lake for remediation purposes. Wetlands are projected to be disturbed as a result of remedial activities associated with the Willis-Semet and Wastebed B/Harbor Brook IRMs and remedial activities at this Site. These disturbed areas will be replaced with compensatory mitigation wetlands comprising an integrated complex of connected and inland wetlands. The eastern shore of the Site has been identified as a suitable location for construction of compensatory mitigation wetlands that are necessary to address the areas noted above.

The mitigation wetlands will consist of 2.3 acres of open water connected wetland to compensate for lost open water lake surface due to the implementation of the Willis-Semet IRM barrier wall, and 5.4 acres of inland wetlands for wetland mitigation purposes associated with Wastebed B/Harbor Brook and Wastebeds 1-8 IRMs. Surface restoration elements of IRM components in the immediate vicinity of the wetland complex were incorporated to be consistent with the enhanced habitat.

A preliminary design for the 2.3 acres of open water connected wetland was submitted to NYSDEC on November 21, 2008 (Honeywell 2008a). Comments were received from NYSDEC on June 4, 2009. A response to these comments was provided to NYSDEC on July 9, 2009 (Honeywell 2009a). The revised interim design for the complete 7.7 acre wetland complex was submitted to NYSDEC on October 1, 2009 (Honeywell 2009b).

The wetlands to be constructed along the eastern shore of the Site, together with the restoration of adjacent areas of the Site both as part of the remedial efforts contemplated in this FFS and as part of the final Site remedy, afford a unique opportunity for habitat enhancement.

2. Site Characterization

This section presents the Site conditions as they relate to this FFS. As described in **Section 1**, this FFS focuses on the following site media:

- Shallow and intermediate groundwater discharge to Onondaga Lake
- Seep discharge to NMC and Onondaga Lake
- Ninemile Creek Sand and Gravel (NMCSG) unit groundwater discharge to NMC and Onondaga Lake
- Surface water erosion of Solvay waste at the eastern shore to Onondaga Lake
- Wind and wave erosion of Solvay waste along the surf zone of Onondaga Lake
- Solvay waste substrate and sediment in the lower reaches of Ditch A
- Seeps in the upper reach of Ditch A.

Site conditions have been evaluated during a series of investigations. This section describes site characteristics of the shallow and intermediate groundwater and areas proximate to NMC OU-2 and Onondaga Lake.

2.1. Previous Investigations

Several investigations have been previously undertaken at or adjacent to the Site and are documented in the following:

- Crucible applications for NYSDEC Part 360 and 364 permits and landfill closure, including supporting documents: *Phase II Geotechnical Investigations, Crucible Inc., Solid Waste Management Facilities and Phase I Hydrogeological Investigations, Crucible Inc., Solid Waste Management Facilities (Thomsen, 1982a; Thomsen, 1982b), and the Revised Landfill Closure Plan Volumes 1 & 2* (C&S 1986)
- *Hydrogeologic Assessment of the Allied Waste Beds in the Syracuse Area* (BBL 1989)
- *Onondaga Lake Project Waste Beds Investigation Report* (TAMS 1995)
- *Geddes Brook/Ninemile Creek Remedial Investigation* (NYSDEC 2003a)
- *Ninemile Creek Supplemental Sampling Program* (O'Brien & Gere 2002)
- *Onondaga Lake Remedial Investigation Report* (NYSDEC 2002)
- *Onondaga Lake Project Waste Beds Investigation Report, Supplemental Wastebeds 1 through 8 Seeps, Sediment, and Water Sampling conducted by NYSDEC* (NYSDEC 2003b)
- *Geddes Brook/Ninemile Creek Feasibility Study Report* (Exponent 2005)
- *Wastebeds 1 through 8 Preliminary Site Assessment (PSA) Data Summary* (O'Brien & Gere 2005a)
- *Environmental Sampling along the Proposed Onondaga Canalways Trail Section 1* (Parsons 2004)
- *Wastebeds 1 through 8 Focused Remedial Investigation (FRI) Report* (O'Brien & Gere 2005b)
- *Wastebeds 1 through 8 Remedial Investigation Report* (O'Brien & Gere 2008b).

During these various investigations, samples of site soil, groundwater, seeps, surface water and sediment were collected and analyzed. The results of these investigations are summarized in the draft RI Report (O'Brien & Gere 2008b), and subsequent supplemental remedial investigations are summarized in **Appendix A**. The draft RI Report is currently being revised. Generally, inorganics, volatile organic compounds (VOCs), and semi-volatile organic compounds (SVOCs) were detected in various media at the Site. Following submittal of the draft RI Report, NYSDEC provided comments in its letter of October 27, 2008 (NYSDEC 2008a). Responses to these comments were provided to NYSDEC on November 21, 2008. As a result of these comments, a *Supplemental Remedial Investigation Work Plan* was submitted to NYSDEC on March 5, 2009 (Honeywell 2009c). Following submittal of the work plan, NYSDEC provided comments in its letter of April 2, 2009 (NYSDEC 2009b). A revised *Supplemental Remedial Investigation Work Plan* was submitted to NYSDEC on March 13, 2009 (Honeywell 2009d). NYSDEC approved the work plan in its letter of May 14, 2009 (NYSDEC 2009c). These additional investigations are currently underway. A summary of the available results of these additional investigations is provided in **Appendix A**. The full data analysis and report will be submitted in a Revised RI Report. For purposes of this FFS Report, results of these field investigations are collectively referred to as RI data.

In accordance with the 2006 RI/FS Work Plan for the Site, risk assessment activities have also been initiated. Specifically, Risk Assessment Guidance for Superfund (RAGS) Tables 1 through 10 was submitted to NYSDEC on November 20, 2008, for the human health risk assessment (Honeywell 2008b). NYSDEC provided comments on the RAGS tables in its letter of February 5, 2009 (NYSDEC 2009d). The following ecological risk assessment documents were submitted to NYSDEC:

- *Problem Formulation Document* (O'Brien & Gere 2007a)
- *Baseline Ecological Risk Assessment Work Plan* (O'Brien & Gere 2007b)
- *Revised Baseline Ecological Risk Assessment Work Plan* (O'Brien & Gere 2007c).

The risk assessments will be completed and submitted subsequent to the completion of the Supplemental RI efforts.

The *Shallow and Intermediate Groundwater Focused Feasibility Study Work Plan* was submitted to NYSDEC in February 2008 (O'Brien & Gere 2008a). As part of this work plan, field activities including a site survey and topographic survey, geotechnical investigation, material compatibility testing, and a groundwater microcosm study were conducted to aid in remedial technology evaluation. An addendum to the work plan was submitted in March 2008, describing additional geotechnical borings within Onondaga Lake (Honeywell 2008c). The details of the microcosm testing were submitted to NYSDEC in the October 3, 2008 *Microcosm Study Work Plan* (Honeywell 2008d). This work plan was approved by NYSDEC in its October 14, 2008 letter (NYSDEC 2008b). The results of the geotechnical investigation are included in **Appendix B**. The results of the material compatibility testing are included in **Appendix C**. The results of the microcosm study are included in **Appendix D**.

For the purpose of evaluating technologies for the collection of shallow and intermediate groundwater in this FFS, a focused groundwater investigation was performed for the shallow and intermediate groundwater along the eastern shore in accordance with the August 28, 2008 work plan entitled *Additional Evaluation of Shallow and Intermediate Groundwater* (O'Brien & Gere 2008c). This work plan was approved by NYSDEC in its letter dated September 2, 2008 (NYSDEC 2008c). These

investigations were performed between September 15, 2008, and April 11, 2009, and the results of these investigations are summarized in **Appendices E and F**.

As observed during the RI, seeps are present at various locations around the Site at intermittent times of the year. To supplement the information on seeps collected during the RI in 2004, additional seep reconnaissance efforts were completed in 2008 and 2009. These are documented in **Appendix G**. Additional seep evaluation is underway in accordance with the June 29, 2009 *Seep Evaluation Work Plan* (Honeywell 2009e).

2.2. Site Geology

This section provides a description of the Site's geology as it relates to the FFS. The Site is located at the base of the Onondaga Escarpment, which marks the boundary between the Ontario Lowlands and Allegheny Plateau physiographic provinces. Ground elevation of the escarpment ranges from 362.5 ft MSL at the surface of Onondaga Lake to 1,000 ft above MSL near the top of the cuesta forming the escarpment.

The lowlands are characterized by low relief and unconsolidated glaciolacustrine and glaciofluvial sediments deposited in and near the proglacial lake formed during glacial retreat. The unconsolidated deposits vary in thickness from negligible to hundreds of feet. The Silurian Age Vernon Shale Formation underlies the unconsolidated deposits in the vicinity of the Site.

The uplands feature higher relief and unconsolidated deposits of predominantly glacial drift or valley train deposits. Bedrock south of the Site changes stratigraphically from the Silurian Vernon Formation at the base of the cuesta through the Syracuse and Helderberg Formations to the Devonian Onondaga Formation found at the top of the cuesta. Each of these formations has a gentle southward dip of one to two degrees (Kantrowitz 1970).

Several geologic cross-sections have been developed to present the Site geology. As shown on **Figure 3**, cross section A-A′ (**Figure 4**) presents a cross-section traversing west to east along the Onondaga Lake shore from NMC to Ditch A, cross section B-B′ (**Figure 5**) presents a north-south (perpendicular to lakeshore) cross-section, and cross section C-C′ (**Figure 6**) presents an east-west cross-section traversing from NMC to the Onondaga Lake shore. As illustrated in these cross-sections, up to 250 ft of both anthropogenic and natural unconsolidated deposits overlie the Silurian Age Vernon Shale. The overburden deposits above the bedrock consist of till, basal sand and gravel, fine sand and silt, glaciolacustrine silt and clay confining layer, marl, and anthropogenic fill.

The overburden deposits occupy a bedrock channel scoured by glacial meltwater. This channel intersects with the Onondaga Lake bedrock channel near the current extent of Onondaga Lake. While regional bedrock dips to the south, the scoured bedrock surface elevation increases from the Onondaga Lake trough to the Onondaga Escarpment. Typically the bedrock surface consists of 2 to 10 ft of weathered bedrock above more competent bedrock. Bedrock borings indicate that much of the bedrock is fractured, however, most fractures have been in-filled with gypsum.

A compacted red, basal till composed of a clay and silt matrix with some sand and gravel overlays the bedrock. The till grades from a sandy, reworked till to a denser silt and clay till in areas. The till ranges in thickness from less than 1 ft to 35 ft.

A basal sand and gravel unit with a thickness of up to 25 ft was observed in deep borings on the Site. This unit typically overlies the basal till unit, but some deep borings indicate that there are locations where the sand and gravel unit is in contact with bedrock. The unit typically coarsens downward from fine to coarse sand to coarse sand and gravel at the base. The basal sand and gravel unit appears to be continuous, however it exhibits variable textures and thicknesses typical of adjacent lakeshore sites.

Glaciolacustrine silts and fine-grained sands overlay the basal sand and gravel at the Site. The silt and sand unit grades into an overlaying silt and clay unit. The lower fine-grained silt and sand unit is typically 35 to 45 ft thick. The upper silt and clay unit is typically 20 to 45 ft thick. However, the silt and clay layer was not encountered under the middle portion of Wastebeds 2, 3, 4, and portions of 7 and 8 at the Site. In general, the glaciolacustrine clay/silt and sand units are thickest towards the axis of Onondaga Lake and thinnest where bedrock and till elevations increase to the south.

Fresh water marl and peat were deposited above the glaciolacustrine units. The marl is characterized by plentiful shells and carbonate deposition. The shell content typically grades downward from abundant to trace. Sediment grain size also fines downward with the decrease in shell content where sand dominant marl grades to clayey silt. Where present, the unit ranges from 3 to 40 ft thick and forms the native base for the wastebeds. The marl thins away from the lake. Under the southern side of the wastebeds, there is often a thin peat layer deposited along the former lakeshore areas. While peat is encountered at various locations on the site, the general trend is that the marl pinches out to a thin peat layer going from north to south across the site.

On the portion of the Site near NMC, localized alluvial sand and gravel deposits were found within the marl. **Figure 7** presents the approximate areal extent of the NMCSG deposits. The alluvial deposits are a combination of sand, gravel, silt, and clay. They range in thickness from 5 to 18 ft and increase in thickness in the vicinity of where the former creek channels entered Onondaga Lake. These deposits are likely related to several former NMC channels that existed at the Site. One former channel was diverted in 1926 (BBL 1989) for the creation of the wastebeds. Other older NMCSG deposits overlain by freshwater marl were identified during PSA and FRI fieldwork activities. Supplemental RI field work has recently been completed and evaluations are underway to assess the extent of the unit, hydraulic characteristics including connectivity of groundwater flow in these deposits to Onondaga Lake and NMC, and the contaminant distribution associated with the former NMCSG.

Wastebeds 1-8 form a tiered fill layer above the natural sediments throughout the entire Site. The upper levels of the wastebeds are up to 65 ft above lake level with a maximum thickness of approximately 78 ft and a typical thickness ranging between 60 and 70 ft. The fill is thinner between the toe of the wastebeds and the lake, where the fill is outside the original wastebed berms.

2.3. Site Hydrogeology

This section provides a description of hydrogeology as it relates to the Site. Because this FFS focuses on shallow and intermediate groundwater in areas proximate to the Onondaga Lake shore and NMC, this description concentrates on shallow and intermediate groundwater flow from the Site to these surface water bodies.

Six hydrogeologic units were encountered at the Site:

1) A shallow zone composed of anthropogenic fill and Solvay waste
2) An intermediate zone composed of marl/peat
3) The former NMCSG
4) A confining layer composed of the silt and clay
5) A deep zone consisting of the silt and fine grained sand unit and the basal sand and gravel unit
6) A bedrock zone.

As described above, the following discussion focuses on the shallow and intermediate groundwater at the Site, and on groundwater in the former NMCSG unit. Deep groundwater is the subject of a separate effort.

Shallow Zone
The shallow groundwater zone consists of the anthropogenic fill and Solvay waste. Laboratory and field permeability tests showed horizontal hydraulic conductivity values within the anthropogenic fill and Solvay waste in the 10^{-3} to 10^{-5} cm/sec range and a mean vertical hydraulic conductivity of 8 x 10^{-6} cm/sec. The lower vertical hydraulic conductivity is due to the layered nature of the hydraulically-placed waste.

Intermediate Zone
The intermediate groundwater zone consists of fine-grained marl/peat immediately underlying the Solvay waste at the Site. The hydraulic conductivity of the marl varies depending upon the proportion of silt, sand, and clay. Laboratory and field permeability tests showed horizontal hydraulic conductivity values in the 10^{-4} to 10^{-6} cm/sec range and a mean vertical hydraulic conductivity of 7 x 10^{-5} cm/sec.

As illustrated in **Figure 8**, the wastebeds are a topographic high; therefore, shallow and intermediate groundwater is not expected to flow into the Site from off site. Instead, recharge from precipitation forms the source of the groundwater in the wastebed shallow and intermediate groundwater zones. The recharge and topographic high of the wastebeds create a mounding effect as shallow and intermediate groundwater (infiltration) flows outward from the wastebeds toward Onondaga Lake, NMC, and other surface water bodies, such as drainage ditches. Groundwater flow within the shallow and intermediate groundwater zones along the northern and eastern shores is towards Onondaga Lake.

Alluvial Deposits (former NMCSG)
Localized alluvial deposits related to the former NMC channel are found in the marl unit. They range in thickness from 5 to 18 ft, increasing in thickness where the former creek channel entered Onondaga Lake. *In situ* testing yielded hydraulic conductivity values in the 10^{-4} to 10^{-6} cm/sec range. Additional RI field work has been completed and evaluations are underway to assess the extent of the unit, hydraulic characteristics including connectivity of groundwater flow in these deposits to Onondaga Lake and NMC.

Silt and Clay Confining Layer
Beneath the intermediate groundwater zone is the glaciolacustrine silt and clay layer. This lower permeability unit acts as a confining layer between the intermediate groundwater zone and the deep groundwater zone. The deep wells along the lakeshore have water elevations above the lake elevation, which indicates a strong upward flow gradient.

2.4. Nature and Extent of Contamination and Media to be Addressed

This section presents a summary of the nature and extent of contamination and media of concern as it relates to this FFS. This FFS focuses on the following site media:

- Shallow and intermediate groundwater discharge to Onondaga Lake
- Seep discharge to NMC and Onondaga Lake
- Ninemile Creek Sand and Gravel (NMCSG) unit groundwater discharge to NMC and Onondaga Lake
- Surface water erosion of Solvay waste at the eastern shore to Onondaga Lake
- Wind and wave erosion of Solvay waste along the surf zone of Onondaga Lake
- Solvay waste substrate and sediment in the lower reaches of Ditch A
- Seeps in the upper reach of Ditch A.

Based on RI data the following preliminary chemical parameters of interest (CPOIs) were identified for the Site: benzene, toluene, ethylbenzene, and xylene (BTEX), polycyclic aromatic hydrocarbons (PAHs), phenols, and various inorganics.

Shallow and Intermediate Groundwater Discharge to Onondaga Lake
Shallow and intermediate groundwater discharges from the Solvay waste and marl units at the Site to Onondaga Lake along SMU-3 and SMU-4. Shallow and intermediate groundwater discharge is generally low, with an estimated total of 29 gpm along the eastern shore. As illustrated in **Figures 9 and 10**, BTEX, naphthalene and phenol were observed in shallow and intermediate groundwater discharging from the Solvay waste and marl units along the eastern shore. Groundwater monitoring well data indicate that the highest BTEX, naphthalene, and phenol concentrations were detected along the eastern shore in the shallow groundwater, while the highest concentrations of these constituents in the intermediate groundwater monitoring wells were detected inland from the eastern shore. Specifically, as illustrated on **Figure 9**, benzene concentrations in shallow groundwater along the eastern shore ranged from 130 µg/L to 9,600 µg/L. Benzene concentrations on the remainder of the Site ranged from less than detection limits to 120 µg/L, with all but one of these wells exhibiting concentrations of 21 µg/L or less. Similarly, toluene, ethylbenzene, and total xylenes (TEX) concentrations in shallow groundwater along the eastern shore ranged from 130 µg/L to 9,592 µg/L, while TEX concentrations elsewhere ranged from less than detection to 46.5 µg/L. As illustrated on **Figure 10**, the highest concentrations of BTEX in intermediate groundwater were detected inland and upgradient of the eastern shore, where concentrations of benzene and TEX ranged from 38 µg/L to 40,000 µg/L, and 4,250 µg/L to 39,920 µg/L, respectively. Concentrations of benzene in intermediate groundwater on the eastern shore of the Site ranged from less than detection limits to 6,600 µg/L, with all but one of these wells exhibiting concentrations of 310 µg/L or less. Concentrations of TEX in intermediate groundwater on the eastern shore of the Site ranged from less than detection limits to 49.5 µg/L. Evaluation of control measures for groundwater discharge from the Solvay waste and marl units along the eastern shore is a focus of this FFS.

The extent of BTEX, naphthalene and phenol in groundwater along the eastern shore was further investigated during field investigations performed subsequent to the RI between September 15, 2008, and April 2009. As described in **Appendix E**, this investigation showed that organic CPOI constituents in groundwater generally extend throughout the marl unit to depths of up to about 45 ft below grade. Specifically, concentrations of BTEX ranged from less than detection limits to 29,492 µg/L, with BTEX concentrations generally exceeding 1,000 µg/L throughout most of the vertical extent of the marl unit in this area. Detected concentrations of naphthalene were not as prevalent throughout the depth of the marl as the BTEX concentrations. The concentrations of naphthalene ranged from less than detection limits to approximately 20,000 µg/L. The distribution of BTEX and naphthalene concentrations with depth, and relative to the corresponding subsurface strata, are illustrated on **Figure 2** of **Appendix E**.

Former NMCSG Unit

Primarily BTEX and phenol are present in the groundwater in the former NMCSG unit. As described in **Section 2.1**, further field work for the NMCSG unit has recently been completed. This information will be evaluated to address the potential for the presence of a focused groundwater discharge to Onondaga Lake and NMC. Once this evaluation is complete it will be provided in a separate deliverable. This FFS Report includes elements to address discharge of the former NMCSG unit groundwater to NMC and Onondaga Lake. However, these elements would be subject to change based upon the results of the NMCSG unit evaluation.

Seep Discharge to NMC and Onondaga Lake

Seeps have been observed along NMC and the Onondaga Lake shores during various field visits to the Site. RI analytical results for samples collected from several seep locations are presented on **Figure 11**. The results show that CPOIs including BTEX, PAHs, and naphthalene were detected in several seeps along the eastern shore, while naphthalene was detected along the northern shore and no CPOIs were detected in the one sample analyzed along NMC. Calcite precipitation and erosion of Solvay waste associated with seep flow also present potential impacts to the Onondaga Lake and NMC remedies. As described above, further seep evaluation is underway. This evaluation will address the potential for calcite formation in NMC and Onondaga Lake and the potential of the seeps to affect vegetation. Once results are available, they will be provided in a separate deliverable. This FFS Report includes elements to address seep discharge to NMC. However, these elements would be subject to change based upon the results of the Seep Evaluation.

The majority of the eastern shore and NMC shore seeps are aligned near the toe of the slope at about the ground elevation of 370 ft, and are located primarily along a stretch of approximately 4,200 ft at the northwestern end of the eastern shore, and along a stretch of approximately 1,800 ft along the NMC shore, as illustrated in **Figure 12**. CPOIs including BTEX, PAHs and naphthalene were detected in seeps along the eastern shore; naphthalene was detected in seeps along the northern shore; 4,4'-DDT was detected in one seep along the NMC shore; and PAHs and phenols were detected in pipe discharge along the northern shore. Since the submittal of the draft RI Report, several seep reconnaissance efforts have been completed at the Site. Field measurement results and memoranda documenting field reconnaissance observations subsequent to the submittal of the draft RI Report are included in **Appendix G**. During these reconnaissance visits, some seeps were observed to reach NMC and Onondaga Lake, and seep flow was found to be intermittent. As documented in **Appendix G**, pH ranged from 10.83 to 12.5 S.U., and seep flow ranged from negligible to approximately 1.6

gpm (during March 2009). Observations of the occurrence of seeps since the submittal of the draft RI Report indicate these locations are consistent with those documented in the draft RI Report.

Surface Water Erosion of Solvay Waste at the Eastern Shore to Onondaga Lake
The surface of the eastern shore proximate to Onondaga Lake is characterized by low lying terrain consisting of Solvay waste, exposed in some areas and covered with varying amounts of vegetation in other areas. The eastern shore exhibits several locations where erosion of Solvay waste appears to occur due to surface water flow. Analytical results of samples collected during the RI indicated the presence of organic CPOIs in Solvay waste on the eastern shore. Preliminary supplemental RI results for this area are included in **Appendix A**. As summarized in **Appendix A**, total BTEX concentrations are generally low at the surface, increasing with depth. Specifically, total BTEX concentrations ranged from less than detection limits to 1,548 µg/kg in the 0- to 1-ft interval for soil samples, with most sample concentrations less than 200 µg/kg, whereas total BTEX concentrations in the 2- to 6-ft interval ranged from less than detection limits to 46,200 µg/kg. Most total BTEX concentrations in the 2- to 6-ft interval exceeded 200 µg/kg. Total BTEX concentrations in soil samples from the 6- to 10-ft interval ranged from less than detection to 103,300 µg/kg, with most detected concentrations also above 200 µg/kg. The relatively higher concentrations present at depth are present across the eastern shore over approximately 27 acres. The depth of Solvay waste is approximately 6 to 15 ft along the eastern shore. This area is illustrated on **Figure 12**.

Wind/Wave Erosion of Solvay Waste along the Surf Zone to Onondaga Lake
Solvay waste is exposed along the surf zone of the eastern and northern shores at the Site. In areas of shallow sloped shore, wind and lake wave action result in erosion of exposed Solvay waste into the lake, while in areas where the shore is steep, such as along portions of the northern shore, lake wave action results in the undermining of the steep embankments. The extent of shallow sloped shore adjacent to Onondaga Lake SMU-3 is approximately 6,700 linear ft, while the extent of steep embankment in Onondaga Lake SMU-3 is approximately 1,850 linear ft. The extent of shallow sloped shore adjacent to Onondaga Lake SMU-4 is approximately 1,450 linear ft, while the extent of steep embankment in Onondaga Lake SMU-4 is approximately 460 linear ft. As described in the Onondaga Lake ROD (NYSDEC and USEPA 2005), stabilization of the shore along Onondaga Lake SMU-3 is required as an element of the Onondaga Lake remedy. The extent of exposed Solvay waste along surf zone shore areas is illustrated on **Figure 12**.

Ditch A Discharge into NMC and Onondaga Lake
Ditch A is a surface drainage feature that discharges to NMC at its northwestern end (upper reach) and to Onondaga Lake at its southeastern end (lower reach). The upper and lower reaches of Ditch A that discharge to NMC and Onondaga Lake, respectively are discussed in this FFS. Surface water and ditch substrate samples were collected as part of the RI. One surface water sample and one ditch substrate sample were collected from the upper reach of Ditch A. CPOI detections in the surface water consisted primarily of phenol, PAHs and naphthalene, whereas the CPOIs in Solvay waste substrate consisted primarily of PAHs. CPOI concentrations were also detected in surface water and sediment samples from the lower reach, near the outlet to Onondaga Lake. The surface water CPOI detections near the outlet to Onondaga Lake consisted primarily of BTEX and naphthalene, whereas the CPOIs in ditch substrate near the outlet to Onondaga Lake consisted primarily of PAHs. Surface water concentrations may be reflective of groundwater discharge to Ditch A. The upper portion of Ditch A discharges to NMC through a drainage pipe. Seep water has been observed to discharge to NMC via this drainage pipe.

The extent of media of concern for this FFS is presented on **Figure 12**.

2.5 Assessment of Land Use

The reasonably anticipated future land use for the site was evaluated consistent with the USEPA's Office of Solid Waste and Emergency Response (OSWER) Directives 9355.7-06 and 9355.7-04 (USEPA 1995). Consistent with these directives, a "reuse assessment assists in developing assumptions regarding the *types* or *broad categories* of reuse that might reasonably occur at a Superfund site. Examples of land use assumptions that appear likely based on the conclusions of a reuse assessment include, but are not limited to, residential, commercial/industrial, recreational and ecological." Based on the assessment that included considerations of the information presented below, the reasonably anticipated future land uses for the Site are ecological and recreational.

The following site-specific information was considered during the assessment of land use for this Site:

- The property is owned by Onondaga County; the property deed includes a restriction that the property be used for park purposes. Related to activities associated with park use, Local Law 2-1965 states that "No persons within the confines of the park, except under permit from the Deputy Commissioner or his representative, shall hunt, pursue, trap or in any way molest any wild birds or animals, nor shall any person have any such wild bird or animal in his possession within the park." The County does not anticipate permitting such activity in Onondaga Lake Park. The law also states "No person shall injure, deface, disturb or befoul any part of the park or any building, sign, equipment or other property found therein; nor shall any tree, flower, fern, shrub, rock or other plant or mineral be removed, injured or destroyed…"

- In 1991, the Metropolitan Development Foundation, the City of Syracuse, County of Onondaga, and New York State Urban Development Corporation jointly sponsored the preparation of a development plan for Onondaga Lake. The resulting report, entitled *1991 Onondaga Lake Development Plan* (The Reimann Buechner Partnership *et al*., 1992), documented "…a comprehensive land use master plan to be used by the community as a tool in selecting policies to develop lakeshore and adjacent properties in a planned and coordinated manner." The report identified the long-term land use of the Wastebeds 1-8 property as Park Land and anticipated land-based sports and recreation facilities.

- A June 2003 report prepared by the Onondaga Lake Cleanup Corporation entitled *Preliminary Design Recommendations for Conducting a Demonstration Project to Assess Stabilization and Habitat Enhancement at the Lakeshore Solvay Wastebeds, Onondaga Lake, New York* (Onondaga Lake Cleanup Corporation, 2003) described the goals for the shore area of the Site as being stabilization and habitat enhancement. It further identified stabilization and ecological goals related to enhancing the quality of the geomorphic zones along the shoreline. Cultural goals were also identified including providing recreational opportunities at the lakeshore that are compatible with the ecological goals; providing multi-faceted, positive aesthetic experiences for the public; and providing habitat enhancement in such a way as to enhance restoration of native flora and fauna.

- In 2007, EcoLogic, LLC prepared a report entitled *Reconnecting with Onondaga Lake – The Community's Vision for the Future of a Revitalized Resource* (EcoLogic, 2007) for the Onondaga Lake Partnership (OLP). As noted in the report, "The OLP was established to promote cooperation among federal, state and local governments, and other involved parties in the management of the environmental issues on Onondaga Lake and in its watershed. Explicit in the Partnership Mission Statement is the obligation to '…restore and conserve water quality, natural resources, and recreational uses to the benefit of the public.'" The following excerpts from the report's Executive Summary reflect the work that went into developing the vision for the future of the Lake and its surroundings, and the vision itself:

    - "The vision presented here represents contributions from a wide cross-section of citizens of Syracuse and Onondaga county, contributions gathered in a number of formats and through a number of channels. Partly the vision represents the input of technical stakeholders, experts with specialized knowledge about the lake, its history or its current condition gathered through intensive individual interviews. Additionally, the project team consulted members of civic groups, outdoor recreation organizations, business persons, and other groups in a series of focus group interviews. Documents from earlier groups who had sought to develop a vision for the future of the Lake were consulted. As the vision presented by these groups began to emerge, elements of the vision were brought to the public for discussion and debate. Finally, a large phone survey was conducted among the County's registered voters to evaluate whether findings of the targeted outreach were reflective of the community at large."
    - "While the community's vision for a rehabilitated Onondaga Lake is complex, the most significant elements may be distilled into a statement: Reconnect with Onondaga Lake.
        - What does this mean?
            - Accessibility – retain public control of and access to the Lake
            - Activities – public resource for entertainment, recreation and aesthetic enjoyment
            - Community commitment to rehabilitation – widespread understanding that these values were contingent on restoring a healthy lake
        - How would the community measure progress?
            - Continued and improved public access to the lake and its shoreline
            - Growing number of attractive activities occurring at or on the lake
            - Signs of an improving environment in a healthy, sustainable ecosystem
        - Elements of the public's vision, largely in order of their importance:
            - Trails
            - Swimmable water and edible fish
            - Fishing
            - Boating
            - Year-round activities ("things to do")
            - Community education centered around the lake and its ecology."

- The *Remedial Design Elements for Habitat Restoration* (*Habitat Plan*) is being developed to present the conceptual habitat restoration and enhancement designs for Onondaga Lake in those portions of the lake (including portions of the Wastebeds 1-8 Site) where remediation activities will be conducted. The *Habitat Plan* is being developed by members of the Habitat Technical Work Group with input from multiple organizations that use the lake on a regular basis. The draft *Habitat Plan* was submitted to NYSDEC in July 2009. With respect to the Wastebeds 1-8 property, the *Habitat Plan* includes:

    - Wetland habitat on the eastern shore of the property that includes connected (Module 6A) and inland (Module 9B) wetlands
    - Upland habitat (Module 8) consisting of upland/riparian habitat with a topsoil substrate and successional field and scrub-shrub vegetative communities that would provide a transition zone for wildlife utilizing the adjacent wetland, lake and forested areas.

- Onondaga County will be constructing a public bike path as part of the Onondaga Lake Canalways Trail (Camp Dresser & McKee [CDM] 2009) in the proximity of the IRM areas.

- Adjacent property is used for New York State Fair parking and Interstate 690 and Route 695.

- Surrounding properties include the New York State Fairgrounds, land owned by Onondaga County, and industrial sites such as Crucible Steel.

Given the foregoing, the reasonably anticipated future land uses for the property are recreational and ecological. These land uses were considered further in the risk evaluation summarized in the following section.

2.6 Streamlined Risk Evaluation

As discussed in **Section 2.1**, the Human Health Risk Assessment (HHRA) Report for the Wastebeds 1-8 Site was submitted to NYSDEC on February 11, 2010 (O'Brien & Gere 2010a). The HHRA Report included the recently collected supplemental RI data. Also, as discussed in **Section 2.1**, a Problem Formulation Document and Baseline Ecological Risk Assessment (BERA) Work Plan have been completed for the site. The BERA Report was submitted to NYSDEC on April 26, 2010 (O'Brien & Gere 2010b).

A Streamlined Risk Evaluation (SRE) was conducted to evaluate the potential risks to human health and ecological receptors from environmental media considered in this FFS. The objective of the SRE is to provide a concise, but thorough, evaluation of potential risks to human and ecological receptors assuming no remedial actions are taken at the Site, for the purposes of the IRM. It should be noted, however, that while the SRE may indicate risks associated with Site media, the screening was conservative and completed using maximum concentrations and conservative screening criteria. As part of the RI/FS process, the HHRA and BERA Reports provide a further evaluation of the potential risks at this Site. The methods and results of the SRE are provided in **Appendix H**.

As discussed in **Section 1** of **Appendix H**, the following pathways that have the potential to transfer Site-related constituents to Onondaga Lake and/or NMC were evaluated in the SRE:

1. The discharge of shallow and intermediate groundwater from the Wastebeds 1-8 Site to Onondaga Lake
2. The discharge of groundwater from the NMCSG unit to Onondaga Lake and NMC
3. Surface water erosion of Solvay waste along the eastern shore of the Wastebeds 1-8 Site to Onondaga Lake
4. Wind and wave erosion of Solvay waste along the surf zone of the Wastebeds 1-8 Site into Onondaga Lake
5. The discharge of Solvay waste substrate and sediment, and surface water from the lower reach of Ditch A into Onondaga Lake
6. The discharge of seeps (surface water) to Onondaga Lake and NMC.

Potential human health and ecological risk from each of these exposure pathways was evaluated by comparing the maximum concentration of each detected constituent to various criteria summarized in **Table 1** of **Appendix H**. USEPA Regional Screening Levels (RSLs) were used to evaluate risk to human receptors (USEPA 2009a). RSLs are risk-based concentrations derived from standardized equations combining exposure assumptions with USEPA toxicity data. The USEPA considers RSLs to be protective for humans (including sensitive groups) over a lifetime. Residential soil RSLs were used to evaluate exposure to Site soils, and tap water RSLs were used to evaluate groundwater or surface water exposure. The selected RSLs are protective for the reasonably anticipated future land use of the Site (recreation). For example, the equations used to derive the residential soil RSLs include incidental ingestion, inhalation of particulates, and dermal contact. The equations used to derive the tap water RSLs include ingestion of 2 liters/day of water and inhalation of volatiles in water. Further, these RSL were derived using an exposure frequency of 350 days/year. In contrast, the typical exposure frequency for a recreational scenario would be considerably less than 350 days/year.

The SRE results indicate that there is a potential threat to human health and the environment from the media and pathways evaluated in this SRE. Response actions in the area of the Site being evaluated in the FFS are warranted based on the following factors from 40 CFR Part 300.415 (B)(2):

- Potential threat of exposure to nearby populations and ecological receptors from COPCs/COPECs
- Potential migration of COPCs/COPECs in surface soils/Solvay waste to Onondaga Lake
- Potential migration or release of COPCs/COPECs to Onondaga Lake due to wind/wave action.

These potential threats were identified through screening of media that identified potentially unacceptable risks due to elevated levels of COPCs in Solvay waste along the eastern shoreline, Solvay waste substrate and sediment in the lower reach of Ditch A, surface water in the lower reach of Ditch A, groundwater discharging from the NMCSG unit to Onondaga Lake and NMC, and shallow and intermediate groundwater discharging from the eastern shore to Onondaga Lake.

3. Development of IRM Alternatives

This section documents the development of four IRM alternatives that were evaluated during the FFS to provide for the protectiveness of the NMC OU-2 and Onondaga Lake remedies and meet the remedial action objectives (RAOs) identified herein. Consistent with *Guidance for Conducting Remedial Investigation and Feasibility Studies Under CERCLA* (USEPA 1988) and the *Shallow and Intermediate Groundwater FFS Work Plan* (O'Brien & Gere 2008a) for the development of IRM alternatives, this section describes RAOs and media-specific response actions that were identified for the FFS. This section also describes the areas and volumes of media to be addressed by the IRM alternatives and identifies specific remedial technologies that, following screening, were used to develop the range of IRM alternatives evaluated in this FFS.

3.1. Development of Remedial Action Objectives

RAOs are media-specific goals for protecting human health and the environment. RAOs form the basis for this FFS by providing overall goals for a site IRM. The RAOs are considered during the identification of appropriate remedial technologies and formulation of alternatives, and later during the evaluation of IRM alternatives. Documentation of the rationale employed in the development of the RAOs is presented in the following sections.

An IRM for this Site is intended to be consistent with, and an integral part of, the final site-wide remedy. The RAOs were developed based on the SRE and on potential impact(s) to nearby Sites; specifically, as identified in **Section 2.5**, the SRE identified that media considered in this FFS pose a potential threat to human health and the environment, based on conservative screening. Additionally, as described in **Section 2.4**, CPOIs in shallow and intermediate groundwater discharging to Onondaga Lake, selected seeps having the potential to flow into NMC and Onondaga Lake, surface water erosion of CPOIs in Solvay waste at the eastern shore, wind/wave erosion of Solvay waste along the surf zone, Solvay waste substrate and sediment in the lower reach of Ditch A, and seep discharge from the upper reach of Ditch A have the potential to adversely affect the NMC OU-2 and Onondaga Lake remedies. For these reasons, the RAOs are to mitigate, to the extent necessary and practicable, and within the context of the IRM, the following:

- Direct contact with and ingestion of exposed Solvay waste along the eastern shore
- Discharge of NMCSG unit and eastern shore groundwater to Onondaga Lake and NMC
- Discharge of shallow and intermediate groundwater to Ditch A
- Discharge of selected NMC, eastern and northern shore seep water to Onondaga Lake and NMC
- Erosion of Solvay waste from the eastern shore to Onondaga Lake
- Erosion of Solvay waste along the surf zone of Onondaga Lake SMU-4 and portions of SMU-3 due to wind and wave action
- Erosion of Solvay waste substrate and sediment from the lower reach of Ditch A to Onondaga Lake
- Discharge of seep water from the upper reach of Ditch A to NMC.

3.2. Development of General Response Actions

General response actions (GRAs) are media-specific actions that may be combined into alternatives to satisfy the RAOs. GRAs that address the RAOs related to the media to be addressed in this FFS are:

- No action
- Hydraulic control actions - actions that collect or control seeps or groundwater flow preventing further migration
- Treatment actions - *in situ* or *ex situ* actions that treat contaminants to reduce mobility or toxicity related to seeps and groundwater
- Containment actions - actions that minimize the potential for direct contact with, and erosion of Solvay waste at the eastern shore via surface water, or Solvay waste substrate and sediment in the lower reach of Ditch A
- Excavation/removal/disposal actions - actions that remove and dispose of the Solvay waste from the eastern shore or Solvay waste substrate and sediment in the lower reach of Ditch A
- Stabilization actions – actions that minimize wind and wave erosion of Solvay waste along the surf zone and provide habitat enhancement.

The GRAs for each medium of concern for this FFS are identified in **Tables 1 through 4**.

3.3. Identification of Volumes or Areas of Media

Site conditions, the nature and extent of contamination, and RAOs were taken into consideration when estimating the volumes and areas of media to be addressed in this FFS by the GRAs. The areal extents of the media described below are depicted in **Figure 12**.

Shallow and Intermediate Groundwater (Eastern Shore)
As identified in **Section 2.4**, this FFS considers approaches to mitigate migration of Site impacted shallow and intermediate groundwater to Onondaga Lake along the eastern shore. The estimated groundwater flow rate from the shallow and intermediate groundwater along the eastern shore is approximately 29 gpm from the Solvay waste and marl units. The basis for the estimated groundwater flow rate is presented in **Appendix I**.

Intermediate Groundwater (Former NMCSG)
As identified in **Section 2.4**, this FFS considers approaches to mitigate migration of Site impacted groundwater to Onondaga Lake and to NMC from the former NMCSG. The estimated groundwater flow rate from the former NMCSG unit is approximately 2 gpm to NMC and 5 gpm to Onondaga Lake. The basis for the estimated groundwater flow rate is presented in **Appendix K-2**.

Seep Discharge
As discussed in **Section 2.4**, seep discharge occurs along NMC and the Onondaga Lake eastern and northern shores of the Site. Based on field investigations, most seeps along NMC that have the potential to directly reach NMC are located along a section approximately 1,800 linear ft in length at the approximate 370 ft elevation contour. Seeps were also observed in this area at higher contour elevations. Several seeps were observed along the shore of the creek. The extent of the seeps considered as part of this FFS may be subject to change based on the results of the ongoing Seep Evaluation. Seeps along the eastern shore that have the potential to reach Onondaga Lake are located

along approximately 4,600 linear ft of shore at the approximate 370 ft elevation contour. Along the northern shore, seeps that reach Onondaga Lake are limited to two seep locations and four pipe locations. As documented in **Appendix G**, seep flow across the Site has been variable and intermittent. During one site visit when seep flow was measured (March 2009), seep flow was documented to range from negligible to approximately 1.6 gpm in individual seeps. For purposes of this FFS, the estimated groundwater discharge rate of 29 gpm includes both the groundwater and seep components, as described in **Appendix I**.

Solvay Waste at the Eastern Shore
The eastern shore of Wastebeds 1-8, extending between the 370 ft elevation contour and the shore, covers an area of approximately 27 acres. The Solvay waste in this area is approximately 6 to 15 ft thick. Based on an average depth of 10 ft, the total volume of Solvay waste along the eastern shore is approximately 440,000 cubic yards. The basis for the estimated total volume of Solvay waste is presented in **Appendix J**.

Erosion of Solvay Waste along the Surf Zone
As discussed in **Section 2.4**, erosion of Solvay waste occurs along the surf zone due to wind and wave action. In SMU-3 the extent of shallow sloped shore exhibiting exposed Solvay waste is approximately 6,700 linear ft, and the approximate extent of steep embankment shore exhibiting exposed Solvay waste is approximately 1,850 linear ft. In SMU-4, the approximate extent of shallow sloped shore exhibiting exposed Solvay waste is approximately 1,450 linear ft, and the approximate extent of steep embankment shore exhibiting exposed Solvay waste is approximately 460 linear ft.

Ditch A (Upper and Lower Reach)
The upper and lower reaches of Ditch A have the potential to impact the NMC OU-2 remedy and the Onondaga Lake remedy, respectively. As discussed in **Section 2.4**, a piped portion of the upper reach of Ditch A appears to discharge seep water to NMC. Approximately 500 linear ft of drainage pipe connects the upper reach of Ditch A to NMC. The substrate of the lower reach of Ditch A is Solvay waste, and has the potential to erode and be transported to Onondaga Lake. The depth of Solvay waste substrate and sediment in the lower reach of Ditch A is anticipated to range between 15 and 20 feet bgs, based on review of data from nearby borings (WB18-SB-01 and WA-MW-100 D/BR), and as depicted on **Figure 4**. CPOIs were detected in the substrate in the lower reach of Ditch A. Also as discussed in **Section 2.4**, surface water samples collected from the lower reach of Ditch A exhibited detectable concentrations of BTEX and naphthalene. Shallow and intermediate groundwater discharge from the Site to Ditch A may affect the surface water quality in Ditch A. The length of the lower reach proposed to be addressed in this FFS is approximately 380 ft, and covers an approximate area of 4,600 square ft. The selected IRM alternative will include the removal, to the extent practicable, of Solvay waste substrate and sediment in the culverts beneath the parking lot access road and I-690, if present.

3.4. Identification and Screening of Remedial Technologies and Process Options

Potentially applicable remedial technology types and process options for each GRA were identified during this step. Technologies and process options were screened on the basis of technical implementability. Technical implementability for each identified process option was evaluated with respect to contaminant information, physical characteristics, and areas and volumes of affected media.

Descriptions for technologies and process options identified for this FFS are presented in **Tables 1 through 4**. Technologies and process options that were viewed as not implementable were not considered further in the FFS. The technologies retained for further consideration for each medium of concern are presented below.

Shallow and Intermediate Groundwater: Groundwater extraction, and *ex situ* physical/chemical treatment.

Seeps: Seep water collection, and *ex situ* physical/chemical treatment.

Solvay Waste (at Eastern Shore and along Surf Zone): Shore stabilization, steep embankment area stabilization, vegetative cover, excavation, on-site placement and disposal.

Ditch A: pipe rehabilitation, habitat layer and isolation cap, excavation and on-site placement.

3.5. Evaluation of Remedial Technologies and Process Options

The remedial technologies and process options remaining after the initial screening were evaluated further according to the criteria of effectiveness, implementability, and cost. The effectiveness criterion included the evaluation of:

- potential effectiveness of the process options in meeting IRM objectives and handling the estimated volumes or areas of media
- potential effects on human health and the environment during construction and implementation
- reliability of the process options for site contaminants and conditions.

Technical and institutional aspects of implementing the process options were assessed for the implementability criterion.

The capital and operation and maintenance (O&M) costs of each process option were evaluated as to whether they were high, medium, or low relative to the other process options of the same technology type.

Based on the evaluation, the more favorable process options of each technology type were chosen as representative process options. The selection of representative process options simplifies the assembly and evaluation of alternatives, but does not eliminate other process options. The process option actually used to implement remediation may change during the remedial design phase. The screening and evaluation of technologies is summarized in **Tables 1 through 4**. A description of the representative process options for retained technologies is presented, by GRA and technology for each medium, in the following sections.

3.5.1 Shallow and Intermediate Groundwater

Hydraulic Control

A hydraulic control system is an engineered system that is designed to control groundwater movement. A hydraulic control system would be designed to intercept and collect shallow and intermediate groundwater. The remedial technology selected for the hydraulic control GRA for groundwater was groundwater extraction. The selected representative process options for

groundwater extraction of shallow and intermediate groundwater were extraction wells and a collection trench with passive wells. These are described as follows:

Groundwater Extraction - Extraction Wells (NMCSG unit)
Contaminated groundwater would be collected by pumping from extraction wells. This technology was selected as representative to achieve hydraulic control of groundwater in the NMCSG unit. It is anticipated that five extraction wells would be required to achieve hydraulic control of groundwater potentially discharging from the NMCSG unit to Onondaga Lake, and two extraction wells would be required to achieve hydraulic control of groundwater potentially discharging from the NMCSG unit to NMC. Calculations for groundwater extraction well requirements are included in **Appendix K-2**.

Groundwater Extraction - Collection Trench with Passive Wells (along NMC, the Eastern Shore and the lower reach of Ditch A)
Collection trenches are buried conduits that would intercept and collect groundwater. Collection trenches are installed perpendicular to groundwater flow and generally consist of pipe drains and permeable granular backfill material. As described below, the collection system need not be coupled with a supplemental physical barrier wall (*i.e.* barrier wall) to be effective. Excavation of a collection trench requires the use of construction equipment (*e.g.*, backhoe). A collection trench along the eastern shore is envisioned to extend through the Solvay waste to an elevation of approximately 355 ft, at the trench bottom, corresponding to a depth ranging from approximately 8 to 15 ft below grade. This elevation is about 6 ft below the lowest lake water level, based on readings from the United States Geological Survey (USGS) Onondaga Lake water stage gage at Liverpool (USGS station 04240495). A collection trench along NMC is envisioned to extend through the Solvay waste to a depth of approximately 13 ft below grade. This elevation is about 3 ft below the lowest NMC water level. Temporary excavation shoring using equipment such as trench boxes would likely be required. Excavated material is envisioned to be managed on site.

Passive wells are groundwater extraction wells that would be installed below the collection trench to collect groundwater from depths greater than the trench installation. A typical passive well is approximately 1 or 2 inches in diameter. In this application the passive wells would extend from the bottom of the trench and would be screened in the marl unit to allow groundwater in the marl unit to enter the collection trench. Groundwater flow in the passive wells would be driven by the natural and enhanced head differentials between the formation and the overlying collection trench. Specifically, as described in **Appendix K**, passive wells would extend from the trench down to the bottom of the intermediate groundwater zone. The top of the passive wells would be connected to the trench and consequently the hydraulic head in the passive wells would be the same as the hydraulic head in the trench. Therefore, when the water level in the trench is lowered for groundwater collection, the head in the passive wells will also be lowered, and intermediate groundwater (since it has a higher hydraulic head) will flow to the passive wells and into the collection trench due to the resultant head differential. In this manner the passive wells would function as extraction wells within the intermediate groundwater zone.

For purposes of this FFS, a 20 ft spacing was assumed for the passive wells used to collect intermediate groundwater. The 20 ft spacing of passive wells is based on modeling performed as documented in **Appendix K** and results of the pump tests documented in

Appendix F. The actual collection system design will be developed during the IRM design phase. Passive wells were selected as the representative process option for this site. However, collection of intermediate groundwater below the collection trench could also be achieved using other process options, such as wick drains. Wick drains consist of a central plastic core, which functions as a free-draining water channel, surrounded by a thin geotextile filter jacket. A typical wick drain is approximately 4 inches wide and 1/8 inch thick. Consistent with USEPA guidance (USEPA 1998) final selection of this process option would be decided during the IRM design phase based on factors such as expected performance, optimum spacing and groundwater characteristics.

To evaluate hydraulic control methods for implementation along the eastern shore at the Site, additional investigation and modeling activities were performed. The results of the additional investigations and modeling efforts, as presented in **Appendices F and K**, respectively, indicate effective groundwater capture can be achieved using a collection trench with passive wells, and that the addition of a barrier wall as a supplemental physical barrier is not necessary to achieve hydraulic control along the eastern shore at the Site. In addition, the modeling shows that an added benefit to the absence of a barrier wall is collection of groundwater outboard of the collection trench.

This conclusion results in a different configuration for a groundwater management system at the Wastebed 1-8 Site than at the nearby Semet/Willis and Wastebed B/Harbor Brook Sites. At these sites, a structural barrier was installed outboard of the groundwater collection trench. This barrier was used in conjunction with the collection system at these sites primarily to mitigate potential Non-Aqueous Phase Liquid (NAPL) flow from these sites to Onondaga Lake. NAPL is not present at the Wastebeds 1-8 Site.

A preliminary slope stability analysis performed along the eastern shore of the Site indicated that the installation of a collection trench along with the presence of a wetland complex and/or outboard excavation to a depth of approximately 10 feet with a 1 vertical on 2 horizontal slope would be stable. The sections analyzed included a collection trench at the shore or at the 370 ft contour. Additionally, a slope stability analysis performed along the NMC shore also indicated the slope would be stable. A summary of the collection trench geotechnical stability evaluations for the Site are included as **Appendix L**.

Ex Situ Treatment

An *ex situ* treatment system would be used to treat the collected water prior to discharge. The remedial technology selected for the *ex situ* GRA for groundwater was physical/chemical treatment. The selected representative process option for physical/chemical treatment of groundwater was the Willis-Semet groundwater treatment plant (GWTP). This process option is described as follows:

Physical/Chemical Treatment - Willis-Semet GWTP

Collected groundwater would be treated at the existing Willis-Semet GWTP. The Willis-Semet GWTP was constructed to treat groundwater, process water and construction water associated with the Willis Avenue/Semet Tar Beds IRM, and was designed for phased expansion to provide one treatment location to manage water generated by the multiple remediation sites. The Willis-Semet GWTP effluent is permitted for direct discharge through Outfall 15A or discharge to the Onondaga County Department of Water Environment Protection (OCDWEP) Metropolitan Wastewater Treatment Plant (Metro WWTP). The

Willis-Semet GWTP provides treatment of water using a metals precipitation treatment unit, filtration, pH adjustment, air stripping, and carbon adsorption. These treatment processes would provide the treatment necessary for groundwater discharged from the hydraulic control systems at the Site to be ultimately direct discharged or discharged to the OCDWEP Metro WWTP.

3.5.2 Seeps

Hydraulic Control

A hydraulic control system is an engineered system that is designed to control seep water movement. A hydraulic control system would be intended to intercept and collect seep water. The remedial technologies selected for the hydraulic control GRAs for seep discharge were seep water containment and seep water collection. The representative process option for seep water containment was weir box backfill/plugging. The selected representative process options for seep water collection were individual catch basin structures and shallow collection trenches. The representative process options are described as follows:

Seep Water Containment – Weir Box Backfill/Pipe Plugging

Remnants of the weir box structures, and the associated metal piping continue to periodically convey groundwater from within the wastebeds toward Onondaga Lake and NMC. These structures were originally constructed to convey supernatant from the Wastebeds, to accelerate the drying process and allow for placement of additional waste. Although currently the weir box structures are generally collapsed, and nearly all of the associated drainage pipes are at least partially plugged by Solvay waste and/or calcium deposits, these structures remain active transport/migration pathways at certain times of the year. Plugging pipes and/or controlling surface water recharge at weir boxes would prevent the discharge of seep/groundwater from the pipes. At each of the weir boxes, associated piping would be located and plugged using flowable or other fill. The weir box area would be filled in with a material such as flowable fill and/or soil and re-graded to redirect surface water so that it does not accumulate in the area.

Seep Water Collection - Individual Catch Basin Structures

Individual catch basin structures have been utilized successfully at the nearby Settling Basins 9 - 15 Site for mitigation of individual seep locations. Individual catch basin structures are catch basins which would be installed to collect seep water to mitigate localized seeps. Collected seep water would be subsequently pumped to a treatment facility.

Seep Water Collection - Shallow Collection Trench

Collection trenches are buried conduits that would intercept and/or collect groundwater upgradient of seeps to mitigate seeps and reduce potential for future seep formation. Collection trenches are installed perpendicular to seep water flow and generally consist of pipe drains and permeable granular backfill. Excavation of a collection trench requires the use of construction equipment (*e.g.*, backhoe).

A seep collection system could be integrated with a groundwater collection trench. In this case, a gravel drainage layer would be installed at grade atop the existing seeps, and connected directly to the gravel within the collection trench, thereby conveying seep water directly to the collection trench.

Ex Situ Treatment

An *ex situ* treatment system would treat the collected water prior to discharge. The remedial technology selected for the *ex situ* GRA for seep water was physical/chemical treatment. The selected representative process option for physical/chemical treatment of seep water was the Willis-Semet GWTP. This process option is described as follows:

Physical/Chemical Treatment - Willis-Semet GWTP:

Collected seep water would be treated at the existing Willis-Semet GWTP. The Willis-Semet GWTP was constructed to treat groundwater, process water and construction water associated with the Willis Avenue/Semet Tar Beds IRM, and was designed for phased expansion to provide one treatment location to manage water generated by the multiple remediation sites. The Willis-Semet GWTP effluent is permitted for direct discharge through Outfall 15A or discharge to the OCDWEP Metro WWTP. The Willis-Semet GWTP provides treatment of water using a metals precipitation treatment unit, filtration, pH adjustment, air stripping, and carbon adsorption. These treatment processes would provide the treatment necessary for seep water discharged from the hydraulic control systems at the Site to be ultimately direct discharged or discharged to the OCDWEP Metro WWTP.

3.5.3 Solvay Waste

Stabilization

Stabilization systems would provide a means of minimizing erosion of Solvay waste along the surf zone of Onondaga Lake that is a result of wind-wave action. Two types of shore stabilization technologies were evaluated for the Site: shore stabilization for the steep embankment area and for shallow sloped shore such as along the eastern shore and portions of the northern shore. The selected representative process option for shore stabilization for the steep embankment area was a live crib wall. The selected representative process option for shore stabilization for the shallow sloped shore area was graded gravel

Shore Stabilization for Steep Embankment Areas - Live Crib Wall

Live crib walls are used to mitigate bank erosion and provide habitat enhancement. They are made of interlocking timbers which are backfilled with soil and subsequently vegetated. Roots of the live vegetation provide further structural support and enhance the habitat potential for the new stabilized embankment. Live crib walls provide effective protection of steep banks and help to establish vegetation. The live crib wall would be installed on a stone base consisting of crushed stone underlain by a geogrid. For the purposes of this FFS, the crib wall accounted for coverage from mean lake water elevation (approximately 362.9 ft above MSL), extending to approximately 368 ft above MSL, which is 3 ft above the high water level (approximately 365; lake level is below 365 approximately 96.5% of the year), resulting in an average height of approximately 5.5 ft above the mean lake water elevation. The exact height of the crib walls would be further evaluated as part of the design.

Shore Stabilization for Shallow Sloped Areas - Graded Gravel

Graded gravel would be placed along shores to protect the water/shore interface from erosion caused by wind-wave action and provide habitat enhancement. The graded gravel would be placed in the surf zone. The graded gravel would provide habitat enhancement by stabilizing shore Solvay waste and promoting submerged macrophyte growth along the shore. Different grades of stone would be used to prevent waves from eroding soil at the shore.

Shore Stabilization for Shallow Sloped Areas – Live Fascines, Live Staking and Branch Layering
Live fascines (bundles of live, woody vegetation), live staking and branch layering would be planted in the graded gravel along the shore to protect the water/shore interface from erosion caused by wind-wave action and to provide habitat enhancement. The vegetation species would be consistent with the Onondaga Lake Habitat Plan for this area.

Containment
Containment systems provide a means of minimizing erosion of Solvay waste at the eastern shore of Onondaga Lake that is a result of surface water flow, and would also serve to enhance the habitat. The remedial technology evaluated for the containment GRA was a vegetative cover. The selected representative process options were a vegetative cover and a low permeability vegetative cover. These are described below:

Vegetative Cover
A vegetative soil cover would consist of a soil layer of an appropriate thickness to sustain plant growth. This area is suited for an upland habitat that would provide a transition area between restored lake habitats and adjacent wetlands and uplands. In addition to the enhancement of the lakeshore habitat, the vegetative cover would minimize erosion of the Solvay waste.

Low Permeability Vegetative Cover
A low permeability vegetative cover is a cover that would minimize erosion of Solvay waste and limit infiltration. The low permeability element of the cover would likely consist of a low permeability clay or a geomembrane system to limit infiltration of surface water. A vegetative cover would also be incorporated with the low permeability element, and would be designed to integrate with the surrounding lake, wetland, and upland habitats. In addition to the enhancement of the lakeshore habitat, the low permeability vegetative cover would limit infiltration and minimize erosion of the Solvay waste.

Removal
The remedial technology evaluated for the removal GRA was excavation. The selected representative process option for excavation of the Solvay waste was mechanical excavation. This process option is further described below:

Excavation - Mechanical Excavation
The mechanical excavation of Solvay waste at the eastern shore would be implemented using construction equipment such as land-side backhoe excavators. Excavated areas would be restored. Preliminary evaluations of geotechnical stability relative to excavation considerations as part of the FFS are included in **Appendix L**. Additional geotechnical stability evaluations would be conducted during design.

Disposal/Placement
Disposal of material would consist of proper management and final disposition of excavated materials. Two GRAs; disposal and placement, were evaluated for the Site. The remedial technology that was evaluated for the disposal GRA for large quantities of Solvay waste, such as Solvay waste at the eastern shore, was off-site disposal. The selected representative process option was disposal at a

commercial facility, which is further described below. The remedial technology that was evaluated for the placement GRA for relatively smaller quantities of Solvay waste, such as Solvay waste from above the water table along the eastern shore, was on-site placement. The selected representative process option was mechanical relocation of material, which is further described below.

Disposal at a Commercial Facility
Excavated Solvay waste could be transported to a regulated, commercial off-site facility for subsequent disposal. Waste characterization sampling and analysis would be completed, and a Waste Manifest would be submitted to, and approved by the landfill prior to disposal.

Mechanical Relocation of Material
Excavated Solvay waste from above the water table along the eastern shore could be transported to an on-site placement area for management. For the purposes of the FFS, the on-site placement area is shown conceptually on **Figure 15** as being on top of the existing wastebeds, within the boundaries of Wastebed 5.

3.5.4 Ditch A

Containment

Containment of sediment in the lower reach of Ditch A would be accomplished by placement of a cover system. The remedial technology evaluated for the containment of the lower reach of Ditch A was a habitat layer and isolation cap. The selected representative process option for the habitat layer and isolation cap in the lower reach of Ditch A was a low permeability habitat cover. Containment of infiltration into the upper reaches of Ditch A would be accomplished by rehabilitation of the Ditch A drainage pipe that currently extends below the I-690 interchange from State Fair Boulevard. The remedial technology evaluated for the containment GRA for the upper reach of Ditch A was pipe rehabilitation. The selected representative process option for pipe rehabilitation of the upper reach of Ditch A was slip lining. The low permeability habitat cover for the lower reach of Ditch A and the slip lining contemplated for the upper reach of Ditch A are described below:

Low Permeability Habitat Cover (lower reach of Ditch A)
A low permeability habitat cover would form a barrier between Ditch A water and the underlying Solvay waste substrate, prevent erosion of underlying Solvay waste substrate, and provide a suitable habitat layer area for plants and wildlife. For purposes of this FFS, the low permeability habitat cover would consist of a geotextile bedding layer overlain with a linear low density polyethylene (LLDPE) textured geomembrane. Depending upon the nature of the substrate, a bridging layer, consisting of a geogrid overlain with crushed stone, may also be necessary in some areas. Other means of providing for low permeability such as clay could also be used and would be evaluated/selected during design. In order to install the cover, the lower reach of the ditch would be dewatered using temporary dams at Onondaga Lake and the influent box culvert. A habitat layer would be installed over the geomembrane and bridging layer.

Pipe Rehabilitation - Slip Lining (upper reach of Ditch A)
The existing drainage pipe that connects the upper reach of Ditch A to NMC would be repaired. It is estimated that this would entail rehabilitation of approximately 500 ft of pipe at this end of the structure. Options for repair include installation of a new pipe within the existing pipe or installation of a cured-in-place liner to repair the existing structure. The

objective of the efforts would be to prevent infiltration of seep water or groundwater into the conveyance pipe. A cured-in-place liner has been assumed for cost estimating purposes.

Removal

Removal of Solvay waste in the lower reach of Ditch A would be accomplished using excavation equipment. The remedial technology evaluated for the removal GRA was excavation. The selected representative process option for excavation of the Solvay waste in the lower reach of Ditch A was mechanical excavation. This is further described below:

Excavation - Mechanical Excavation (lower reach of Ditch A)

The excavation of Solvay waste in the lower reach of Ditch A would be implemented to both remove Solvay waste and to prepare for the installation of the low permeability habitat cover. Solvay waste would be removed using construction equipment such as land-side backhoe excavators.

Placement

Placement of excavated material would consist of proper management and final disposition of excavated materials on site. The remedial technology that was evaluated for the placement GRA for relatively small volumes of excavated material, such as the lower reach of Ditch A, was placement on site. The selected representative process option for placement on site was mechanical relocation of material. Mechanical relocation of material is further described below:

Mechanical Relocation of Material

Construction equipment would be used to move Solvay waste to another location on site. The current on-site placement area envisioned for the Site would be the eastern shore where the material would be consolidated under the vegetative cover. For relatively low-volume excavations, such as the lower reach of Ditch A and groundwater and seeps collection trenches, consolidated materials would be transported to this location. Restoration of the placement area would be addressed as part of the eastern shore cover system.

3.6. Assembly of IRM Alternatives

Four IRM alternatives were developed by assembling GRAs and representative process options into combinations that address shallow and intermediate groundwater (including former NMCSG unit groundwater) discharge to Onondaga Lake and NMC, seep discharge to NMC and Onondaga Lake, surface water erosion of Solvay waste at the eastern shore, wind/wave erosion of Solvay waste along the surf zone, and transport of Solvay waste substrate and sediment in the lower reach of Ditch A into Onondaga Lake. A summary of the alternatives and their components is presented in **Table 5**. The four IRM Alternatives discussed in this section of the FFS report are as follows:

- Alternative 1, No Action, which is required by the National Oil and Hazardous Substances Contingency Plan (NCP) and serves as a benchmark for the evaluation of action alternatives.

- Alternative 2, Low Permeability Vegetative Cover with Inland Groundwater Collection, which includes:
    - hydraulic control of groundwater along the 370 ft elevation contour (approximately the toe of the slope) of the eastern shore

- a 16.7 acre low permeability vegetative cover along the eastern shore,
- hydraulic control of the NMCSG unit groundwater,
- hydraulic control of seeps along the eastern shore, and selected seeps along the NMC and northern shores
- treatment of collected seep water and groundwater
- shore stabilization along the surf zone of SMU-4 and a portion of SMU-3 shores of Onondaga Lake
- limited excavation/containment of Solvay waste substrate and sediment in the lower reach of Ditch A
- pipe rehabilitation in the upper reach of Ditch A

- Alternative 3, Vegetative Cover with Lakeshore Groundwater Collection, which includes:
  - hydraulic control of groundwater primarily along the eastern shore
  - a 14.4 acre vegetative cover along the eastern shore
  - hydraulic control of the NMCSG unit groundwater
  - hydraulic control of seeps along the eastern shore, and selected seeps along the NMC and northern shore
  - treatment of collected seep water and groundwater
  - shore stabilization along the surf zone of SMU-4 and a portion of SMU-3 shores of Onondaga Lake
  - limited excavation/containment of Solvay waste substrate and sediment in the lower reach of Ditch A
  - pipe rehabilitation in the upper reach of Ditch A

- Alternative 4, Excavation with Inland Groundwater Collection, which includes:
  - hydraulic control of groundwater along the 370 ft elevation contour of the eastern shore
  - removal of approximately 27 acres of Solvay waste along the eastern shore
  - hydraulic control of the NMCSG unit groundwater
  - hydraulic control of seeps along the eastern shore, and selected seeps along the NMC and northern shore
  - shore stabilization along the surf zone of SMU-4 and a portion of SMU-3 shores of Onondaga Lake
  - treatment of collected seep water and groundwater
  - limited excavation/containment of Solvay waste substrate and sediment in the lower reach of Ditch A
  - pipe rehabilitation of the upper reach of Ditch A

A detailed description of each alternative is included in the following subsections.

3.6.1 Alternative 1 – No Action

Alternative 1 is the no action alternative. The no action alternative is required by the NCP and serves as a benchmark for the evaluation of action alternatives. This alternative provides for an assessment of the environmental conditions if no active remedial actions are implemented.

3.6.2 Common Components of Alternatives

Each active remedial alternative proposed in subsequent sections includes a number of common components. Those that are common to each alternative are described in this section to reduce redundancy and simplify the discussion of alternatives.

Hydraulic Control of Former NMCSG Unit Discharge to Onondaga Lake and NMC

As necessary, groundwater discharging through the former NMCSG unit would be collected using groundwater recovery wells. At the Onondaga Lake discharge of the NMCSG unit, five 4-inch diameter wells would be installed to an elevation of approximately 333 ft. Well pumps would discharge recovered groundwater to the eastern shore collection system (described below in **Sections 3.6.3, 3.6.4, and 3.6.5)** via high density polyethylene (HDPE) piping; for cost estimating purposes the length of piping is 500 linear feet. At the NMC discharge of the NMCSG unit, two 4-inch diameter wells would be installed at an elevation of approximately 333 ft. Well pumps would discharge recovered groundwater to the eastern shore collection system via HDPE piping; for cost estimating purposes the length of piping is 500 linear feet. An estimated combined flow of 7 gpm was assumed for NMCSG wells (**Appendix K-1**). As described in **Section 2.4**, these elements of the alternatives may change based on the results of the Supplemental RI.

Hydraulic Control of Seeps along the Northern Shore (Onondaga Lake SMU-4)

Seep collection along the northern shore (along Onondaga Lake SMU-4) would address four observed pipe seeps and two localized areas of ground seeps along the northern shore. The observed pipe seeps would be eliminated by physically plugging the pipes and abandoning the associated weir boxes. An individual catch basin structure, consisting of a collection and pump system, would be installed downstream of the observed ground seeps to collect the seep water. For FFS cost estimation purposes, it was assumed that the system would consist of approximately 60 linear ft of 6-inch perforated collection pipe embedded in a gravel apron installed at existing grade to serve as a drainage layer from the seeps to the collection piping. It was assumed that the piping would drain to an HPDE manhole and be pumped approximately 1,175 linear ft to the eastern shore collection system (described below in **Section 3.6.2**). An estimated combined flow of 5 gpm was assumed for the northern shore seep collection system (**Appendix I**). It was also assumed that a geomembrane and vegetative cover would be placed over the collection areas to minimize infiltration of surface water runoff into the seep collection systems.

Hydraulic Control of Seeps along NMC

A collection trench would be installed for hydraulic control of seeps along NMC, proximate to the 370 ft elevation contour. The groundwater collection trench would extend from the ponded area as shown on **Figure 2**, northwesterly approximately 1,800 linear ft along the 370 ft elevation contour. For FFS cost estimation it was assumed that the trench would be installed to a width of 4 ft and average depth of 15 ft, and filled with gravel. The depth was assumed to be sufficient to minimize seep formation along the creek banks, in addition to controlling seeps at the 370 ft elevation. A 6-inch perforated HDPE collection pipe would be installed in the bottom of the trench. Clean-out manholes would be installed at approximately 200-ft intervals along the collection trench for maintenance purposes. Passive wells would be installed within the collection trench, approximately at 20-ft intervals to an average depth of approximately 20 ft bgs. The 20-ft spacing of passive wells is based on modeling performed as documented in **Appendix K** and results of the pump tests documented in **Appendix F**. The actual trench design will be developed during the IRM design phase. As a result of further pre-design investigation (PDI) investigations or field observations, the actual trench configuration, passive well spacing, pipe diameters, pump sizes and wetwell size may

vary from the FFS conceptual assumptions. The final design will consider borings and hydraulic conductivity measurements along the path of the collection trench to refine anticipated groundwater discharge and depth of trench and passive wells. The need for contingency plans to modify the collection system would be evaluated during the design phase.

A gravel drainage layer would be installed along the collection trench to capture seeps from varying locations near the 370 ft elevation contour. The gravel layer would be installed at grade atop the existing seeps, and connected directly to the gravel within the collection trench, thereby conveying seep water directly to the collection system. The seep collection layer would be covered by a layer of geotextile fabric, geomembrane and topsoil and restored with vegetation. An estimated combined flow of 12 gpm was assumed for NMC seep volume. As described in **Section 2.4**, these elements of the alternatives may be subject to change based on the results of the Seep Evaluation. The shoreline stabilization along the eastern shore is depicted on **Figures 12 through 15** for illustrative purposes. It will be addressed as part of the Lake Remedy, and will not be implemented as part of the IRM.

Shoreline Stabilization of Solvay Waste along the Surf Zone

Shoreline stabilization would be placed along 1,900 linear ft of existing northern shore along the Onondaga Lake SMU-4 shore. The shore stabilization would be graded gravel with live fascines, live staking and branch layering that would be placed within the surf zone (approximately elevation 360 ft to 365 ft) to stabilize the substrate to reduce re-suspension of Solvay waste due to wind and wave action. The graded gravel would provide habitat enhancement through stabilization of the shore Solvay waste and promotion of submerged macrophyte growth. The material would be placed along the entire shore to a depth of 2.5 ft within Onondaga Lake. For FFS cost estimation purposes, an approximately 150 ft wide layer of graded gravel was assumed to be placed from 2.5 ft below the mean lake level of 362.5 ft to the high lake level of 365 ft. Additionally, live crib walls would be installed along 2,170 linear ft of the northern shore along Onondaga Lake, SMU-4, and a portion of SMU-3. The live crib walls would be composed of 6-inch square timbers and built to a width of 8 ft and a height of approximately 5.5 ft (approximate top of wall at El. 368 ft above MSL). The sides and top of walls would be vegetated.

Conveyance and Treatment of Collected Water

The water recovered from the NMC and eastern shore collection trenches (described below in **Sections 3.6.3, 3.6.4, and 3.6.5**), various seep locations and the former NMCSG unit would be conveyed to and treated at the existing Willis-Semet GWTP. For FFS cost evaluation purposes it was assumed that collected water would be pumped from the proposed collection system pump station, situated at the southern end of the eastern shore collection trench adjacent to Ditch A, to the existing Willis-Semet groundwater pumping station via 4,200 linear ft of 6-inch diameter HPDE piping. Also for FFS cost evaluation purposes, the pump station was assumed to consist of a 10-ft diameter wet well with above-ground duplex pumps and controls. Transmission to the treatment plant would be via the existing facilities of the Willis-Semet groundwater pumping station.

Ditch A Limited Containment

The lower reach of Ditch A that discharges to Onondaga Lake at the southern point of the eastern shore would be excavated to allow for the installation of a low permeability habitat cover. For FFS cost evaluation purposes, it was assumed that an overall depth of 2 ft of Solvay waste substrate and sediment would need to be removed from this area. Approximately 350 cubic yards of material would be removed over the 4,600 square foot ditch area, and be replaced with an equal volume of habitat cover and isolation cap material. Excavation activities would need to be conducted with

special consideration of the potential presence of an existing underground gas line located in the vicinity of Ditch A. The habitat layer material would be sand and organic material, and management of excavated Solvay waste substrate and sediment was assumed to be on site. The current on-site placement area envisioned for the Site would be the eastern shore under the vegetative cover. Since it is anticipated that Solvay waste will remain following excavation, and may continue to be a potential source of future contamination as off-site groundwater continues to discharge to Ditch A through this Solvay waste, the habitat layer material would be placed over a low permeability cover. For the purposes of this FFS, a geomembrane was assumed. The target area within the ditch extends from the lakeshore to the existing box culvert 380 ft to the southwest along the ditch alignment. The suitability of this assumption will be assessed in the IRM design, and modified if required.

Ditch A Pipe Rehabilitation
At the upper reach of Ditch A, an approximately 500 linear ft of existing drainage pipe connects the upper reach of Ditch A to NMC. The pipe would be rehabilitated with a new pipe liner to address seep or groundwater infiltration. A cured-in-place liner has been assumed for cost estimating purposes.

3.6.3 Alternative 2 - Low Permeability Vegetative Cover with Inland Groundwater Collection

In addition to the common components described in **Section 3.6.2**, Alternative 2 would include a combined groundwater and seep collection system installed at the 370 ft elevation contour along the eastern shore and a 16.7 acre low permeability vegetative cover on the eastern shore. An illustration of the general components of Alternative 2 is depicted on **Figure 13**. These elements would result in protectiveness to human health and the environment and to the Onondaga Lake remedy while enhancing the habitat along the Site's eastern shore of Onondaga Lake.

Groundwater and Seep Collection Trench
The collection trench would extend from the proposed pump station noted in **Section 2.6.2** along the edge of Ditch A and northwesterly approximately 6,900 linear ft along the 370 ft elevation contour. For cost estimation purposes, it was assumed that the trench would be installed to a width of approximately 4 ft and average depth of approximately 16 ft, as described in **Appendix K**. A 6-inch perforated HDPE collection pipe would be installed and the trench would be filled with gravel. The depth of approximately 16-ft was chosen such that groundwater would be depressed and hydraulic control would extend to the shoreline, providing groundwater capture outboard of the collection trench. Clean-out manholes would be installed at approximately 200-ft intervals along the collection trench for maintenance purposes. For the purpose of this FFS, passive wells were assumed to be installed within the collection trench area, at approximately 20-ft intervals to an average depth of approximately 33 ft bgs. The 20-ft spacing of passive wells is based on modeling and pump tests performed as documented in **Appendix K**. An estimated combined flow of 42 gpm was estimated for the eastern shore groundwater/seep collection system for Alternative 2 (**Appendix I**).

Seep collection would be integral to the eastern shore collection trench. Seep collection would comprise a gravel drainage layer installed adjacent to the northernmost 4,200 linear ft of collection trench. The gravel layer would be installed at grade atop the existing seeps, and connected directly to the gravel within the collection trench, thereby conveying seep water directly to the collection system. The seep collection layer would be covered by a layer of geotextile fabric, geomembrane, and topsoil and restored with vegetation.

For the purpose of cost estimation, assumptions based on current information have been made regarding trench depth and length, well spacing, and pump and piping sizes. The actual trench design will be advanced during the IRM design phase. As a result of further PDI investigations or field observations, the actual trench configuration, well spacing, pipe diameters, pump sizes and wetwell size may vary from the FFS conceptual assumptions. The need for contingency plans to account for flow ranges for the collection system would be evaluated during the design phase.

Low Permeability Vegetative Cover System
Surface restoration of the area between the proposed trench and the lakeshore would encompass an area of approximately 18.7 acres that would be designed to enhance habitat and limit infiltration and erosion, using a 16.7-acre low permeability vegetative cover system with the balance of the area dedicated to roadways. Existing wetlands on the eastern shore impacted by the cover construction would be mitigated on site as part of the compensatory wetlands complex planned for the eastern shore. For cost estimation purposes, the cover was assumed to comprise a 1-ft thick sand layer and a 1-ft thick vegetated topsoil layer over a geocushion, LLDPE geomembrane and geocomposite fabric. The low permeability component of the cover system was selected for Alternative 2 to maximize the hydraulic capture of groundwater outboard of the groundwater collection system, as described in **Appendix K**.

As described in **Section 1.4**, compensatory mitigation wetlands (not part of this alternative) are proposed for approximately 7.7 acres of this area. The trench alignment in this alternative would accommodate the installation of 2.3 acres of connected wetlands (not part of this IRM), to compensate for open water mitigation associated with the Willis Avenue/Semet Ponds IRM, outboard of the collection trench. Together, the cover system included in this IRM and the 7.7 acres of planned compensatory mitigation wetlands would result in comprehensive habitat enhancement for the entire eastern shore area as envisioned in the Onondaga Lake Habitat Plan.

For cost purposes, the O&M for this alternative was assumed to be for five years. The duration of five years was selected because the final remedy for the site is anticipated to be implemented in approximately that timeframe, at which time the IRM O&M will be incorporated into site-wide O&M.

3.6.4 Alternative 3 - Vegetative Cover with Lakeshore Groundwater Collection

In addition to the common components described in **Section 3.6.2**, Alternative 3 would include a groundwater collection trench installed primarily along the lakeshore of the eastern shore, approximately 20 ft away from the lakeshore at average lake level (362.5 ft). Portions of the trench would revert to an alignment toward the 370 ft elevation contour to accommodate mitigation wetlands. A separate seep collection system would be installed along the area where the seeps are present, approximately along the 370 ft elevation. The seep system would be integrated with the groundwater system, for trench portions inland from the lakeshore. Alternative 3 would also include a 14.4 acre vegetative cover on the eastern shore. An illustration of the general components of Alternative 3 is depicted on **Figure 14**. These elements would be protective to human health and the environment and the Onondaga Lake remedy while enhancing the habitat along the Site's eastern shore of Onondaga Lake.

Groundwater Collection System
An approximately 7,100 ft groundwater collection trench, to include approximately 6,250 linear ft of trench installed approximately 20 feet offset from the lakeshore and an approximately 850 linear ft of

trench installed inboard of the 2.3-acre connected wetland (not included in this IRM), would be installed in Alternative 3. For FFS cost estimation, it was assumed that the trench would be installed with a width of approximately 4 ft and average depth of approximately 8 ft, and filled with gravel. The depth of the collection trench was selected such that the hydraulic head in the trench can be maintained 0.5-ft below lake water level (note the depth of the trench is shallower than Alternative 2 due to surface topography). A 6-inch perforated HDPE collection pipe would be installed in the bottom of the trench. Passive wells would be installed below the collection trench, at regular intervals to the base of the marl. For the purpose of this FFS it was assumed that passive wells would be installed approximately at 20-ft intervals to an average depth of approximately 33 ft below ground surface. The 20-ft spacing of passive wells is based on modeling and pump tests performed as documented in **Appendix K**. The depth of the system and interval of passive wells would be to capture shallow and intermediate groundwater discharging to Onondaga Lake. Clean-out manholes would be installed at approximately 200-ft intervals along the collection trench for maintenance purposes. An estimated combined flow of 42 gpm was estimated for the eastern shore groundwater/seep collection seep in Alternative 3. As discussed in **Section 3.6.3**, the actual trench configuration, well spacing, pipe diameters, pump sizes and wetwell size may vary from the FFS assumptions. The need for contingency plans to account for flow ranges for the collection system would be evaluated during the design phase.

Eastern Shore Seep Collection

Seep collection would be accomplished using a collection trench along the 4,200 ft section where seeps are observed. Seep collection would comprise a gravel drainage layer installed at grade over the seep area. The drainage layer would connect to a 4-ft deep gravel collection trench with a 6-inch perforated HDPE collection pipe. The collection pipe would run the length of the 4,200 linear ft seep collection layer and would be connected to the groundwater collection trench situated at the lakeshore at four locations by 800 linear ft of solid wall HDPE piping. The seep collection layer would be covered by a layer of geotextile fabric, geomembrane, and topsoil and restored with vegetation. As described above, an estimated combined flow of 42 gpm was assumed for the eastern shore groundwater/seep collection system for Alternative 3 (**Appendix I**).

As discussed in **Section 3.6.3**, the actual trench configuration and pipe diameters may vary from the FFS assumptions. The need for contingency plans to account for flow ranges for the seep collection system would be evaluated during the design phase.

Vegetative Cover System

Surface restoration of the area inboard of the proposed trench would encompass an area of approximately 18.7 acres that would be designed to enhance habitat and limit erosion, using a vegetative cover system (for 14.4 acres) with the balance of the area dedicated to access paths constructed to be consistent with the habitat enhancements. Existing wetlands on the eastern shore impacted by the cover construction would be mitigated on site as part of the compensatory wetlands complex planned for the eastern shore. For FFS cost estimation purposes, this vegetative cover system was assumed to comprise a 1-ft thick stone layer, overlain by geofabric and geogrid (for stability of the stone sub-base), overlain by a 1-ft thick sand layer and a 1-ft thick vegetated topsoil layer. A low permeability element was not included in the Alternative 3 cover system, since full capture of groundwater would be achieved with the shore alignment which is outboard of the cover system.

As described in **Section 1.4**, compensatory mitigation wetlands (not part of this alternative) are proposed for 7.7 acres of this area. The trench alignment in this alternative would accommodate the installation of 2.3 acres of connected wetlands (not part of this IRM), to compensate for open water mitigation associated with the Willis Avenue/Semet Ponds IRM, outboard of the collection trench. Together, the cover system included in this IRM and the 7.7 acres of planned compensatory mitigation wetlands would result in the comprehensive habitat enhancement for the entire eastern shore area as envisioned in the Onondaga Lake Habitat Plan.

For cost purposes, the O&M for this alternative was assumed to be for five years. The duration of five years was selected because the final remedy for the site is anticipated to be implemented in that timeframe, at which time the IRM O&M will be incorporated into site-wide O&M.

3.6.5 Alternative 4 - Excavation with Inland Groundwater Collection

In addition to the common components described in **Section 3.6.2**, Alternative 4 would include a combined groundwater and seep collection system installed at the 370 ft elevation contour along the eastern shore and removal of Solvay waste along the eastern shore. An illustration of the general configuration and components of Alternative 4 is depicted on **Figure 15**.

Groundwater and Seep Collection System

The groundwater collection trench would extend from the proposed pump station noted in **Section 3.6.2** along the edge of Ditch A and northwesterly approximately 6,800 linear ft along the 370 ft elevation contour. For cost estimation purposes, the trench was assumed to be installed with a width of approximately 4 ft and average depth of approximately 12 ft, corresponding to the top of marl, as described in **Appendix K-1**. The depth of the collection trench was selected such that the hydraulic head in the trench could be maintained 0.5-ft below lake water level. The depth of this trench would not be as deep as that required in Alternative 2, since the Solvay waste outboard of the trench would be excavated. The collection system in Alternative 4 would collect groundwater in Solvay waste and marl inboard of the system and would also be expected to collect groundwater in marl outboard of the system. A 6-inch perforated HDPE collection pipe would be installed and the trench would be filled with permeable granular material. Clean-out manholes would be installed approximately at 200-ft intervals along the collection trench for maintenance purposes. For the purpose of this FFS, it was assumed that passive wells would be installed within the collection trench area to the base of the marl, approximately at 20-ft intervals to an average depth of approximately 33 ft bgs. The 20-ft spacing of passive wells is based on modeling and pump tests performed as documented in **Appendices I and K**. An estimated combined flow of 42 gpm was estimated for the eastern shore groundwater/seep collection system for Alternative 4 (**Appendix I**).

Seep collection would be integral to the eastern shore collection trench. Seep collection would comprise a gravel drainage layer installed adjacent to the northernmost 4,200 linear ft of collection trench. The gravel layer would be installed at grade atop the existing seeps, and connected directly to the collection trench, thereby conveying seep water directly to the collection system. The seep collection layer would be covered by a layer of geotextile fabric, geomembrane, and topsoil and restored with vegetation.

As discussed in **Section 3.6.3**, the actual trench configuration, well spacing, pipe diameters, pump sizes and wetwell size may vary from the FFS assumptions. The final design will consider borings and hydraulic conductivities along the path of the collection trench to refine anticipated groundwater

discharge and depth of trench and passive wells. The need for contingency plans to account for ranges in flow would be evaluated during the design phase.

Excavation of Solvay Waste Outboard of Collection Trench
Approximately 27 acres of existing Solvay waste would be removed outboard of the collection trench. This would include excavation of approximately 440,000 cubic yards (average depth of 10 ft) of Solvay waste on the eastern shore with management of the excavated material from above the water table on site (150,000 cy), and management of material from below the water table at an off-site commercial landfill (290,000 cy). For cost estimation purposes, the restoration was assumed to include 3.5 ft of sand and 0.67 ft of fine gravel. Thus, the excavated area would be restored to open water. The removal of the shore proposed in Alternative 4 and creation of open water is not conducive to the construction of the diverse wetland complex envisioned in the Onondaga Lake Habitat Plan.

The proposed sheeting area assumes that the excavation will occur “in the dry” and would therefore require sheeting around the circumference of the excavation to provide both stability and prevent excessive water infiltration from the lake. The quantity is based on an assumed sheeting length of 15,300 linear feet installed to a depth of 30 feet. For cost purposes, the O&M for this alternative was assumed to be for five years. The duration of five years was selected because the final remedy for the site is anticipated to be implemented in that timeframe, at which time the IRM O&M will be incorporated into site-wide O&M.

4. Detailed Analysis of IRM Alternatives

This section documents the detailed analysis of the four IRM alternatives that were developed during the FFS. The detailed analysis of the IRM alternatives was conducted consistent with the *Guidance for Developing Remedial Investigation and Feasibility Studies under CERCLA* (USEPA 1988) and consistent with the *Shallow and Intermediate Groundwater FFS Work Plan* (O'Brien & Gere 2008a). This section describes the individual and comparative analysis of the IRM alternatives with respect to nine evaluation criteria that embody the specific statutory requirements that must be evaluated to satisfy the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) remedy selection process.

4.1 Individual Analysis of Alternatives

The preamble to the NCP (Federal Register 1990) indicates that, during remedy selection, nine criteria should be categorized into three groups: threshold criteria, primary balancing criteria, and modifying criteria. The two threshold criteria, overall protection of human health and the environment, and compliance with ARARs, must be satisfied in order for an alternative to be eligible for selection. Long-term effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; short-term effectiveness; implementability; and cost are primary balancing criteria that are used to balance the differences between alternatives. The modifying criteria are state and community acceptance; they are formally considered after public comment is received.

The objective of the detailed analysis of alternatives was to analyze and present sufficient information to allow the alternatives to be compared and a remedy selected. The analysis consisted of an individual assessment of each alternative with respect to the seven above referenced evaluation criteria that encompass statutory requirements and overall feasibility and acceptability. The seven evaluation criteria are:

- Overall protectiveness of human health and the environment
- Compliance with ARARs
- Long-term effectiveness and permanence
- Reduction of toxicity, mobility, or volume through treatment
- Short-term effectiveness
- Implementability
- Cost

In the individual analysis of alternatives, each of the remedial alternatives was evaluated with respect to the above-listed evaluation criteria. The criteria are described below and the summary of this analysis is presented in **Table 6**.

4.1.1 Overall Protection of Human Health and the Environment

The analysis of each alternative with respect to this criterion provides an evaluation of whether the alternative would achieve and maintain adequate protection and a description of how site risks would be eliminated, reduced, or controlled through treatment, engineering, or institutional controls.

4.1.2 Compliance with Site-Specific Applicable or Relevant and Appropriate Requirements

Each alternative is evaluated to assess whether it would attain ARARs or provide grounds for invoking a waiver. Potential ARARs for the Site are presented in **Table 7**.

4.1.3 Long-Term Effectiveness and Permanence

Each alternative is evaluated to assess the long-term effectiveness and permanence it would afford. Factors considered, as appropriate, include:

- the magnitude of potential residual risk from materials remaining at the conclusion of the remedial activities. The characteristics of the remaining materials are considered to the degree that they remain hazardous, taking into account their mobility, toxicity and volume, as well as their propensity to bioaccumulate.
- the adequacy and reliability of controls, such as containment systems and institutional controls, necessary to manage materials left on site. This factor addresses the uncertainties of remedial components, the assessment of the potential need to replace components of the alternative, and the potential exposure pathways and risks posed should the remedial action need replacement.

4.1.4 Reduction of Toxicity, Mobility or Volume through Treatment

For each alternative, the degree to which the alternative results in the reduction of mobility, toxicity or volume is assessed. Factors considered, as appropriate, include:

- the treatment or recycling processes the alternative would employ and the materials it would treat
- the amount of hazardous substances, pollutants, or contaminants that would be treated or recycled
- the degree of expected reduction of mobility, toxicity or volume of the waste due to treatment or recycling and the specification of which reduction(s) would occur
- the degree to which treatment would be irreversible
- the type and quantity of residuals that would remain following treatment, considering the persistence, toxicity, mobility and propensity to bioaccumulate such hazardous substances and their constituents
- the degree to which treatment would reduce the inherent hazards posed by the Site.

4.1.5 Short-Term Effectiveness

The short-term impacts of each alternative are assessed, considering the following:

- short-term potential risks that might be posed to the community during implementation of the alternative
- potential impacts to workers during implementation of the remedy and the effectiveness and reliability of protective measures
- potential environmental impacts of the remedial action and the effectiveness and reliability of mitigative measures during implementation
- time until protection would be achieved.

4.1.6 Implementability

Each alternative is assessed relative to the ease or difficulty of implementation by considering the following types of factors, as appropriate:

- technical feasibility, including technical difficulties and unknowns associated with the construction and operation of a technology, the reliability of the technology, the ease of undertaking additional remedial actions, and the ability to monitor the effectiveness of the remedy
- administrative feasibility, including activities needed to coordinate with other offices and agencies
- ability and time required to obtain any necessary approvals and permits from agencies
- availability of services and materials, including the availability of adequate offsite treatment, storage and disposal capacity and services; the availability of necessary equipment and specialists, provisions to obtain necessary additional resources; and the availability of prospective technologies.

4.1.7 Cost

Detailed cost estimates for Alternatives 1 through 4 are included as **Tables 8 through 11**.

Alternative 1, the no action alternative, is the least cost alternative with an estimated present worth value of approximately $0.

Alternative 2, the low permeability vegetative cover with inland groundwater collection alternative, has an estimated present worth of approximately $23.6 Million. As described in **Section 3.6.3**, this alternative includes a groundwater collection trench installed along the 370 ft elevation contour of the eastern shore; an 16.7 acre low permeability vegetative cover along the eastern shore; hydraulic control of the NMCSG unit groundwater; hydraulic control of seeps along the eastern shore, and selected seeps along the NMC and northern shore; shore stabilization along the Onondaga Lake shore of the Site; treatment of collected seep water and groundwater; limited sediment excavation/low permeability habitat cover of the lower reach of Ditch A; and pipe rehabilitation of the upper reach of Ditch A.

Alternative 3, the vegetative cover with lakeshore groundwater collection alternative, has an estimated present worth of approximately $23.8 Million. As described in **Section 3.6.4**, this alternative includes a groundwater collection trench installed primarily along the eastern shore; allowance for outboard construction of 2.3 acres of connected wetland; a 14.4 acre vegetative cover along the eastern shore; hydraulic control of the NMCSG unit groundwater; hydraulic control of seeps along the eastern shore, and selected seeps along the NMC and northern shore; shore stabilization along the surf zone of Onondaga Lake; treatment of collected seep water and groundwater; limited sediment excavation/low permeability habitat cover of the lower reach of Ditch A; and pipe rehabilitation of the upper reach of Ditch A.

Alternative 4, the mechanical excavation with inland groundwater collection alternative, has an estimated present worth of approximately $113 Million. As described in **Section 3.6.5**, this alternative includes a groundwater collection trench installed along the 370 ft elevation contour of the eastern shore; removal of approximately 27 acres of Solvay waste along the eastern shore; hydraulic control of the NMCSG unit groundwater; hydraulic control of seeps along the eastern shore, and

selected seeps along the NMC and northern shore; shore stabilization along surf zone of Onondaga Lake; treatment of collected seep water and groundwater; limited sediment excavation/low permeability habitat cover of the lower reach of Ditch A; and pipe rehabilitation of the upper reach of Ditch A. The excavation methods for Alternative 4 consist of land-based mechanical excavation of approximately 150,000 cubic yards of Solvay waste on the eastern shore with management of the excavated material from above the water table on site, and management of approximately 294,000 cubic yards of material from below the water table at an off-site commercial landfill. Alternative 4 would require full excavation in the dry. As such, sheeting and dewatering has been incorporated for both excavation stability and water control. Approximately 15,300 linear feet of sheeting would be placed to contain the excavation area on both the land-side as well as along the lakeshore. The sheeting would be driven into the marl, as required for stability, and extend beyond the high lake level to prevent overflow from the lake to the excavation, and grouted to preclude infiltration to the extent practicable. Dewatering of the contained area assumes the use of temporary dewatering pumps and piping to temporary holding tanks discharging to the shoreline collection system as capacity allows. Provisions for trucking collected excavation water directly to treatment facilities are also included.

For cost purposes, the O&M for the alternatives was assumed to be for five years. The duration of five years was selected because the final remedy for the site is anticipated to be implemented in that timeframe, at which time the IRM O&M will be incorporated into site-wide O&M.

4.2 Comparative Analysis of Alternatives

The detailed analysis of alternatives also included a comparative evaluation designed to consider the relative performance of the alternatives and identify major trade-offs among them. The comparative evaluation of alternatives is presented in the following subsections. In the comparative analysis of alternatives, the performance of each alternative relative to the others was evaluated for each criterion. As discussed in the following subsections, with the exception of Alternative 1, each alternative would satisfy the threshold criteria by providing protection to human health and the environment, and by addressing the identified ARARs. Therefore, alternatives 2, 3, and 4 would be eligible for selection as the IRM. The primary balancing criteria (long-term effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; short-term effectiveness; implementability; and cost) were used in the comparative evaluation of alternatives.

As described in **Section 4.1**, the detailed evaluation with respect to the FS criteria for each of the alternatives is presented in **Table 6**.

4.2.1 Overall Protection of Human Health and the Environment

Alternative 1 would not provide protection of human health and the environment. Alternatives 2, 3 and 4 would each meet the RAOs for this FFS. As described below, Alternatives 2, 3, and 4 would provide equal protection of human health and the environment.

Alternatives 2 and 3 both would afford protectiveness of human health and the environment through the use of a vegetative and low permeability vegetative cover and the use of a groundwater collection trench that would mitigate shallow and intermediate groundwater discharge to Onondaga Lake along the eastern shore. The alignment of this collection trench differs for each of these alternatives, with Alternative 3 aligned mostly along the lakeshore, and with Alternative 2 aligned inland from the

lakeshore at the 370 elevation contour. Both alignments would provide similar protectiveness relative to groundwater and Solvay waste impacts to the Onondaga Lake remedy.

Protectiveness of human health and the environment would be provided in Alternative 4 through the use of a groundwater collection trench and excavation of Solvay waste material outboard of the collection trench. Alternative 4 would provide similar protectiveness relative to groundwater and Solvay waste that would potentially impact the Onondaga Lake remedy.

In summary, Alternatives 2, 3, and 4 would be protective of human health and the environment.

4.2.2 Compliance with ARARs

Alternative 1 would not address ARARs identified for the Site, whereas Alternatives 2, 3, and 4 would address ARARs identified for the Site. Specifically, compliance with chemical-specific groundwater ARARs would be addressed through interception of shallow and intermediate groundwater and seep water, and the subsequent off-site treatment of collected water. Compliance with items to be considered (TBCs) for Solvay waste substrate and sediment in the lower reaches of Ditch A would be addressed through Solvay waste substrate and sediment removal and installation of a low permeability habitat cover. With regard to location-specific ARARs and TBCs, Alternatives 2, 3 and 4 would be completed in a manner consistent with federal and state floodplain and wetland requirements, as well as the requirements for cultural, archaeological and historical resources. Compliance with action-specific ARARs would be addressed by conducting proposed actions in a manner consistent with Fish and Wildlife Coordination Act requirements for protection of Onondaga Lake and NMC. Excavation activities would meet air quality requirements.

4.2.3 Long-term Effectiveness and Permanence

Alternative 1 would not provide long-term effectiveness and permanence, whereas Alternatives 2, 3, and 4 would. The common elements of Alternatives 2, 3, and 4 would provide long term effectiveness and permanence through control of seeps along the NMC shore, addressing seep discharge and Solvay waste substrate and sediment in the upper and lower reaches of Ditch A, respectively, controlling groundwater discharge from the former NMCSG unit to Onondaga Lake and NMC, and controlling shore erosion along Onondaga Lake. In addition, the groundwater collection system, vegetative cover and/or Solvay waste removal technologies included in these alternatives can be designed to adequately and reliably manage residual risks following IRM construction.

Alternatives 2 and 3 both would provide long-term effectiveness and permanence through the use of a groundwater collection trench, which would be both an adequate and reliable means for ensuring the effectiveness of the Onondaga Lake remedy as it relates to groundwater discharge along the eastern shore. Containment of shore Solvay waste using the vegetative cover included in Alternatives 2 and 3 would be an adequate and reliable method of addressing erosion of Solvay waste at the eastern shore.

Long-term effectiveness and permanence would be provided in Alternative 4 through the use of a groundwater collection trench and excavation of Solvay waste material outboard of the collection trench. The groundwater collection trench included in Alternative 4 would be an adequate and reliable means for controlling groundwater reaching the collection trench. In summary, Alternatives 2, 3, and 4 each would provide long-term effectiveness and permanence.

4.2.4 Reduction of Toxicity, Mobility, or Volume through Treatment

There would be no reduction in toxicity, mobility or volume provided in Alternative 1. Alternatives 2, 3 and 4 would each afford reductions in toxicity, mobility or volume through treatment. Alternatives 2 and 3 would include approximately the same amount of contaminated Solvay waste, soils, and sediments removed, and the amount of contaminated groundwater/seep water collected and treated. Alternative 4 provides a higher reduction in toxicity, mobility and volume which is afforded through removal of Solvay waste from the eastern shore.

The common elements of Alternatives 2, 3, and 4 would provide reduction in mobility through control of seeps along the NMC shore, control groundwater discharge from the former NMCSG unit to Onondaga Lake and NMC, and control of wind/wave erosion of Solvay waste along the surf zone of Onondaga Lake SMU-4 and a portion of SMU-3. Alternatives 2, 3, and 4 each would provide for reduction in mobility of eastern shore groundwater and seep water through the use of a groundwater collection system and seep collection system that would mitigate shallow and intermediate groundwater and seep water discharge to Onondaga Lake along the eastern shore. Treatment of the collected groundwater would afford a reduction in toxicity of the groundwater for each of these alternatives.

In summary, Alternatives 2, 3 and 4 would each provide reductions in mobility, volume, and toxicity through treatment. Alternative 4 provides greatest reduction in toxicity, mobility and volume through removal of Solvay waste from the eastern shore.

4.2.5 Short-term Effectiveness

There are no short-term effects relative to Alternative 1. Alternatives 2, 3 and 4 would be constructed using proper protective equipment to manage risks to on-site workers, and proper precautions and monitoring to be protective of the general public and the environment. Due to the extensive excavation included in Alternative 4, potential impacts to the surrounding community related to transportation of material would be substantially greater than for Alternatives 2 and 3. While Alternative 4 would provide similar protectiveness as Alternatives 2 and 3, the effort to remove 27 acres of Solvay waste along the eastern shore would be significantly greater than that required for Alternatives 2 and 3, and is therefore more energy intensive as compared to Alternatives 2 and 3.

Potential risks to construction workers in areas of contamination in Alternatives 2, 3 and 4 through dermal contact, incidental ingestion and inhalation related to the removal, handling, and processing of the sediment, Solvay waste, groundwater, and seep water would be mitigated by utilizing proper protective equipment. Impacts related to noise and odor associated with the extensive excavation and transportation of Solvay waste included in Alternative 4 would also be mitigated through use of proper protective equipment and proper construction practices. Excavation activities would meet air quality requirements, and construction activities would meet current Occupational Safety and Health Administration (OSHA) requirements.

Under Alternatives 2, 3 and 4, disturbance of the land during excavation activities is anticipated to result in the need to manage construction water. This construction water would be properly managed to minimize adverse impacts. Due to the significantly larger amount of excavation associated with Alternative 4, these impacts would be significantly greater than for Alternatives 2 and 3. Appropriate measures would have to be taken during excavation activities to minimize generation of nuisance dust and volatile organic compounds.

Each of the above mentioned alternatives would increase vehicle traffic and impact the local roadway system, and could subject nearby residents to increased noise and odor levels; however, the amount of vehicular traffic and impact to the local roadway system would be substantially higher for Alternative 4, due to the material handling necessary for the excavation of the approximate 440,000 cy of Solvay waste (approximately 29,000 truck loads off site, and approximately 15,000 truck loads placed on site), as well as the material handling required for placement of material for the associated lake bottom restoration. The greater fuel requirements associated with excavation and transportation of larger excavation quantities for Alternative 4 contribute to the greater energy/resource requirements for this alternative, when compared to Alternatives 2 and 3.

Alternatives 2 and 3 would be expected to be completed within an approximately 2- to 3-year timeframe. Due to the significant volumes of excavation and associated construction activities included in Alternative 4, it is anticipated that the construction of Alternative 4 will take substantially longer (up to 4 yrs longer) to complete than Alternatives 2 and 3. Maintenance and operation of the collection trench and associated equipment and treatment systems, for each Alternative, would be required in the long-term.

In summary, Alternatives 2, 3, and 4 can be constructed in a manner that is protective of workers, the surrounding community, and the environment. Alternative 4 would result in a greater impact to the surrounding community than Alternatives 2 and 3, due to the increased volume of traffic associated with the off-site transportation of approximately 290,000 cy of material. The excavation volumes associated with Alternative 4 would also result in greater energy/resource needs associated with excavation, transportation and construction water management.

4.2.6 Implementability

Each alternative can be implemented, and with the exception of Alternative 1 (which does not include any technologies) incorporates readily constructible and reliable technologies. Alternative 4 would be expected to be more difficult to execute than Alternatives 2 and 3, as the additional proposed excavation of Solvay waste outboard of the collection trench would require management of groundwater, stormwater, and lake infiltration.

Monitoring the effectiveness of Alternatives 2, 3, and 4 would be accomplished through monitoring of recovered groundwater within the collection trench. Alternatives 2 and 3 would include inspection and maintenance of the vegetative cover systems. Seep control and erosion control would be monitored through site inspection and maintenance of these systems.

Each alternative would require coordination with other agencies, including the United States Environmental Protection Agency (USEPA), Onondaga County, and the Town of Geddes. Treatment facilities for collected groundwater would be readily available at the Willis-Semet GWTP. The necessary equipment and specialists would be available for each alternative.

4.2.7 Cost

Detailed cost estimates and associated assumptions for Alternatives 2, 3 and 4 are included as **Tables 8 through 11**, and are summarized as follows:

Alternative	Total estimated capital cost	Total estimated present worth of O&M	Total estimated net present worth cost
1 – No Action	$0	$0	$0
2 – Low Permeability Vegetative Cover with Inland Groundwater Collection	$17.5 Million	$6.1 Million	$23.6 Million
3 – Vegetative Cover with Lakeshore Groundwater Collection	$17.1 Million	$6.7 Million	$23.8 Million
4 – Excavation with Inland Groundwater Collection	$106.8 Million	$6.2 Million	$113 Million

Alternative 1, the no further action alternative, is the lowest cost alternative, with a total estimated 30-yr present worth cost of $0. The estimated 5-yr net present worth costs of active IRM alternatives ranged from $23.6 Million for Alternative 2 to $113 Million for Alternative 4.

Alternative 4, which includes excavation of Solvay waste outboard of the collection trench, was the most costly alternative (with a total estimated 5-yr present worth cost of $113 Million) due to the large volume of excavated waste and associated management of excavated waste, as compared to the other alternatives.

5. Recommendations

As part of Honeywell's overall goal to provide long-lasting protection to the local community and environment, and restore the Onondaga Lake shore to the community, four IRM alternatives were developed and evaluated for the Site to address RAOs and provide continued effectiveness of the Onondaga Lake and NMC remedies. This section presents the recommended IRM alternative that is proposed in this FFS to provide long-lasting protection to these remedies.

Following the evaluation of alternatives as documented in Section 4, Honeywell recommends Alternative 3 (see **Figure 14**) as the IRM for the Site. Alternative 3 would provide the best balance of the evaluation criteria while achieving the RAOs set forth in this FFS Report. RAOs would be achieved by Alternative 3 as follows:

- Direct contact with and ingestion of exposed Solvay waste along the eastern shore would be addressed by the vegetative cover system
- Migration of eastern shore shallow and intermediate groundwater to Onondaga Lake would be addressed by means of a collection trench and passive wells,
- Migration of NMCSG unit groundwater would be addressed by means of groundwater collection wells
- Migration of site shallow and intermediate groundwater to the lower reach of Ditch A
- Discharge of selected seeps along NMC, northern, and eastern shores would be addressed by seep collection systems,
- Erosion of exposed Solvay waste at the eastern shore would be addressed by the vegetative cover system,
- Erosion of Solvay waste due to wind- and wave action along the surf zone of Onondaga Lake SMU-4 and a portion of SMU-3 would be addressed by a combination of graded gravel and live crib walls
- Erosion of Solvay waste and contaminated sediments from the lower reach of Ditch A to Onondaga Lake would be addressed by partial excavation and installation of an isolation cap/cover system and habitat layer, and
- Seep discharge to NMC via the upper reach of Ditch A would be addressed by rehabilitation of the existing pipe that discharges to NMC.

In addition to addressing the RAOs identified for this IRM, the remedy components would provide for Site use consistent with the reasonably anticipated future land uses for the Site.

As documented in **Section 4.2**, Alternative 3 would be protective of human health and the environment because it would mitigate shallow and intermediate groundwater discharge to Onondaga Lake along the eastern shore, control seeps along the NMC shore, address erosion of Solvay waste substrate and sediment from the lower reach of Ditch A, control groundwater discharge from the former NMCSG unit to Onondaga Lake and NMC, and control erosion along Onondaga Lake. While not a part of Alternative 3, the recommended alterative also would accommodate the installation of a 7.7 acre integrated wetland which, together with the 14.4 acre vegetative cover in Alternative 3, would prevent the potential for direct contact with and erosion of exposed Solvay waste on the

eastern shore and provide habitat enhancements along the Onondaga Lake shore as envisioned in the Onondaga Lake Habitat Plan.

Alternative 3 is similar to Alternative 2, with the major difference being the alignment of the eastern shore groundwater collection trench. Both alternatives would be protective of human health and the environment and of the Onondaga Lake and NMC remedies. However, the alignment of the trench in Alternative 3 would result in the added benefit of containment of eastern shore Solvay waste inboard of the groundwater collection system. Monitoring to verify that site media are not migrating to neighboring surface water would be part of the recommended alternative. It is the intent that the collection system would operate continuously to reduce the potential for off-site migration of contaminants.

While equally protective as Alternative 4, Alternative 3 could be implemented in a shorter amount of time (relative to Alternative 4) and would therefore provide more timely mitigation of potential impacts from the Site to the Onondaga Lake and NMC remedies, and at a considerably lower cost than Alternative 4.

Preliminary green remediation concepts have been considered during the development of the FFS alternatives. Examples include measures for minimizing energy use and greenhouse gas emissions such as optimizing groundwater collection, passive groundwater collection technologies, efficient material handling methods, and local material sourcing. Additionally, habitat enhancement through measures such as integration of surface restoration with the mitigation wetland complex, and sensitivity to existing natural communities and proximity to Onondaga Lake have been considered during the development of the FFS alternatives.

As the project advances, Honeywell will continue to identify and evaluate opportunities to implement green remediation, including opportunities identified in the USEPA's Region 2 "Clean and Green" policy, throughout the remediation process and further integrate them into the IRM. For example, as part of the design phase, Honeywell will consider green remediation concepts such as the use of energy efficient equipment and renewable energy sources. During construction, the use of clean or efficient alternate fuel (such as clean diesel or biodiesel), local construction materials, recycled construction materials, alternative construction materials (such as green concrete), or the use of on-site materials such as cleared and chipped vegetation for erosion control would be considered.

As part of the process established for IRMs under the ACO, following review of the evaluations documented in this FFS Report, NYSDEC and USEPA will identify an alternative to propose as the preferred remedial action to be documented in a PRAD. Following receipt of public comments on the PRAD, the selected remedial action will be documented in a RAD. The remedial action selected by the NYSDEC may be different from that recommended in this FFS Report.

As described in **Section 1**, Honeywell is conducting a site-wide RI/FS. The FS process will evaluate remedial alternatives to address risks identified during the risk assessment, and media of concern identified in the RI, including areas addressed by this IRM. The final site remedy will be documented in a Record of Decision.

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Table 1. Screening of remedial technologies and process options for groundwater.

GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY	PROCESS OPTION	DESCRIPTION	IMPLEMENTABILITY	EFFECTIVENESS	RELATIVE COST	RETAINED OR NOT RETAINED FOR FURTHER CONSIDERATION
No action	None	No action*	No action	Implementable	Not effective in mitigating groundwater flow and potential impacts to Onondaga Lake or NMC OU-2 remedies. Relies solely on natural attenuation.	No capital cost No O&M cost	Required for consideration by the NCP.
Hydraulic control	Physical barrier wall	Slurry wall	Soil- or cement-bentonite slurry wall placed along the perimeter of the area of contamination to contain groundwater. Containment wall should extend into a confining layer.	Compatibility testing indicated that bentonite was incompatible with site groundwater. Depth of confining layer (approximately 50 feet) makes implementation difficult.	Effective at hydraulically containing groundwater if used in conjunction with a groundwater extraction system. As described in Appendix K, a slurry wall supplemental physical barrier, together with a groundwater extraction system, would not be necessary to achieve hydraulic control.	High capital Low O&M	Not Retained
		Sheet piles	Sheet piles installed along the area of contamination to contain groundwater. Sheet pile materials include HDPE, fiberglass, vinyl and steel. Sheet piles should extend into a confining layer.	Implementable. Compatibility testing indicated that HDPE can be used with site conditions. Steel has been used at other sites nearby.	Effective at hydraulically containing groundwater if used in conjunction with a groundwater extraction system. As described in Appendix K, a sheet pile supplemental physical barrier, together with a groundwater extraction system, would not be necessary as a to achieve hydraulic control.	Medium to High capital Low O&M	Not Retained
	Groundwater extraction	Extraction wells (vertical or horizontal)*	Removal of groundwater by pumping from recovery wells for hydraulic control.	Potentially applicable for limited use only (e.g., for Ninemile Creek Sand and Gravel unit), due to low soil hydraulic conductivity conditions for most areas at the Site.	Effective at collecting groundwater. Effective at hydraulically controlling groundwater flow, depending on well spacing.	Low capital (medium to high for larger areas) High O&M	Retained for limited use only
		Collection trench with wick drains	Collection trench installed with wick drains to provide hydraulic control. The water, driven by the natural and enhanced head differential between the formation and the overlying collection trench, flows through the wick drain core, and vertically upward into the collection trench.	Readily implementable	Effective for hydraulic control of groundwater.	Medium capital (high capital for smaller areas) Medium O&M	Retained
		Collection trench with passive wells*	Collection trench installed with passive wells to provide hydraulic control. The water, driven by the natural and enhanced head differential between the formation and the overlying collection trench, flows through the passive well, and vertically upward into the collection trench.	Readily implementable	Effective for hydraulic control of groundwater.	Medium capital Medium O&M	Retained
In situ treatment	Monitored natural attenuation	Natural degradation	Long-term monitoring of the natural biotic and abiotic degradation of organic constituents.	Readily implementable	Results of the Site-specific microcosm study performed showed a lack of biological degradation of CPOIs in microcosms constructed using Site groundwater and solids.	Low capital Low O&M	Not Retained
	Biological	Enhanced Bioremediation	Injection of microbial populations, nutrient sources, or electron donors into groundwater to enhance biological degradation of organic constituents.	Potentially applicable for limited use only, due to low soil permeability conditions in most areas at the Site.	Results of the Site-specific microcosm study performed showed a lack of biological degradation of CPOIs in microcosms constructed using Site groundwater and solids.	Low capital Low O&M	Not Retained
	Chemical	Chemical oxidation	Injection of oxidation agents such as hydrogen peroxide, ozone, or permanganate into groundwater to oxidize/destroy organic contaminants.	Potentially applicable for limited use only, due to low soil permeability conditions in most areas at the Site.	Effective for oxidizing VOC in the saturated zone. Distribution of oxidant is restricted in low permeability soil, such as along the eastern shoreline. A treatability study would be necessary. Could be effective for limited areas such as the more permeable NMCSG unit; however, without source remediation, application of oxidant would be required over the long term.	Medium capital Low O&M	Not Retained

Table 1. Screening of remedial technologies and process options for groundwater.

GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY	PROCESS OPTION	DESCRIPTION	IMPLEMENTABILITY	EFFECTIVENESS	RELATIVE COST	RETAINED OR NOT RETAINED FOR FURTHER CONSIDERATION
In situ treatment	Physical	In-well air stripping	Injection of air into the water column within the well to volatilize constituents. Groundwater circulation is performed *in situ* , with groundwater entering the well at one screen interval, and being discharged through a second screen interval. Air is collected and treated as necessary.	Implementability is limited due to low soil permeability and heterogeneous nature of conditions in most areas at the Site. Injection of air may result in precipitation of ionic constituents that may result in further reducing the permeability of the formation due to plugging.	Effective to address VOC in saturated zone. Effectiveness is limited in low permeability soil, such as along the eastern shoreline.	Medium capital Medium O&M	Not Retained
		Air sparging	Injection of air into the saturated zone to volatilize constituents. Emissions are then collected in the unsaturated zone using a soil vapor extraction system.	Implementability is limited due to low soil permeability and heterogeneous conditions in most areas at the Site. Injection of air may result in precipitation of ionic constituents that may result in further reducing the permeability of the formation due to plugging.	Effective to address VOC in saturated zone. Effectiveness is limited in heterogeneous, low permeability soil, such as along the eastern shoreline.	Medium capital Medium O&M	Not Retained
	Treatment wall	Permeable Reactive Barrier	Construction of a reactive material wall, air sparging zone, or biobarrier to treat groundwater as it flows through the treatment zone.	Implementability is limited due to low soil permeability and heterogeneous conditions in most areas at the Site.	Generally effective for treating VOC; however, multiple treatment zones/units would be necessary for treatment. There is a potential for fouling of reactive materials due to ionic waste constituent concentrations in groundwater. Periodic replacement of reactive material would be anticipated.	High capital High O&M	Not Retained
Ex situ treatment	Biological/Physical	Constructed treatment wetland	Engineered wetlands developed specifically to treat contaminants in water that flows through them.	Implementable for the shallow/intermediate zone to treat soluble groundwater constituents.	Effective for treating VOC. A pilot study would be required to demonstrate effectiveness.	Medium capital Low O&M	Retained
	Physical/Chemical	Willis-Semet Groundwater Treatment Plant (GWTP)*	Treatment of collected groundwater at the Willis-Semet GWTP.	Implementable	Effective for treating Site CPOIs.	Medium capital Low O&M	Retained

Notes:
* - Representative process option
CPOI - Chemical Parameter of Interest
HDPE - High Density Polyethylene
NCP - National Oil and Hazardous Substances Contingency Plan
NMC - Ninemile Creek
O&M - Operation and Maintenance
VOC - Volatile Organic Compound

Table 2. Screening of remedial technologies and process options for seeps.

GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY	PROCESS OPTION	DESCRIPTION	IMPLEMENTABILITY	EFFECTIVENESS	RELATIVE COST	RETAINED OR NOT RETAINED FOR FURTHER CONSIDERATION
No action	None	No action	No action	Implementable	Not effective in mitigating seep water flow to Onondaga Lake or NMC OU-2.	No capital cost No O&M cost	Required for consideration by the NCP.
Hydraulic control	Seep water collection	Individual catch basin structures*	Install catch basins to collect seep water to mitigate localized seeps.	Implementable	Effective at collecting seep water.	Low capital (medium for multiple locations) Low O&M	Retained
		Shallow collection trench*	Intercept or collect groundwater to mitigate seeps and reduce potential for future seep formation. Includes installation of a drainage layer to divert seepage to the collection trench, which is installed perpendicular to groundwater flow and generally includes pipe drains and permeable granular backfill material.	Implementable	Effective at collecting groundwater and hydraulically controlling groundwater prior to seep formation.	Medium capital Medium O&M	Retained
	Seep water containment	Regrading	Regrading would be performed to encourage evaporation and infiltration prior to the seep reaching the surface water body.	Implementable	Potentially effective at minimizing the potential for seep water to reach the surface water body.	Low capital Low O&M	Retained for limited use for isolated seeps.
		Weir box backfill/pipe plugging*	Control seep discharge by plugging pipes and/or backfilling collapsed weir boxes.	Implementable	Effective at minimizing discharge from pipes and weir box structures.	Low capital Low O&M	Retained
In situ treatment	Biological	Phytoremediation	Control of seeps by re-establishing vegetation and enhancing evapotranspiration.	Implementability limited due to high pH of seep water and localized highly intermittent flow.	Effectiveness is being evaluated by a seep evaluation study.	Low capital Low O&M	Retained for limited use for isolated seeps.
	Chemical	Reactive barrier	Use of a reactive barrier to treat seep water.	Implementability limited due to potential for fouling of reactive materials due to ionic waste constituent concentrations in groundwater.	Treatability study would be necessary.	High capital Medium O&M	Retained for limited use for isolated seeps.
Ex situ treatment	Biological/Physical	Constructed treatment wetland	Engineered wetlands developed specifically to treat contaminants in water.	Implementable	Effective for treating VOC. Pilot study may be required to demonstrate effectiveness.	Medium capital Low O&M	Retained
	Physical/Chemical	Willis-Semet Groundwater Treatment Plant (GWTP)*	Treatment of collected seep water at the Willis-Semet GWTP.	Implementable	Effective for treating Site CPOIs.	Medium capital Low O&M	Retained

Notes:
* - Representative process option
CPOI - Chemical Parameter of Interest
NCP - National Oil and Hazardous Substances Contingency Plan
NMC - Ninemile Creek
O&M - Operation and Maintenance
PVC - Polyvinyl Chloride
VOC - Volatile Organic Compounds

Table 3. Screening of remedial technologies and process options for shoreline Solvay waste.

GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY	PROCESS OPTION	DESCRIPTION	IMPLEMENTABILITY	EFFECTIVENESS	RELATIVE COST	RETAINED OR NOT RETAINED FOR FURTHER CONSIDERATION
No Action	None	No action	No action	Implementable	Not effective in mitigating potential for erosion of shoreline Solvay waste.	No capital No O&M	Required for consideration by the NCP.
Stabilization	Shallow sloped shoreline area stabilization	On-shore revetment at toe of slope	Stone facing placed at the surf zone (water's edge) to prevent wind and wave action erosion.	Implementable	Effective for controlling erosion caused by wind and waves along shoreline.	Medium capital Low O&M	Retained
		Graded gravel*	Installation of graded gravel within the surf zone to stabilize the substrate. Includes varied grades of stone over the surf zone (smaller stone in the core and largest stone on the exterior).	Implementable	Effective for controlling erosion caused by wind and waves along shoreline.	Low capital Low O&M	Retained
		Offshore breakwater	Small structures placed offshore to reduce the intensity of wave action on inshore waters. Structures may include boulder clusters and biologs.	Implementable	Effective for controlling erosion caused by wind and waves along shoreline.	Low capital Low O&M	Retained
		Live fascines*	Bundles of live woody vegetation/live staking/branch layering along the shoreline in trenches. These would develop root mass that hold soil in place and protect the shoreline.	Implementable	Effective for erosion control and slope stabilization.	Medium capital Low O&M	Retained
		Soil amendment	Soil amendments are materials that are added to soil to improve its physical, chemical or biological properties to provide conditions necessary to support vegetation. Soil amendments would support vegetation to protect the soil from erosion.	Implementable	Effective for erosion control and slope stabilization.	Low capital No O&M	Retained
	Steep embankment area stabilization	Regrade slope material	Regrade steep sloped shore to result in shallower slope for shoreline. May require shoreline armor to prevent regraded slopes from being undermined.	Implementable. Care would need to be taken to avoid damage to existing berms.	Would increase slope stability. Current calculations show existing slopes to be stable (exclusive of undermining)	Low capital Medium O&M	Retained
		Cellular confinement	Cellular confinement systems consist of solid, textured, or perforated cell walls made of polyethylene or similar materials. The cells are backfilled with soil or rock and may be vegetated. The cellular confinement system provides frictional interlock between cell walls and concrete, stone, or vegetative infill materials while significantly improving surface slope stability and drainage characteristics.	Implementable	Effective for erosion control. Limited to surface soil stabilization.	Medium capital Medium O&M	Retained
		On-shore revetment	Embankment constructed along the shoreline within Onondaga Lake with revetment (stone facing) placed on the lake side of the embankment.	Implementable	Stone placed at toe of slope would act as a buttress and increase slope stability. Stone would also prevent erosion and undermining due to wave action.	Medium capital Low O&M	Retained
		Live crib wall*	Installation of crib wall, wherein the chambers are made of interlocking untreated timber or logs, and backfilled and vegetated.	Implementable	Provides effective erosion protection of steep banks and helps to establish vegetation.	Medium capital Low O&M	Retained
		Cantilever sheet pile retaining wall	Installation of sheet piles in a row to form a sheet pile wall. Slope above the wall to be regraded.	Implementable. Not conducive to habitat improvement.	Effective for controlling wave action erosion and associated undermining. Also effective at slope stabilization.	High capital Low O&M	Not Retained
		Soldier beam and lagging	Installation of vertical wide flanged steel members with horizontal timber lagging.	Implementable. Not conducive to habitat improvement.	Effective for controlling wave action erosion and associated undermining.	High capital Low O&M	Not Retained
		Gabions	Installation and assembly of wire mesh baskets filled with stone. Voids may be filled with soil to allow establishment of vegetation. Following installation of gabions, slope can be regraded above the gabions.	Implementable	Effective for controlling wave action erosion and associated undermining. Also effective at slope stabilization.	High capital Low O&M	Retained
		Reinforced earth wall	Wall built in layers with a facing, geosynthetic reinforcement, and compacted backfill.	Implementable. Not conducive to habitat improvement.	Effective for controlling wave action erosion and associated undermining.	High capital Medium O&M	Not Retained

Table 3. Screening of remedial technologies and process options for shoreline Solvay waste.

GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY	PROCESS OPTION	DESCRIPTION	IMPLEMENTABILITY	EFFECTIVENESS	RELATIVE COST	RETAINED OR NOT RETAINED FOR FURTHER CONSIDERATION
Stabilization	Steep embankment area stabilization	Steel mesh and gunnite	Placement of steel mesh over slope, and treated with spray-applied gunnite to protect slope from erosion.	Implementable. Not conducive to habitat improvement.	Effective for controlling wave action erosion and associated undermining. Also effective at slope stabilization.	Medium capital Low O&M	Not Retained
		Soil nails	Near horizontal holes drilled into slope with steel tendons inserted and then grouted in place. Soil nailswould be installed in a grid pattern into the side of the slope. A wire mesh and soil system or shotcrete could be installed over the face.	Dependent on compatibility with on-site soils.	Effective for erosion control and slope stabilization. Not effective at minimizing erosion and undermining due to wave action.	Medium capital Low/Medium O&M	Not Retained
Containment	Vegetative Cover	Vegetative cover*	Use of vegetated soil cover to minimize erosion of eastern shore Solvay waste.	Implementable	Effective means of minimizing erosion of eastern shore Solvay waste.	Low capital. Low O&M	Retained
		Evapotranspiration cover	Use of evapotranspiration cover to minimize erosion of, and limit infiltration of surface water into eastern shore Solvay waste. Vegetation and soil cover thickness would be selected to promote evapotranspiration.	Implementable	Effective means of minimizing erosion of and infiltration into eastern shore Solvay waste.	Medium capital. Low O&M	Retained
		Low permeability vegetative cover*	Use of low permeability vegetative cover to minimize erosion of and/or limit infiltration of surface water into eastern shore Solvay waste. Low permeability cover components may consist of low permeability clay or a geomembrane system to limit infiltration of surface water.	Implementable	Effective means of minimizing erosion of and infiltration into eastern shore Solvay waste.	High capital. Medium O&M	Retained
Removal	Excavation	Mechanical excavation*	Use of construction equipment (e.g., land-side excavators) to remove eastern shore Solvay waste.	Implementable. Care would need to be taken to avoid damage to existing berms. Additional geotechnical stability evaluation would be necessary during design to evaluate shoring needs.	Effective for removing shoreline Solvay waste.	High capital No O&M	Retained
	Dredging	Mechanical/hydraulic dredging	Use of dredging equipment to remove submerged eastern shore Solvay waste.	Implementable for near shore, submerged Solvay waste. Implementability limited to small areas due to need for potentially extensive in-lake dredging to approach shoreline. Additional geotechnical stability evaluation would be necessary during design to evaluate shoring needs.	Effective for removing Solvay waste.	Medium capital. No O&M	Retained
Placement	On-site placement	Mechanical relocation of material*	Use of construction equipment to move Solvay waste to another location on Site.	Implementable	Effective for relocating excavated Solvay waste.	Low capital No O&M	Retained
Disposal	Offsite disposal	Disposal at a commercial facility*	Disposal at a commercial facility.	Implementable	Effective	High capital No O&M	Retained

Notes:
* - Representative process option
O&M - Operation and Maintenance
NCP - National Oil and Hazardous Substances Contingency Plan

Table 4. Screening of remedial technologies and process options for Ditch A (upper and lower reach).

GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY	PROCESS OPTION	DESCRIPTION	IMPLEMENTABILITY	EFFECTIVENESS	RELATIVE COST	RETAINED OR NOT RETAINED FOR FURTHER CONSIDERATION
No Action	None	No action	No action	Implementable	Not effective .	No capital No O&M	Required for consideration by the NCP.
Containment	Habitat layer and isolation cap (lower reach of Ditch A)	Sub-aqueous cap	Multi-layered cap composed of sand, gravel and stone.	Implementable	Effective at mitigating potential erosion of Ditch A substrate and direct contact with Solvay waste substrate.	Medium capital Low O&M	Retained
		Low permeability habitat cover*	Installation of a geomembrane-based cover that would form a barrier between Ditch A water and the underlying Solvay waste substrate. A habitat layer would be installed over the geomembrane.	Implementable	Effective at mitigating potential erosion of Ditch A substrate and direct contact with Solvay waste substrate.	Low capital Low O&M	Retained
		Clay cap	Installation of a low permeability clay cover that would form a barrier between Ditch A water and the underlying Solvay waste substrate.	Implementable	Effective at mitigating potential erosion of Ditch A substrate and direct contact with Solvay waste substrate.	Medium capital Low O&M	Retained
	Pipe rehabilitation (upper reach of Ditch A)	Slip lining*	Rehabilitation of the existing pipe with a new fiberglass/plastic pipe liner or cured-in-place liner to address seep or groundwater infiltration.	Implementable	Effective at mitigating potential seep or groundwater infiltration/inflow into the existing pipe.	Medium capital Low O&M	Retained
Removal	Excavation (lower reach of Ditch A)	Mechanical excavation*	Use of construction equipment to excavate Solvay waste substrate.	Implementable	Effective for removing Solvay waste substrate.	Medium capital Low O&M	Retained
Placement	On-site placement (lower reach of Ditch A)	Mechanical relocation of material*	Use of construction equipment to move Solvay waste to another location on Site.	Implementable	Effective at relocating excavated material.	Low capital Low O&M	Retained
Disposal	Off-site disposal (lower reach of Ditch A)	Disposal at a commercial facility	Disposal at a commercial facility.	Implementable	Effective	High capital No O&M	Retained

Notes:
* - Representative process option
O&M - Operation and Maintenance
NCP - National Oil and Hazardous Substances Contingency Plan

Table 5. Interim remedial alternatives summary.

Areas and Media Addressed	Interim Remedial Alternatives			
	1 – No action	**2 – Low Permeability Vegetative Cover and Inland Groundwater Collection**	**3 – Vegetative Cover and Lakeshore Groundwater Collection**	**4 – Excavation and Groundwater Collection**

NMC shoreline (seeps):	• No action	• Hydraulic control of seep water along the NMC shoreline
		  • Collection trench along NMC shoreline
		• Treatment of collected water at Willis-Semet GWTP
			• Hydraulic control of seep water along the NMC shoreline
			  • Collection trench along NMC shoreline
			• Treatment of collected water at Willis-Semet GWTP
				• Hydraulic control of seep water along the NMC shoreline
				  • Collection trench along NMC shoreline
				• Treatment of collected water at Willis-Semet GWTP

Northern Onondaga Lake shoreline (NMCSG groundwater, seeps, shoreline Solvay waste):	• No action	• Shoreline stabilization along SMU-4 (graded gravel with live fascines)
		• Steep embankment area stabilization SMU-3/-4 (vegetated crib walls)
		• Hydraulic control of seep water along SMU-4
		  • Control of pipe seeps along SMU-4 shoreline (plugging)
		  • Collection of selected ground seeps along SMU-4 shoreline (collection/pumping to eastern shore system)
		• NMCSG unit groundwater recovery (recovery well/pumping to eastern shore system)
		• Treatment of collected water at Willis-Semet GWTP
			• Shoreline stabilization along SMU-4 (graded gravel with live fascines)
			• Shoreline steep embankment area stabilization SMU-3/-4 (vegetated crib walls)
			• Hydraulic control of seep water along SMU-4
			  • Control of pipe seeps along SMU-4 shoreline (plugging)
			  • Collection of selected ground seeps along SMU-4 shoreline (collection/pumping to eastern shore system)
			• NMCSG unit groundwater recovery (recovery well/pumping to eastern shore system)
			• Treatment of collected water at Willis-Semet GWTP
				• Shoreline stabilization along SMU-4 (graded gravel with live fascines)
				• Steep embankment area stabilization SMU-3/-4 (vegetated crib walls)
				• Hydraulic control of seep water along SMU-4
				  • Control of pipe seeps along SMU-4 shoreline (plugging)
				  • Collection of selected ground seeps along SMU-4 shoreline (collection/pumping to eastern shore system)
				• NMCSG unit groundwater recovery (recovery well/pumping to eastern shore system)
				• Treatment of collected water at Willis-Semet GWTP

Eastern Onondaga Lake shoreline (shallow/ intermediate groundwater, seeps, Solvay waste):	• No action	• Hydraulic control of shallow and intermediate groundwater along the eastern shoreline
		  • 16 ft deep collection trench with passive wells along 370 ft elevation contour
		• Hydraulic control of seep water along the eastern shoreline
		  • Seep collection integrated with groundwater collection trench along eastern shoreline
		• Treatment of collected water at Willis-Semet GWTP
		• 16.7 acre low permeability vegetative cover
			• Hydraulic control of shallow and intermediate groundwater along the eastern shoreline
			  • 8 ft deep collection trench with passive wells along lakeshore alignment
			• Hydraulic control of seep water along the eastern shoreline
			  • 4 ft deep seep collection trench installed at 370 ft alignment
			• Treatment of collected water at Willis-Semet GWTP
			• 14.4 acre vegetative cover
				• Hydraulic control of shallow and intermediate groundwater along the eastern shoreline
				  • 12 ft deep collection trench with passive wells along 370 ft elevation contour
				• Hydraulic control of seep water along the eastern shoreline
				  • Seep collection integrated with groundwater collection trench along eastern shoreline
				• Treatment of collected water at Willis-Semet GWTP
				• Removal of 27 acres (440,000 CY) of Solvay Waste outboard of collection trench
				• Disposal of excavated Solvay waste on site and off site
				• Installation of 27 acre isolation/habitat layer in footprint of excavation

Upper Reach Ditch A (NMC discharge) (seep infiltration)	• No action	• Rehabilitation of Ditch A pipe discharge to NMC	• Rehabilitation of Ditch A pipe discharge to NMC	• Rehabilitation of Ditch A pipe discharge to NMC
Lower Reach Ditch A (Onondaga Lake discharge) (sediment and surface water):	• No action	• Hydraulic control of shallow groundwater along Ditch A near Onondaga Lake end *(eastern shoreline collection trench)* • Removal of lower reach of Ditch A Solvay waste substrate by excavation • Placement of a low permeability habitat cover for the lower reach of Ditch A • On-site placement of excavated Solvay waste substrate.	• Hydraulic control of shallow groundwater along Ditch A near Onondaga Lake end *(eastern shoreline collection trench)* • Removal of lower reach of Ditch A Solvay waste substrate by excavation • Placement of a low permeability habitat cover for the lower reach of Ditch A • On-site placement of excavated Solvay waste substrate.	• Hydraulic control of shallow groundwater along Ditch A near Onondaga Lake end *(eastern shoreline collection trench)* • Removal of lower reach of Ditch A Solvay waste substrate by excavation • Placement of a low permeability habitat cover for the lower reach of Ditch A • On-site placement of excavated Solvay waste substrate.

Notes: cy – Cubic Yards NMCSG – Ninemile Creek Sand and Gravel SMU – Sediment Management Unit
NMC – Ninemile Creek GWTP – Groundwater Treatment Plant

Table 6. Detailed evaluation of IRM alternatives

Criterion	Alternative 1 - No Action	Alternative 2 - Low Permeability Vegetated Cover and Inland Groundwater Collection	Alternative 3 - Vegetated Cover and Lakeshore Groundwater Collection	Alternative 4 - Excavation and Groundwater Collection
	• No action	**• Hydraulic control of shallow groundwater and seep water along the eastern shoreline (inland alignment) and NMC** **• Hydraulic control of groundwater in the former NMCSG unit** **• Limited Solvay waste substrate removal/habitat layer and isolation cap for the lower reach of Ditch A** **• Pipe rehabilitation of the upper reach of Ditch A** **• Shoreline stabilization of Solvay waste along northern shorelines** **• Treatment of collected groundwater and seeps** **• Installation of low permeability vegetative cover (16.7 acres) for eastern shore**	**• Hydraulic control of shallow groundwater and seep water along the eastern shoreline (lakeshore alignment) and Ninemile Creek (NMC)** **• Hydraulic control of groundwater in the former NMC Sand and Gravel (NMCSG) unit** **• Limited Solvay waste substrate removal/habitat layer and isolation cap for the lower reach of Ditch A** **• Pipe rehabilitation of the upper reach of Ditch A** **• Shoreline stabilization of Solvay waste along northern shorelines** **• Treatment of collected groundwater and seeps** **• Installation of vegetative cover (14.4 acres) for eastern shore**	**• Hydraulic control of shallow groundwater and seep water along the eastern shoreline (inland alignment) and NMC** **• Hydraulic control of groundwater in the former NMCSG unit** **• Limited Solvay waste substrate removal/habitat layer and isolation cap for the lower reach of Ditch A** **• Pipe rehabilitation of the upper reach of Ditch A** **• Shoreline stabilization of Solvay waste along northern shorelines** **• Treatment of collected groundwater and seeps** **• Excavation of Solvay waste outboard of the collection trench** **• Disposal on site and off site**
Overall protection of human health and the environment				
Overall protection of human health	Not protective of human health.	Protection of human health would be provided through mitigation of seep water and groundwater (eastern shallow/intermediate groundwater and NMCSG groundwater) discharge to Onondaga Lake and NMC; mitigation of erosion of eastern shore Solvay waste; removal and cover of Solvay waste in the lower reach of Ditch A; and pipe rehabilitation at the upper reach of Ditch A. The low permeability vegetative cover over the 16.7 acres of eastern shoreline area outboard of the collection trench would also provide protection from risks direct contact with Solvay waste along the eastern shore.	Protection of human health would be provided through mitigation of seep water and groundwater (eastern shallow/intermediate groundwater and NMCSG groundwater) discharge to Onondaga Lake and NMC; mitigation of erosion of eastern shore Solvay waste; removal and cover of Solvay waste in the lower reach of Ditch A; and pipe rehabilitation at the upper reach of Ditch A. The vegetative cover over the 14.4 acres of eastern shoreline area outboard of the collection trench would also provide protection from risks direct contact with Solvay waste along the eastern shore.	Protection of human health would be provided through mitigation of seep water and groundwater (eastern shallow/intermediate groundwater and NMCSG groundwater) discharge to Onondaga Lake and NMC; mitigation of erosion of surf zone Solvay waste; removal/cover of Solvay waste substrate in the lower reach of Ditch A; pipe rehabilitation for the upper reach of Ditch A; and removal of Solvay waste along the eastern shoreline.
Overall protection of the environment	Not protective of the environment.	Protection of the environment would be provided through mitigation of seep water and groundwater (eastern shallow/intermediate groundwater and NMCSG groundwater) discharge to Onondaga Lake and NMC; mitigation of erosion of surf zone and eastern shore Solvay waste; Solvay waste substrate removal/low permeability habitat cover of the lower reach of Ditch A; and pipe rehabilitation at the upper reach of Ditch A. The low permeability vegetative cover over the 16.7 acres of eastern shoreline area outboard of the collection trench would provide protection from risks associated with surface water erosion of the Solvay waste along the eastern shore.	Protection of the environment would be provided through mitigation of seep water and groundwater discharge (eastern shallow/intermediate groundwater and NMCSG groundwater) to Onondaga Lake and NMC; mitigation of erosion of surf zone and eastern shore Solvay waste; Solvay waste substrate removal/low permeability habitat cover of the lower reach of Ditch A; and pipe rehabilitation at the upper reach of Ditch A. The vegetative cover over the 14.4 acres of eastern shoreline area inboard of the collection trench would provide protection of the environment from impacts associated with surface water erosion of the Solvay waste at the eastern shore.	Protection of the environment would be provided through mitigation of seep water and groundwater (eastern shallow/intermediate groundwater and NMCSG groundwater) discharge to Onondaga Lake and NMC; mitigation of erosion of surf zone Solvay waste; Solvay waste substrate removal/low permeability habitat cover of the lower reach of Ditch A; pipe rehabilitation for the upper reach of Ditch A; and removal of Solvay waste along the eastern shoreline.
Compliance with applicable, relevant and appropriate requirements (ARARs) and to be considered material (TBCs)				
Compliance with chemical-specific ARARs and TBCs	Attainment of groundwater standards would not be likely.	Groundwater ARARs for groundwater (eastern shallow/intermediate groundwater and NMCSG groundwater) and seeps would be addressed through groundwater hydraulic control. Sediment TBCs for lower reach of Ditch A would be addressed by Solvay waste substrate removal and containment actions. Surface water ARARs for the lower reach of Ditch A would be addressed by containment and hydraulic control of site groundwater. Installation of the low permeability vegetative cover over 16.7 acres of Solvay waste would address soil ARARs by minimizing the potential for erosion of Solvay waste.	Groundwater ARARs for groundwater (eastern shoreline shallow/intermediate groundwater and NMCSG groundwater) and seeps would be addressed through groundwater hydraulic control. Sediment TBCs for the lower reach of Ditch A would be addressed by Solvay waste substrate removal and containment actions. Surface water ARARs for the lower reach of Ditch A would be addressed by containment and hydraulic control of groundwater. Installation of the vegetative cover over 14.4 acres of Solvay waste would address soil ARARs by minimizing the potential for erosion of Solvay waste.	Groundwater ARARs for groundwater (eastern shallow/intermediate groundwater and NMCSG groundwater) and seeps would be addressed through groundwater hydraulic control. Sediment TBCs for lower reach of Ditch A would be addressed by Solvay waste substrate removal and containment actions. Surface water ARARs for the lower reach of Ditch A would be addressed by containment and hydraulic control of site groundwater. Removal of 27 acres (440,000 CY) of Solvay waste would address soil ARARs.
Compliance with location-specific ARARs and TBCs	No location-specific ARARs triggered.	Proposed actions would be conducted in a manner consistent with federal and state floodplain and wetland requirements. Activities would also be conducted consistent with federal and state requirements for cultural, archeological, and historical resources.	Proposed actions would be conducted in a manner consistent with federal and state floodplain and wetland requirements. Activities would also be conducted consistent with federal and state requirements for cultural, archeological, and historical resources.	Proposed actions would be conducted in a manner consistent with federal and state floodplain and wetland requirements. Activities would also be conducted consistent with federal and state requirements for cultural, archeological, and historical resources.
Compliance with action-specific ARARs and TBCs	No actions.	Proposed actions would be conducted in a manner consistent with Fish and Wildlife Coordination Act requirements for protection of Onondaga Lake, NMC and Ditch A. Excavation activities would be conducted consistent with air quality standards. Federal guidance for sediment management/remediation would be considered. Site construction activities would be conducted in accordance with OSHA safety requirements.	Proposed actions would be conducted in a manner consistent with Fish and Wildlife Coordination Act requirements for protection of Onondaga Lake, NMC and Ditch A. Excavation activities would be conducted consistent with air quality standards. Federal guidance for sediment management/remediation would be considered. Site construction activities would be conducted in accordance with OSHA safety requirements.	Proposed actions would be conducted in a manner consistent with Fish and Wildlife Coordination Act requirements for protection of Onondaga Lake, NMC and Ditch A. Excavation activities would be conducted consistent with air quality standards. Federal guidance for sediment management/remediation would be considered. Site construction activities would be conducted in accordance with OSHA safety requirements. Off-site disposal would be subject to solid waste landfill regulations.
Long-term effectiveness and permanence				
Magnitude of residual risk	The effectiveness of the Onondaga Lake and NMC OU-2 remedies would not be supported by a no action alternative.	The effectiveness of the Onondaga Lake and NMC OU-2 remedies are supported through hydraulic control and treatment of eastern shoreline and NMCSG unit shallow/intermediate groundwater; hydraulic control of seeps; shoreline stabilization along Onondaga Lake shore; Solvay waste substrate removal/low permeability habitat cover in the lower reach of Ditch A; pipe rehabilitation for the upper reach of Ditch A; and placement of a low permeability vegetative cover for the eastern shore. The resulting residual risk magnitude would be minimal.	The effectiveness of the Onondaga Lake and NMC OU-2 remedies are supported through hydraulic control and treatment of eastern shoreline shallow/intermediate groundwater and NMCSG unit groundwater; hydraulic control of seeps; shoreline stabilization along the surf zone of Onondaga Lake shore; Solvay waste substrate removal/low permeability habitat cover in the lower reach of Ditch A; pipe rehabilitation for the upper reach of Ditch A; and placement of a vegetative cover for the eastern shore. The resulting residual risk magnitude would be minimal.	The effectiveness of the Onondaga Lake and NMC OU-2 remedies are supported through hydraulic control and treatment of eastern shoreline shallow/intermediate groundwater and NMCSG unit groundwater; hydraulic control of seeps; shoreline stabilization along the surf zone of the Onondaga Lake shore; and Solvay waste substrate removal//low permeability habitat cover in the lower reach of Ditch A; pipe rehabilitation for the upper reach of Ditch A; and Solvay waste removal along the eastern shore. The resulting residual risk magnitude would be minimal.
Adequacy and reliability of controls	No controls are included in this alternative.	Hydraulic control and treatment of eastern shoreline and NMCSG unit groundwater, hydraulic control of seeps, shoreline stabilization along the surf zone of the Onondaga Lake shoreline, Solvay waste substrate removal/low permeability habitat cover in the lower reach of Ditch A, and pipe rehabilitation for the upper reach of Ditch A would be adequate and reliable controls to effectively the effectiveness of the Onondaga Lake and NMC OU-2 remedies. Placement of low permeability vegetative cover would be an effective and reliable means of limiting erosion of Solvay waste.	Hydraulic control and treatment of eastern shoreline, and NMCSG unit groundwater, hydraulic control of seeps, shoreline stabilization along the surf zone of the Onondaga Lake shoreline, Solvay waste substrate removal/low permeability habitat cover in the lower reach of Ditch A, and pipe rehabilitation for the upper reach of Ditch A would be adequate and reliable controls to support the effectiveness of the Onondaga Lake and NMC OU-2 remedies. Placement of a vegetated cover would be an effective and reliable means of limiting erosion of Solvay waste.	Hydraulic control and treatment of eastern shoreline and NMCSG unit groundwater, hydraulic control of seeps, shoreline stabilization along the surf zone of the Onondaga Lake shoreline, excavation/removal of waste, Solvay waste substrate removal/low permeability habitat cover associated in the lower reach of Ditch A, and pipe rehabilitation for the upper reach of Ditch A would be adequate and reliable controls to effectively support the Onondaga Lake and NMC OU-2 remedies. Removal of Solvay waste along the eastern shore would be a reliable means of mitigating erosion of Solvay waste.
Reduction of toxicity, mobility, or volume through treatment				
Treatment process used and materials treated	No treatment processes are used in this alternative.	Groundwater (eastern shoreline shallow/intermediate groundwater and NMCSG groundwater) and seep water collected as part of this IRM would be treated off site at the Willis/Semet GWTP.	Groundwater (eastern shoreline shallow/intermediate groundwater and NMCSG groundwater) and seep water collected as part of this IRM would be treated off site at the Willis/Semet GWTP.	Groundwater (eastern shoreline shallow/intermediate groundwater and NMCSG groundwater) and seep water collected as part of this IRM would be treated off site at the Willis/Semet GWTP.

Table 6. Detailed evaluation of IRM alternatives

Criterion	Alternative 1 - No Action	Alternative 2 - Low Permeability Vegetated Cover and Inland Groundwater Collection	Alternative 3 - Vegetated Cover and Lakeshore Groundwater Collection	Alternative 4 - Excavation and Groundwater Collection
	• No action	**• Hydraulic control of shallow groundwater and seep water along the eastern shoreline (inland alignment) and NMC** **• Hydraulic control of groundwater in the former NMCSG unit** **• Limited Solvay waste substrate removal/habitat layer and isolation cap for the lower reach of Ditch A** **• Pipe rehabilitation of the upper reach of Ditch A** **• Shoreline stabilization of Solvay waste along northern shorelines** **• Treatment of collected groundwater and seeps** **• Installation of low permeability vegetative cover (16.7 acres) for eastern shore**	**• Hydraulic control of shallow groundwater and seep water along the eastern shoreline (lakeshore alignment) and Ninemile Creek (NMC)** **• Hydraulic control of groundwater in the former NMC Sand and Gravel (NMCSG) unit** **• Limited Solvay waste substrate removal/habitat layer and isolation cap for the lower reach of Ditch A** **• Pipe rehabilitation of the upper reach of Ditch A** **• Shoreline stabilization of Solvay waste along northern shorelines** **• Treatment of collected groundwater and seeps** **• Installation of vegetative cover (14.4 acres) for eastern shore**	**• Hydraulic control of shallow groundwater and seep water along the eastern shoreline (inland alignment) and NMC** **• Hydraulic control of groundwater in the former NMCSG unit** **• Limited Solvay waste substrate removal/habitat layer and isolation cap for the lower reach of Ditch A** **• Pipe rehabilitation of the upper reach of Ditch A** **• Shoreline stabilization of Solvay waste along northern shorelines** **• Treatment of collected groundwater and seeps** **• Excavation of Solvay waste outboard of the collection trench** **• Disposal on site and off site**
Amount of hazardous material destroyed or treated	No treatment processes or removal are used in this alternative.	It is anticipated that the following flows will be collected by the proposed alternative: - Groundwater and seep water from the eastern shoreline: 42 gpm - Seep water from the northern shoreline seep collection: 5 gpm - Groundwater and seep water from (NMCSG unit): 7 gpm - Seep water from the NMC shores: 12 gpm	It is anticipated that the following flows will be collected by the proposed alternative: - Groundwater and seep water from the eastern shoreline: 42 gpm - Seep water from the northern shoreline seep collection: 5 gpm - Groundwater and seep water from (NMCSG unit): 7 gpm - Seep water from the NMC shores: 12 gpm	It is anticipated that the following flows will be collected by the proposed alternative: - Groundwater and seep water from the eastern shoreline: 42 gpm - Seep water from the northern shoreline seep collection: 5 gpm - Groundwater and seep water from (NMCSG unit): 7 gpm - Seep water from the NMC shores: 12 gpm
Degree of expected reduction in toxicity, mobility, or volume	No treatment processes or removal are used in this alternative.	The toxicity and mobility of CPOIs in groundwater and seep water would be reduced by treatment. The mobility of Solvay waste would be reduced by shoreline stabilization and the low permeability vegetative cover. Approximately 350 cubic yards of Solvay waste substrate would be removed from Ditch A and a habitat layer and isolation cap would be installed.	The toxicity and mobility of CPOIs in groundwater and seep water would be reduced by treatment. The mobility of Solvay waste would be reduced by shoreline stabilization and the vegetative cover. Approximately 350 cubic yards of Solvay waste substrate would be removed from Ditch A and a habitat layer and isolation cap would be installed.	The toxicity and mobility of CPOIs in groundwater and seep water would be reduced by treatment. The mobility of Solvay waste would be reduced by shoreline stabilization. Toxicity, mobility and volume would be reduced by excavation of approximately 440,000 cubic yards of Solvay waste from the eastern shore. Approximately 350 cubic yards of Solvay waste substrate would be removed from Ditch A and a habitat layer and isolation
Degree to which treatment is irreversible	No treatment processes are used in this alternative.	Treatment of groundwater and seep water would be irreversible.	Treatment of groundwater and seep water would be irreversible.	Treatment of groundwater and seep water would be irreversible.
Type and quantity of residuals remaining after treatment	No treatment processes or removal are used in this alternative.	Treatment residuals including precipitates and spent carbon would be anticipated related to groundwater and seep water treatment.	Treatment residuals including precipitates and spent carbon would be anticipated related to groundwater and seep water treatment.	Treatment residuals including precipitates and spent carbon would be anticipated related to groundwater and seep water treatment.
Short-term effectiveness				
Protection of community during remedial actions	No active components are related to this alternative.	Dust and volatile emissions, if any, would be controlled during construction/excavation activities.	Dust and volatile emissions, if any, would be controlled during construction/excavation activities.	Dust and volatile emissions, if any, would be controlled during construction/excavation activities. Safety of the public would be maintained during transportation of excavated shoreline Solvay waste to the selected off-site disposal facility.
Protection of workers during remedial actions	No active components are related to this alternative.	Proper health and safety measures would be established and implemented during remedial activities, and would be effective in protecting workers from exposure to contaminants.	Proper health and safety measures would be established and implemented during remedial activities, and would be effective in protecting workers from exposure to contaminants.	Proper health and safety measures would be established and implemented during remedial activities, and would be effective in protecting workers from exposure to contaminants.
Environmental impacts	No active components are related to this alternative.	Dust, volatile emissions, surface runoff controls, and sediment control measures would be instituted to minimize impacts to the environment during implementation of this alternative. IRM would result in enhancements to existing habitats.	Dust, volatile emissions, surface runoff controls, and sediment control measures would be instituted to minimize impacts to the environment during implementation of this alternative. IRM would result in enhancements to existing habitats.	Dust, volatile emissions, surface runoff controls, and sediment control measures would be instituted to minimize impacts to the environment during implementation of this alternative. IRM would result in enhancements to existing habitats. It is anticipated that Alternative 4 would be more energy-intensive than Alternatives 2 and 3 due to the extensive earth moving activities and waste transportation.
Time until remedial action objectives are achieved	Remedial action objectives would not be met with this alternative.	Remedial action objectives would be achieved upon completion of the IRM. The IRM is anticipated to be completed in two construction seasons.	Remedial action objectives would be achieved upon completion of the IRM. The IRM is anticipated to be completed in two construction seasons.	Remedial action objectives would be achieved upon completion of the IRM. The IRM is anticipated to be constructed in eight construction seasons.
Implementability				
Ability to construct and operate the technology	There are no technologies to be constructed in this alternative.	Groundwater and seep collection trench with passive wells for the eastern shoreline, groundwater hydraulic control system for NMCSG unit and seep collection trench along NMC are readily constructible technologies. Periodic maintenance would be anticipated to maintain hydraulic control systems operation. Shoreline stabilization technologies, Solvay waste substrate removal/low permeability habitat cover technologies, and pipe rehabilitation are readily constructible.	Groundwater and seep collection trench with passive wells for the eastern shoreline, groundwater hydraulic control system for NMCSG unit and seep collection trench along NMC are readily constructible technologies. Periodic maintenance would be anticipated to maintain hydraulic control systems operation. Shoreline stabilization technologies, Solvay waste substrate removal/low permeability habitat cover technologies, and pipe rehabilitation are readily constructible.	Groundwater and seep recovery trench with passive wells for the eastern shoreline, groundwater hydraulic control system for NMCSG unit and seep recovery trench along NMC are readily constructible technologies. Periodic maintenance would be anticipated to maintain hydraulic control systems operation. Shoreline stabilization technologies, Solvay waste substrate removal/low permeability habitat cover technologies, and pipe rehabilitation are readily constructible. Construction constraints would be expected with regard to excavation of 27 acres of Solvay waste down to an average depth of 15 ft as it pertains to groundwater and lake water infiltration (and resulting construction water management).
Reliability of technology	There are no technologies to be constructed in this alternative.	Hydraulic control and subsequent treatment of groundwater and seep water for the eastern shoreline, NMC, and the NMCSG unit are reliable technologies for groundwater and seep water control. Shoreline stabilization measures for shoreline Solvay waste are reliable technologies to mitigate erosion. Solvay waste substrate removal/low permeability habitat cover in Ditch A are reliable technologies to address Solvay waste substrate impacts. Low permeability vegetative cover is a reliable technology to address erosion of Solvay waste at the eastern shore. These technologies provide a reliable means of supporting the effectiveness of the Onondaga Lake and NMC OU-2 remedies.	Hydraulic control and subsequent treatment of groundwater and seep water for the eastern shoreline, NMC, and the NMCSG unit are reliable technologies for groundwater and seep water control. Shoreline stabilization measures for surf zone Solvay waste are reliable technologies to mitigate erosion. Solvay waste substrate removal/low permeability habitat cover in Ditch A are reliable technologies to address Solvay waste substrate impacts. A vegetative cover is a reliable technology to address erosion of Solvay waste at the eastern shore. These technologies provide a reliable means of supporting the effectiveness of the Onondaga Lake and NMC OU-2 remedies.	Hydraulic control and subsequent treatment of groundwater and seep water for the eastern shoreline, NMC, and the NMCSG unit are reliable technologies for groundwater and seep water control. Shoreline stabilization measures for surf zone Solvay waste are reliable technologies to mitigate erosion. Solvay waste substrate removal/low permeability habitat cover in Ditch A are reliable technologies to address Solvay waste substrate impacts. Excavation/removal of Solvay waste outboard of the collection trench is a reliable technology to address erosion of Solvay waste at the eastern shoreline. These technologies provide a reliable means of supporting the effectiveness of the Onondaga Lake and NMC OU-2 remedies.
Ease of undertaking additional remedial actions, if necessary	Additional remedial actions, if necessary, would be readily implementable.	Additional remedial actions, if necessary, may be implementable.	Additional remedial actions, if necessary, may be implementable.	Additional remedial actions, if necessary, may be implementable.
Ability to monitor effectiveness of remedy	Remedy effectiveness could be monitored with periodic site inspection.	Effectiveness of remedy could be monitored through inspection of Ditch A and stabilization measures; observation and monitoring of recovered groundwater within the trenches; and inspection and maintenance of the cover.	Effectiveness of the remedy could be monitored through inspection of Ditch A and stabilization measures; observation and monitoring of recovered groundwater within the trenches; and inspection and maintenance of the cover.	Effectiveness of remedy could be monitored through inspection of Ditch A and stabilization measures, and observation and monitoring of recovered groundwater within the trenches.
Coordination with other agencies and property owners	None required.	Coordination with other agencies including USEPA, Onondaga County, and the Town of Geddes would be necessary.	Coordination with other agencies including USEPA, Onondaga County, and the Town of Geddes would be necessary.	Coordination with other agencies including USEPA, Onondaga County, and the Town of Geddes would be necessary.
Availability of off-site treatment storage and	None required.	Off-site treatment facilities are readily available.	Off-site treatment facilities are readily available.	Off-site treatment, storage and disposal facilities are readily available.
Availability of necessary equipment, specialists,	None required.	Equipment, specialist and materials are readily available.	Equipment, specialist and materials are readily available.	Equipment, specialist and materials are readily available.

Table 6. Detailed evaluation of IRM alternatives

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Costs				
Capital cost	$0	$17.5 Million	$17.1 Million	$106.8 Million
Present worth of operation and maintenance cost	$0	$6.1 Million	$6.7 Million	$6.2 Million
Approximate total net present worth cost	$0	$23.6 Million	$23.8 Million	$113 Million

Notes:

ARAR - Applicable or Relevant and Appropriate Requirement
CPOI - Chemical Parameter of Interest
CY - Cubic Yards
GPM - Gallons Per Minute
GWTP - Groundwater Treatment Plant
IRM - Interim Remedial Measure
NMC - Ninemile Creek
NMCSG - Ninemile Creek Sand and Gravel
OSHA - Occupational Safety and Health Administration
OU - Operable Unit
TBC - To Be Considered
USEPA - United States Environmental Protection Agency
YR - Year

Table 7. Evaluation of potential ARARs and TBCs

Medium/Location/ Action	Citation	Requirements	Comments	Potential ARAR	Potential TBC
Potential chemical-specific ARARs and TBCs					
Groundwater	6 NYCRR 700.1 - Definitions	Promulgated state regulation that provides groundwater definitions.	Fresh groundwater is defined as groundwater with a chloride concentration equal to or less than 250 mg/L, or a total dissolved solids concentration (TDS) equal to or less than 1,000 mg/L. Saline groundwater is defined as groundwater with a chloride concentration greater than 250 mg/l, or a TDS concentration greater than 1,000 mg/l.	Yes	No
	6 NYCRR 701 - Classifications - Surface Waters and Ground Waters	Promulgated state regulation that provides groundwater classifications.	6 NYCRR Part 701.15 states that Class GA groundwater is fresh groundwater, and the best use of Class GA groundwater is potable use. 6 NYCRR Part 701.16 states that Class GSA groundwater is saline groundwater, and the best use of Class GSA groundwater is as a source of potable mineral waters, conversion to fresh potable waters, or as raw material for the manufacture of sodium chloride or its derivatives or similar products. 6 NYCRR Part 701.18 states that the groundwater classifications defined in Sections 701.15 (Class GA fresh groundwaters) and 701.16 (Class GSA saline groundwaters) are assigned to all the groundwaters of New York State.	Yes	No
Shallow/Intermediate Groundwater	6 NYCRR Part 703 - Class GSA groundwater quality standards	Promulgated water quality standards for saline groundwater, consisting of narrative standards for taste-, color-, odor-producing, toxic, and other deleterious substances and thermal discharges.	Potentially applicable for saline groundwater.	Yes	No
	6 NYCRR Part 703 - Class GA groundwater quality standards	Promulgated water quality standards for fresh groundwater, including narrative and constituent-specific standards.	Potentially applicable for fresh groundwater.	Yes	No
	NYS TOGS 1.1.1 – Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations	Guidance that summarizes groundwater standards and guidance values. Guidance values are provided where standards are not available.	To be considered material for site groundwater.	No	Yes
	40 CFR Part 141 - Drinking Water Standards	Promulgated federal regulation that establishes primary drinking water regulations applicable to public water systems.	Not applicable, relevant or appropriate because site groundwater is not used as drinking water source, nor is it suitable for drinking water source.	No	No

Medium/Location/ Action	Citation	Requirements	Comments	Potential ARAR	Potential TBC
Potential chemical-specific ARARs and TBCs (continued)					
Soil	6 NYCRR Part 375-6 Remedial Program Soil Cleanup Objectives	Promulgated state regulation that provides guidance for soil cleanup objectives for various property uses.	Potentially applicable to site soil.	Yes	No
	NYSDEC TAGM HWR-94-4046 - Recommended soil cleanup objectives	Guidance that provides recommended soil cleanup objectives.	To be considered material for site soil constituents that are not addressed in 6 NYCRR Part 375.	No	Yes
	USEPA - Ecological Soil Screening Levels (Eco-SSL)	Guidance that provides soil screening numbers. Screening ecotoxicity values are derived to avoid underestimating risk.	To be considered material for site soil.	No	Yes
Sediment	NYSDEC Technical Guidance for Screening Contaminated Sediment (1999)	Guidance that provides methodology for establishing sediment criteria for the purpose of screening contaminated sediment. Provides sediment screening values for non-polar organics and metals. Screening values are not cleanup goals. Sediments defined as bottom materials of lakes [and ponds], rivers [and streams], bays, estuaries, and oceans.	To be considered material for Solvay waste substrate in the lower reach of Ditch A at the Site. **Note:** Sediments in Onondaga Lake and Ninemile Creek are being addressed in separate reports.	No	Yes
	Site-specific sediment effect concentration in Onondaga Lake. Onondaga Lake RI (TAMS, 2002)	Guidance on site-specific sediment effect concentrations and probable effect concentrations in Onondaga Lake.			
	USEPA Supplemental Guidance to RAGS: Region 4 Bulletins, Ecological Risk Assessment. Ecological Screening Values (2001)	Guidance documents and technical references presenting screening concentrations for sediment.	To be considered material for Solvay waste substrate in the lower reach of Ditch A at the Site. **Note:** Sediments in Onondaga Lake and Ninemile Creek are being addressed in separate reports.	No	Yes
	USEPA Ecotox Thresholds (1996)	Guidance document and technical reference presenting screening concentrations for sediment.			
	National Oceanic & Atmospheric Administration. Screening Quick Reference Tables (SQuiRTs; 1999)	Guidance document and technical reference presenting screening concentrations for sediment.			
	Handbook of Chemical Risk Assessment; Health Hazards to Humans, Plants, and Animals:A33 Volumes 1 (Metals) and 2 (Organics) (Eisler 2000)	Guidance document and technical reference presenting screening concentrations for sediment.			
	Contaminated Sediment Remediation Guidance for Hazardous Waste Sites (OSWER Directive 9355.9-85; 2005)	Federal guidance document that provides technical and policy guidance for addressing contaminated sediment, including wetland sediment.			

Medium/Location/ Action	Citation	Requirements	Comments	Potential ARAR	Potential TBC
Potential chemical-specific ARARs and TBCs (continued)					
Sediment (cont.)	Principles for Managing Contaminated Sediment Risks at Hazardous Waste Sites (OSWER Directive 9285.6-08l 2002)	Federal guidance that presents risk management principles that site managers should consider when making risk management decisions at contaminated sediment sites.	To be considered material for Solvay waste substrate in the lower reach of Ditch A at the Site. **Note**: Sediments in Onondaga Lake and Ninemile Creek are being addressed in separate reports.	No	Yes
	Contaminated Sediment Strategy (EPA-823-R-98-001; 1998)	Unpromulgated federal document that establishes an Agency-wide strategy for contaminated sediment.			
Great Lakes Drainage Basin	40 CFR 132 - Water Quality Guidance For The Great Lakes System	Promulgated federal regulation that provides Water Quality Guidance for the Great Lakes System. The Guidance in this part identifies minimum water quality standards, antidegradation policies, and implementation procedures for the Great Lakes System to protect human health, aquatic life, and wildlife. Criteria are provided for several constituents for the various states in the Great Lakes System (Great Lakes Drainage Basin). For New York State, the chronic water quality criteria and values for the protection of aquatic life, or site-specific modifications thereof, shall apply, and the criterion for mercury.	Not considered TBC material since Ditch A is an intermittent stormwater drainage feature. **Note**: Surface water and sediment in Onondaga Lake and Ninemile Creek are being addressed in separate reports.	No	No
Potential location-specific ARARs and TBCs					
Great Lakes Drainage Basin (cont.)	USEPA - Final Water Quality Guidance for the Great Lakes System (March 23, 1995)	Guidance document providing water quality criteria for 29 pollutants to protect aquatic life, wildlife, and human health; methodologies to develop criteria for additional pollutants; implementation procedures to develop more consistent, enforceable water quality-based effluent limits in discharge permits; total maximum daily loads of pollutants that can be allowed to reach the Lakes and their tributaries; and antidegradation policies and procedures.	Not considered TBC material since Ditch A is an intermittent stormwater drainage feature. **Note**: Surface water and sediment in Onondaga Lake and Ninemile Creek are being addressed in separate reports.	No	Yes
Wetlands	6 NYCRR 663 - Freshwater wetland permit requirements	Actions occurring in a designated freshwater wetland (within 100 ft) must be approved by NYSDEC or its designee. Activities occurring adjacent to freshwater wetlands must: be compatible with preservation, protection, and conservation of wetlands and benefits; result in no more than insubstantial degradation to or loss of any part of the wetland; and be compatible with public health and welfare.	Substantive requirements are potentially applicable for activities being implemented within delineated wetlands at the site.	Yes	No
	Clean Water Act Section 404 33 CFR Parts 320 - 330	Regulatory policies and permit requirements for work affecting waters of the United States, including wetlands.	Substantive requirements are potentially applicable for activities being implemented within water bodies and delineated wetlands at the site.	Yes	No
	Clean Water Act Section 404 40 CFR Parts 230-231	Provides for restoration and maintenance of integrity of waters of the United States, including wetlands, through the control of dredged or fill material discharge.	Potentially applicable for activities being implemented within water bodies and delineated wetlands at the site.	Yes	No
	Executive Order 11990 - Protection of Wetlands	Executive order requires federal agencies to avoid, to the extent possible, the long- and short-term adverse impacts associated with the destruction or loss of wetlands if a practical alternative exists.	Potentially applicable for activities being implemented within delineated wetlands at the site.	Yes	No

Medium/Location/ Action	Citation	Requirements	Comments	Potential ARAR	Potential TBC
Potential location-specific ARARs and TBCs (continued)					
Wetlands & Floodplains	Policy on Flood Plains and Wetland Assessments for CERCLA Actions (OSWER Directive 9280.0-02)	Federal guidance that provides requirements for wetlands and floodplain assessments.	To be considered material for wetland and floodplain assessment at the site.	No	Yes
Floodplains	6 NYCRR 373-2.2 - Location standards for hazardous waste treatment, storage, and disposal facilities -100-yr floodplain	Hazardous waste treatment, storage, or disposal facilities located in a 100-yr floodplain must be designed, constructed, operated and maintained to prevent washout of hazardous waste during a 100-yr flood.	Not applicable or relevant and appropriate. No hazardous waste treatment, storage, or disposal facilities are planned to be located on site.	No	No
	40 CFR Part 264.18(b) - Location Standards - Floodplains	Hazardous waste treatment, storage, or disposal facilities located in a 100-yr floodplain must be designed, constructed, operated and maintained to prevent washout of hazardous waste during a 100-yr flood.	Not applicable or relevant and appropriate. No hazardous waste treatment, storage, or disposal facilities are planned to be located on site.	No	No
	Executive Order 11988 - Floodplain Management	USEPA is required to conduct activities to avoid, to the extent possible, the long- and short- term adverse impacts associated with the occupation or modification of floodplains. The procedures also require USEPA to avoid direct or indirect support of floodplain development wherever there are practicable alternatives and minimize potential harm to floodplains when there are no practicable alternatives.	Potentially applicable as site is located in the 100-year floodplain. 100-year floodplain present on the northwestern tip of the site adjacent to Ninemile Creek and general lakeshore area immediately adjacent to Onondaga Lake.	Yes	No
	6 NYCRR 500 - Floodplain Management Regulations Development Permits	Promulgated state regulations providing permit requirements for development in areas of special flood hazard (floodplain within a community subject to a one percent or greater chance of flooding in any given year).	Substantive permit requirements are potentially applicable to construction activities within the 100-year floodplain. 100-year floodplain present on the northwestern tip of the site adjacent to Ninemile Creek and general lakeshore area immediately adjacent to Onondaga Lake.	Yes	No
Within 61 meters (200 ft) of a fault displaced in Holocene time	40 CFR Part 264.18(a) - Location Standards - Seismic considerations	New treatment, storage, or disposal of hazardous waste is not allowed.	Not applicable or relevant and appropriate. No hazardous waste treatment, storage, or disposal facilities are planned to be located on site. Site is not located within 200 ft of a fault displaced in Holocene time, as listed in 40 CFR 264	No	No
Within salt dome or bed formation, underground mine, or cave	40 CFR Part 264.18 (c) - Location standards; salt dome formations, salt bed formations, underground mines and caves.	Placement of non-containerized or bulk liquid hazardous waste is not allowed.	Not applicable or relevant and appropriate. No bulk liquid hazardous waste is planned to be located on site. No salt dome formations, salt bed formations, underground mines or caves present at site.	No	No
Habitat of an endangered or threatened species	6 NYCRR 182	Promulgated state regulation that provides requirements to minimize damage to habitat of an endangered species.	Not applicable or relevant and appropriate, unless endangered or threatened wildlife species, rare plants or significant habitats be identified at the site. **Note:** not anticipated to be present based on research performed on nearby Semet Site.	No	No

Medium/Location/ Action	Citation	Requirements	Comments	Potential ARAR	Potential TBC
Potential location-specific ARARs and TBCs (continued)					
Habitat of an endangered or threatened species (cont.)	Endangered Species Act	Provides a means for conserving various species of fish, wildlife, and plants that are threatened with extinction.	Not applicable or relevant and appropriate, unless endangered or threatened wildlife species, rare plants or significant habitats be identified at the site. **Note:** not anticipated to be present based on research performed for Semet Site, where USFWS indicated that no federally listed or proposed endangered or threatened species exist within two miles of that site. One threatened plant within 2 miles of site on north shore of Onondaga Lake not anticipated to be impacted by site activities.	No	No
	50 CFR Part 17 - Endangered and Threatened Wildlife and Plants and 50CFR Part 402 - Interagency Cooperation	Promulgated federal regulation that requires that federal agencies ensure authorized, funded, or executed actions will not destroy or have adverse modification of critical habitat.	Not applicable or relevant and appropriate, unless endangered or threatened wildlife species, rare plants or significant habitats be identified at the site. **Note:** not anticipated to be present based on research performed for Semet Site, where USFWS indicated that no federally listed or proposed endangered or threatened species exist within two miles of that site. One threatened plant within 2 miles of that site on north shore of Onondaga Lake not anticipated to be impacted by activities at this Site.	No	No
Historical property or district	National Historic Preservation Act 36 CFR 800- Preservation of Historic Properties Owned by a Federal Agency	Remedial actions are required to account for the effects of remedial activities on any historic properties included on or eligible for inclusion on the National Register of Historic Places.	Potentially applicable. A draft Phase 1 assessment identified the potential for prehistoric and historic resources in and in the vicinity of the Site.	Yes	No
	National Historic Preservation Act 36 CFR Part 65 - National Historic Landmarks Program	Promulgated federal regulation requiring that actions must be taken to preserve and recover historical/archeological artifacts found.	Potentially applicable. A draft Phase 1 assessment identified the potential for prehistoric and historic resources in and in the vicinity of the Site.	Yes	No
	New York State Historic Preservation Act of 1980 9 NYCRR Parts 426 - 428	State law and regulations requiring the protection of historic, architectural, archeological and cultural property.	Potentially applicable. A draft Phase 1 assessment identified the potential for prehistoric and historic resources in and in the vicinity of the Site.	Yes	No
Wilderness area	Wilderness Act +A1650 CFR Part 35 - Wilderness Preservation and Management	Provides for protection of federally-owned designated wilderness areas.	Not applicable or relevant and appropriate. Site not located in wilderness area.	No	No
Wild, scenic, or recreational river	Wild and Scenic Rivers Act	Provides for protection of areas specified as wild, scenic, or recreational.	Not applicable or relevant and appropriate. Site not located near wild, scenic or recreational river.	No	No
Coastal zone	Coastal Zone Management Act	Requires activities be conducted consistent with approved State management programs.	Not applicable or relevant and appropriate. Site not located in coastal zone.	No	No
Coastal barrier	Coastal Barrier Resources Act	Prohibits any new Federal expenditure within the Coastal Barrier Resource System.	Not applicable or relevant and appropriate. Site not located in coastal barrier.	No	No

Medium/Location/ Action	Citation	Requirements	Comments	Potential ARAR	Potential TBC
Potential location-specific ARARs and TBCs (continued)					
Protection of waters	33 U.S.C. 1341 - Clean Water Act Section 401, State Water Quality Certification Program	States have the authority to veto or place conditions on federally permitted activities that may result in water pollution.	Potentially applicable to site.	Yes	No
Potential action-specific ARARs and TBCs					
Modifications in/near waterbody	6 NYCRR 608 - Use and Protection Of Waters	Promulgated state regulation that provides requirements for the disturbance of protected (classified) streams. Provides restrictions on excavation and placement of fill in navigable waters.	Substantive, non-administrative requirements potentially applicable to work affecting Onondaga Lake. **Note:** Surface water in Onondaga Lake and Ninemile Creek are being addressed in separate reports.	Yes	No
	16 USC 661 - Fish and Wildlife Coordination Act	Requires protection of fish and wildlife in a stream when performing activities that modify a stream or river.	Potentially relevant or appropriate for actions in the vicinity of NMC and Onondaga Lake.	Yes	No
Construction in wetlands	33 CFR Parts 330 - Nationwide Permit Program	Promulgated federal regulation related to permitting of activities involving filling of wetlands.	Substantive requirements applicable, relevant or appropriate for wetlands at the site. **Note:** a Wetland Delineation Report has been submitted for this site that indicates 0.7 acres of wetlands are present at the site.	Yes	No
Sediment actions	Contaminated Sediment Remediation Guidance for Hazardous Waste Sites (OSWER Directive 9355.9-85; 2005)	Federal guidance document that provides technical and policy guidance for addressing contaminated sediment, including wetland sediment.	Potential TBC for sediment actions at the Site.	No	Yes
	Principles for Managing Contaminated Sediment Risks at Hazardous Waste Sites (OSWER Directive 9285.6-08l 2002)	Federal guidance that presents risk management principles that site managers should consider when making risk management decisions at contaminated sediment sites.			
	Contaminated Sediment Strategy (EPA-823-R-98-001; 1998)	Unpromulgated federal document that establishes an Agency-wide strategy for contaminated sediment.			
Landfilling of solid wastes	40 CFR Part 257 - Criteria for Classification of Solid Waste Disposal Facilities and Practices	Promulgated federal regulation that provides criteria for solid waste disposal facilities to protect health and the environment.	Landfilling of wastes may be applicable for the site.	Yes	No
Generation and management of solid waste	6 NYCRR 360 - Solid Waste Management Facilities	Promulgated state regulation that provides requirements for management of solid wastes, including disposal and closure of disposal facilities.	Potentially applicable to alternatives including disposal of residuals generated by treatment processes.	Yes	No
Land disposal	6 NYCRR 376 - Land Disposal Restrictions	Promulgated federal and state regulations that provide treatment standards to be met prior to land disposal of hazardous wastes.	No hazardous waste anticipated at the site.	No	No
	40 CFR Part 268 - Land Disposal Restrictions				
	62 CFR 25997 - Phase IV Supplemental Proposal on Land Disposal of Mineral Processing Wastes				
General excavation	6 NYCRR 257 - Air Quality Standards	Promulgated state regulation that provides specific limits on generation of SO_2, particulates, CO_2, photochemical oxidants, hydrocarbons (non-methane), NO_2, fluorides, beryllium and H2S from point sources.	No air emissions sources anticipated as part of IRM alternatives.	No	No
	40 CFR Part 50.1 - 50.12 - National Ambient Air Quality Standards	Promulgated federal regulation that provides air quality standards for pollutants considered harmful to public health and the environment. The six principle pollutants are carbon monoxide, lead, nitrogen dioxide, particulates, ozone, and sulfur oxides.	Potentially applicable to IRM alternatives during which dust generation may result, such as during earth moving, grading, and excavation.	Yes	No

Medium/Location/ Action	Citation	Requirements	Comments	Potential ARAR	Potential TBC
Potential action-specific ARARs and TBCs (continued)					
General excavation (cont.)	NYS TAGM 4031 - Dust Suppressing and Particle Monitoring at Inactive Hazardous Waste Disposal Sites	State guidance document that provides limitations on dust emissions.	To be considered material where more stringent than air-related ARARs.	No	Yes
Construction	29 CFR Part 1910.120 - Occupational Safety and Health Standards - Hazardous Waste Operations and Emergency Response	Promulgated federal regulation requiring that remedial activities must be in accordance with applicable OSHA requirements.	Potentially applicable for construction activities.	Yes	No
	29 CFR Part 1926 - Safety and Health Regulations for Construction	Promulgated federal regulation requiring that remedial construction activities must be in accordance with applicable OSHA requirements.	Potentially applicable for construction activities.	Yes	No
Transportation	6 NYCRR 364 - Waste Transporter Permits	Promulgated state regulation requiring that hazardous waste transport must be conducted by a hauler permitted under 6 NYCRR 364.	No hazardous waste anticipated at the site.	No	No
	49 CFR 107, 171-174 and 177-179 - Department of Transportation Regulations	Promulgated federal regulation requiring that hazardous waste transport to offsite disposal facilities must be conducted in accordance with applicable DOT requirements.	No hazardous waste anticipated at the site.	No	No

Notes:
ARAR – Applicable or Relevant and Appropriate Requirement
CERCLA – Comprehensive Environmental Response, Compensation and Liability Act
CFR – Code of Federal Regulations
DOT – Department of Transportation
Eco-SSL – Ecological Soil Screening Levels
FS – Feasibility Study
FT – Feet or Foot
HWR – Hazardous Waste Regulations
IRM – Interim Remedial Measure
NCP – National Oil and Hazardous Substances Contingency Plan
NRWQC – National Recommended Water Quality Criteria
NYCRR – New York Code of Rules and Regulations
NYSDEC – New York State Department of Environmental Conservation
OSHA – Occupational Safety and Health Administration
OSWER - Office of Solid Waste and Emergency Response
RAGS – Risk Assessment Guidance for Superfund
RI – Remedial Investigation
SPDES – State Pollutant Discharge Elimination System
SQuiRTs – Screening Quick Reference Tables
SVOCs – Semi-Volatile Organic Compounds
TAGM – Technical and Administrative Guidance Memorandum
TAMS – TAMS Consultants, Inc.
TBC – To Be Considered
TDS – Total Dissolved Solids
TOGS – Technical and Operational Guidance Series
USC – United States Code
Agency
USFWS – Unites States Fish and Wildlife Service

Table 8
Wastebeds 1-8 Focused Feasibility Study
Alternative 1

No Action

	QTY	UNIT	UNIT COST	TOTAL COST	Notes
DIRECT CAPITAL CONSTRUCTION COSTS					
TOTAL DIRECT CAPITAL COST				**0**	
Indirect Costs			**18%**	**0**	
Engineering/Design/Oversight			**11%**	**0**	
Contingency			**20%**	**0**	
TOTAL ALTERNATIVE CAPITAL COST				**0**	
OPERATION AND MAINTENANCE COSTS					
TOTAL ANNUAL O&M COST (rounded)				**$0**	
TOTAL PERIODIC O&M COST (rounded)				**$0**	

Present Worth Analysis (Years 1-5)

Cost Type	**Total Cost**	**DF (7%)**	**Cost Per Yr**	**Present Value**
Capital Cost - Year 0	$0	1.000	$0	$0
Annual O&M - Years 1-5	$0	4.100	$0	$0
Periodic Costs - 5 yr	$0	0.713	$0	$0
TOTAL PROJECT PRESENT WORTH (rounded)				**$0**

Notes
1) DF = Discount Factor

Table 9
Wastebeds 1-8 Focused Feasibility Study
Alternative 2

Low Permeability Vegetated Cover and
Inland Collection System

	QTY	UNIT	UNIT COST	TOTAL COST	Notes
DIRECT CAPITAL CONSTRUCTION COSTS[1]					
Eastern Shoreline Groundwater and Seep Collection					
General Conditions, Surveys, & Permits	8	mo	$2,080	$16,640	Trailer, electrical and maintenance
Surveys, & Permits	1	ls	$6,000	$6,000	Applies to entire site
Clearing	8.0	ac	$4,900	$39,200	Clearing, grubbing and chipping
Erosion Control	15,840	lf	$2.00	$31,680	Double layer silt fence and hay bales
Install Construction Roadway (25-ft width)	7,000	lf	$140	$980,000	Gravel, geogrid, geocomp; 2-ft thick; partial removal
Install Eastern Shoreline Shallow/Intermediate Groundwater Collection					
Install Collection Trench (16-ft depth)	6,800	lf	$118	$802,400	4-ft wide; 6-inch slotted pipe and fittings
Install Manholes (19-ft depth)	32	ea	$8,800	$281,600	4-ft dia structure
Install Passive Wells (20-ft spacing)	12,580	vf	$22	$276,760	37-ft average depth; flushmount with box
Install seep collection apron (20-ft width)	84,000	sf	$2.30	$193,200	Stone, topsoil and geosynthetic; 2-ft thick
Hydroseeding (seep coll. apron area El. 370+)	84,000	sf	$0.12	$10,080	
Install Eastern Shoreline Pump Station					
Install wet well (23-ft depth)	1	ea	$239,700	$239,700	10-ft dia; inc sheeting for installation
Install Pre-cast pump station building	1	ea	$15,000	$15,000	Slab on grade; Inc. piping, fittings and valves
Install above-ground pumps	2	ea	$11,800	$23,600	
Install Pump Control	2	ea	$2,700	$5,400	
Electrical Service; connection and equipment	1	ls	$90,000	$90,000	
Electrical Service; conduit	500	lf	$46	$23,000	Excavation, backfill, conduit, hand holes and cable.
Install Transmission Force Main					
Install force main (4-ft depth)	4,200	lf	$85	$357,000	4-ft wide; 4-inch solid pipe; Inc discharge connection
Install clean outs	21	ea	$1,500	$31,500	200-ft spacing
Grading of trench spoils	16,771	cy	$6.00	$100,626	
Dewatering	75	day	$1,000	$75,000	Pumps, piping; temp. tanks; discharge to WS GWTP
Install Access Path; finish course (13-ft wide)	7,000	lf	$28	$196,000	Add/grade 1-ft material to roadway
			SUBTOTAL (rounded):	**$3,794,000**	
SMU 3/SMU 4 Shoreline Stabilization					
General Conditions	2	mo	$2,080	$4,160	Trailer, electrical and maintenance
Clearing	4.6	ac	$4,900	$22,540	Clearing, grubbing and chipping
Turbidity Curtain	3,580	lf	$35	$125,300	Low areas of SMU-4 and Crib Walls (SMU-3/-4)
Install Construction Roadway (13-ft width)	3,000	lf	$56	$168,000	Gravel, geogrid, geocomp; 2-ft thick
Place crib wall sub-base	965	cy	$55	$53,075	18-inch thick stone, geogrid; El. 364 top of sub-base
Install and back fill Crib walls	2,170	LF	$103	$223,510	Inc. topsoil backfill; 8-ft width 4-ft avg height
Plant crib wall vegetation	5,400	sf	$5.00	$27,000	As live branches
Install gravel toe protection (El. 360 to El. 362.5)	4,570	cy	$47	$214,790	6-inch thick; 130-ft x 1,900-lf
Install gravel toe protection (El. 362.5 to El. 365)	1,580	cy	$18	$28,440	12-inch thick; 30-ft x 1,420-lf
Install Live Stakes/Fascines/Bundles	1,420	lf	$24	$34,080	within gravel toe protection area (> El. 362.5)
			SUBTOTAL (rounded):	**$901,000**	
Ninemile Creek Seep Collection					
General Conditions	5	mo	$2,080	$10,400	Trailer, electrical and maintenance
Clearing	1.5	ac	$4,900	$7,350	Clearing, grubbing and chipping
Erosion Control	3,600	lf	$2.00	$7,200	Double layer silt fence and hay bales
Install NMC Seep Collection System					
Install Collection Trench (13-ft depth)	1,800	lf	$103	$185,400	6-inch slotted pipe and fittings
Install Manholes (13-ft depth)	5	ea	$6,300	$31,500	4-ft dia structure
Install Passive Wells (20-ft spacing)	3,100	vf	$22	$68,200	34-ft average depth; flushmount with box
Install Slope Seep Collection layer					
Place seep collection components and topsoil	60,600	sf	$2.80	$169,680	Geogrid, geonet and topsoil; 1-ft thick
Hydroseeding (slope area)	60,600	sf	$0.12	$7,272	
NMC Pump Station					
Install wet well (18-ft depth)	1	ea	$216,200	$216,200	10-ft dia; Inc sheeting for installation
Install Pre-cast pump station building	1	ea	$15,000	$15,000	Slab on grade; Inc. piping, fittings and valves
Install above-ground pumps	2	ea	$9,500	$19,000	
Install Pump Control	2	ea	$2,700	$5,400	Inc. above-ground controls enclosure
Electrical Service; connection and equipment	1	ls	$90,000	$90,000	
Electrical Service; conduit	7,000	lf	$46	$322,000	Excavation, backfill, conduit, hand holes and cable.

Table 9
Wastebeds 1-8 Focused Feasibility Study
Alternative 2

Low Permeability Vegetated Cover and
Inland Collection System

	QTY	UNIT	UNIT COST	TOTAL COST	Notes
Ninemile Creek Seep Collection (continued)					
Directional drill 2-inch HDPE discharge piping	2,700	lf	$70	$189,000	
Transport and Grading of trench spoils	3,689	cy	$20	$73,780	Handling on-site to eastern shoreline
Dewatering	20	day	$1,000	$20,000	Pumps, temp. tanks; discharge to WB-B system
			SUBTOTAL (rounded):	**$1,437,000**	
Ditch A Limited Containment /Ditch A Pipe Rehabilitation					
Lower Ditch A (Lake)					
Turbidity Curtain	200	lf	$35	$7,000	Across mouth of Ditch at Lake; double layer
Excavate existing sediment	350	cy	$74	$25,900	In the wet by landside equipment; 2-ft cut
Install LLDPE Liner and Sand Layer	4,610	sf	$3.40	$15,674	In the wet by landside equipment; 2-ft thick
Grading of excavated sediments	350	cy	$4.00	$1,400	
Upper Ditch A (NMC)					
Rehabilitation of Culvert by CIP Pipe	700	lf	$150	$105,000	Cleaning and Lining
			SUBTOTAL (rounded):	**$155,000**	
NMCSG Unit Groundwater Recovery/ North Shore Seep Collection					
Install NMCSG Unit Recovery Wells					
Install 4-inch diameter recovery well to 50-ft	5	ea	$33,300	$166,500	In. casing, screen, development, manhole and pump
Install 4-inch diameter recovery well to 75-ft	2	ea	$46,400	$92,800	In. casing, screen, development, manhole and pump
Install electrical service	400	lf	$46	$18,400	Exc., backfill, conduit, hand holes and cable.
Electrical Service; connection and equipment	1	ls	$7,000	$7,000	
Transport and Grading of trench spoils	1,068	cy	$20	$21,360	
Install North Shore Seep Collection					
Erosion Control	200	lf	$3.30	$660	Double layer silt fence and hay bales
Install Seep Collection Apron	390	cy	$46	$17,940	2.5 ft thick, 65-ft square; Inc. 6-inch slotted pipe
Install Manhole (6-ft depth)	1	ea	$3,150	$3,150	5-ft diameter
Install Pump and Controls	1	ea	$4,900	$4,900	Inc. above-ground controls enclosure
Install electrical service	4,150	lf	$46	$190,900	Excavation, backfill, conduit, hand holes and cable.
Electrical Service; connection and equipment	1	ls	2,000	$2,000	
Directional drill 2-inch HDPE discharge piping	1,800	lf	$70	$126,000	
Decommission Weir Box	9	ea	$15,000	$135,000	grout (by tremie) by track mounted drilling rig
			SUBTOTAL (rounded):	**$787,000**	*Utilizes SMU3/SMU4 const. roadways*
Eastern Shoreline Cover System (16.7 ac.; El. 365 to El. 370)					
General Conditions	10	mo	$2,080	$20,800	
Clearing	18.4	ac	$4,900	$90,160	Clearing, grubbing and chipping
Install Cover Base layer	26,946	cy	$29	$781,434	Stone; 1-ft thick
Install Cover liner	727,542	sf	$2.50	$1,818,855	Inc. geocomposite, LLDPE, geogrid, geocushion
Install Cover Vegetated layer	53,892	cy	$34	$1,832,328	Sand and topsoil, 2-ft thick
Hydroseeding	727,542	sf	$0.12	$87,305	
Live Plantings (10% cap area)	364	ea	$5.00	$1,819	1 planting/200 sf
			SUBTOTAL (rounded):	**4,633,000**	
TOTAL DIRECT CAPITAL COST (rounded)				**11,707,000**	
Indirect Costs			**18%**	**2,107,260**	
Engineering/Design/Oversight			**11%**	**1,287,770**	
Contingency			**20%**	**2,341,400**	
TOTAL ALTERNATIVE CAPITAL COST (rounded)				**17,443,000**	
OPERATION AND MAINTENANCE COSTS					
Annual Costs					
Inspection/Operation					
Site Inspection	96	hr	$100	$9,600	24 hrs x 2 Persons per 6 Months
Pump Station Operations/Oversight	1,040	hr	$50	$52,000	Assumes two persons 10 hours weekly.
Maintenance					
Cleaning of Eastern Shore Main Trench	28	da	$3,000	$84,000	Approx. 500-lf per day; 2x annually

Table 9
Wastebeds 1-8 Focused Feasibility Study
Alternative 2

Low Permeability Vegetated Cover and
Inland Collection System

	QTY	UNIT	UNIT COST	TOTAL COST	Notes
Annual Costs (continued)					
Cleaning of Northern Shore Seep Collection	2	da	$3,000	$6,000	Approx. 500-lf per day; 2x annually
Cleaning of NMC Seep Trench	8	da	$3,000	$24,000	Approx. 500-lf per day; 2x annually
Spot repair of vegetation	36,377	sf	$0.12	$4,365	5% of cover area annually
Power/Treatment Costs[2]					
Power for Eastern Shoreline PS	49,275	kwh	$0.046	$2,267	1 (3 HP) pump at 80% efficiency
Power for NMCSG Unit Recovery Wells	57,488	kwh	$0.046	$2,644	7 (0.5 HP) pumps at 80% efficiency
Power for North Shore PS	12,319	kwh	$0.046	$567	1 (0.75 HP) pump at 80% efficiency
Power for NMC Seep collection PS	24,638	kwh	$0.046	$1,133	1 (1.5 HP) pump at 80% efficiency
Operation of Willis-Semet GWTP (incremental cost)	37,843,200	gal	$0.0237	$896,884	Actual Cost Jan-April, 2009 (OMI by email 6-5-09)
Reporting	1	yr	$10,000	$10,000	Annual report
			SUBTOTAL (rounded):	**$1,093,000**	
Contingency			**20%**	**$218,600**	
Technical Support			**10%**	**$109,300**	
TOTAL ANNUAL O&M COST (rounded)				**$1,420,900**	
Periodic Costs (Year 5)					
Maintenance of Roadway; General	32,500	sy	$10.00	$325,000	Place and grade 6-inch resurface; 25% total area
			SUBTOTAL:	**$325,000**	
Contingency			**20%**	**$65,000**	
Technical Support			**10%**	**$32,500**	
TOTAL PERIODIC O&M COST (rounded)				**$422,500**	

Present Worth Analysis (Years 1-5)

Cost Type	**Total Cost**	**DF (7%)**	**Cost Per Yr**	**Present Value**
Capital Cost - Year 0	$17,443,000	1.000	$17,443,000	$17,443,000
Annual O&M - Years 1-5	$7,104,500	4.100	$1,420,900	$5,825,690
Periodic Costs - 5 yr	$422,500	0.713	$422,500	$301,243
TOTAL PROJECT PRESENT WORTH (rounded)				**$23,570,000**

Notes
1) "Install" costs include the costs to purchase and deliver materials, excavation, installation of materials and backfill as appropriate.
2) Pump power estimate doubled as an allotment for controls and misc. power consumption within the PS.
3) DF = Discount Factor
4) O&M Costs for this IRM are included for a 5-yr period. Costs for O&M of these components for years 6-30 will be included as part of the Sitewide FS
5) Manhole and Passive well depths are based on the proposed grade after capping (equal to 3-ft greater than existing grade)

Table 10
Wastebeds 1-8 Focused Feasibility Study
Alternative 3

Vegetated Cover and Lakeshore Groundwater Collection

	QTY	UNIT	UNIT COST	TOTAL COST	Notes
DIRECT CAPITAL CONSTRUCTION COSTS[1]					
Eastern Shoreline Groundwater and Seep Collection					
General Conditions, Surveys, & Permits	12	mo	$2,080	$24,960	Trailer, electrical and maintenance
Surveys, & Permits	1	ls	$6,000	$6,000	Applies to entire site
Clearing	16.6	ac	$4,900	$81,340	Clearing, grubbing and chipping
Erosion Control	15,840	lf	$2.00	$31,680	Double layer silt fence and hay bales
Install Construction Roadway (25-ft width)	14,700	lf	$140	$2,058,000	Gravel, geogrid, geocomp; 2-ft thick; partial removal
Install Eastern Shoreline Shallow/Intermediate Groundwater Collection					
Install Collection Trench (8-ft depth)	7,100	lf	$72	$511,200	4-ft wide; 6-inch slotted pipe and fittings
Install Manholes (11-ft depth)	36	ea	$4,700	$169,200	4-ft dia structure
Install Passive Wells (20-ft spacing)	13,135	vf	$22	$288,970	37-ft average depth; flushmount with box
Install Eastern Shoreline Seep Collection					
Install Collection Trench (4-ft depth)	4,200	lf	$63	$264,600	4-ft wide; 6-inch slotted pipe, fittings
Install Manholes (7-ft depth)	21	ea	$3,000	$63,000	4-ft dia structure
Install Conveyance Trench (6-ft depth average)	1,800	lf	$60	$108,000	4-ft wide; 6-inch solid pipe and fittings
Install seep collection apron (20-ft width)	84,000	sf	$2.30	$193,200	Stone, topsoil and geosynthetic; 2-ft thick
Hydroseeding (seep coll. apron area El. 370+)	84,000	sf	$0.12	$10,080	
Install Eastern Shoreline Pump Station					
Install wet well (18-ft depth)	1	ea	$216,200	$216,200	10-ft dia; inc sheeting for installation
Install Pre-cast pump station building	1	ea	$15,000	$15,000	Slab on grade; Inc. piping, fittings and valves
Install above-ground pumps	2	ea	$11,800	$23,600	
Install Pump Control	2	ea	$2,700	$5,400	
Electrical Service; connection and equipment	1	ls	$90,000	$90,000	
Electrical Service; conduit	500	lf	$46	$23,000	Excavation, backfill, conduit, hand holes and cable.
Install Transmission Force Main					
Install force main (4-ft depth)	4,200	lf	$85	$357,000	4-ft wide; 4-inch solid pipe; Inc discharge connection
Install clean outs	21	ea	$1,500	$31,500	200-ft spacing
Grading of trench spoils	16,771	cy	$6	$100,626	
Dewatering and treatment	100	day	$1,000	$100,000	Pumps, piping; temp. tanks; discharge to WS GWTP
Install Access Path (13-ft wide)	14,700	lf	$28	$411,600	Add/grade 1-ft material to roadway
		SUBTOTAL (rounded):		**$5,184,000**	
SMU 3/SMU 4 Shoreline Stabilization					
General Conditions	2	mo	$2,080	$4,160	Trailer, electrical and maintenance
Clearing	4.6	ac	$4,900	$22,540	Clearing, grubbing and chipping
Turbidity Curtain	3,580	lf	$35	$125,300	Low areas of SMU-4 and Crib Walls (SMU-3/-4)
Install Construction Roadway (13-ft width)	3,000	lf	$56	$168,000	Gravel, geogrid, geocomp; 2-ft thick
Place crib wall sub-base	965	cy	$55	$53,075	18-inch thick stone, geogrid; El. 364 top of sub-base
Install and back fill Crib walls	2,170	LF	$103	$223,510	Inc. topsoil backfill; 8-ft width 4-ft avg height
Plant crib wall vegetation	5,400	sf	$5.00	$27,000	As live branches
Install gravel toe protection (El. 360 to El. 362.5)	4,570	cy	$47	$214,790	6-inch thick; 130-ft x 1,900-lf
Install gravel toe protection (El. 362.5 to El. 365)	1,580	cy	$18	$28,440	12-inch thick; 30-ft x 1,420-lf
Install Live Stakes/Fascines/Bundles	1,420	lf	$24	$34,080	within gravel toe protection area (> El. 362.5)
		SUBTOTAL (rounded):		**$901,000**	
Ninemile Creek Seep Collection					
General Conditions	5	mo	$2,080	$10,400	Trailer, electrical and maintenance
Clearing	1.5	ac	$4,900	$7,350	Clearing, grubbing and chipping
Erosion Control	3,600	lf	$2.00	$7,200	Double layer silt fence and hay bales
Install NMC Seep Collection System					
Install Collection Trench (13-ft depth)	1,800	lf	$103	$185,400	6-inch slotted pipe and fittings
Install Manholes (13-ft depth)	5	ea	$6,300	$31,500	4-ft dia structure
Install Passive Wells (20-ft spacing)	3,100	vf	$22	$68,200	34-ft average depth; flushmount with box
Install Slope Seep Collection layer					
Place seep collection components and topsoil	60,600	sf	$2.80	$169,680	Geogrid, geonet and topsoil; 1-ft thick
Hydroseeding (slope area)	60,600	sf	$0.12	$7,272	
NMC Pump Station					
Install wet well (18-ft depth)	1	ea	$216,200	$216,200	10-ft dia; Inc sheeting for installation

Table 10
Wastebeds 1-8 Focused Feasibility Study
Alternative 3

Vegetated Cover and Lakeshore Groundwater Collection

	QTY	UNIT	UNIT COST	TOTAL COST	Notes
Ninemile Creek Seep Collection (continued)					
Install Pre-cast pump station building	1	ea	$15,000	$15,000	Slab on grade; Inc. piping, fittings and valves
Install above-ground pumps	2	ea	$9,500	$19,000	
Install Pump Control	2	ea	$2,700	$5,400	Inc. above-ground controls enclosure
Electrical Service; connection and equipment	1	ls	$90,000	$90,000	
Electrical Service; conduit	7,000	lf	$46	$322,000	Excavation, backfill, conduit, hand holes and cable.
Directional drill 2-inch HDPE discharge piping	2,700	lf	$70	$189,000	
Transport and Grading of trench spoils	3,689	cy	$20	$73,780	Handling on-site to eastern shoreline
Dewatering and treatment	20	day	$1,000	$20,000	Pumps, temp. tanks; discharge to WB-B system
		SUBTOTAL (rounded):		**$1,437,000**	
Ditch A Limited Containment /Ditch A Pipe Rehabilitation					
Lower Ditch A (Lake)					
Turbidity Curtain	200	lf	$35	$7,000	Across mouth of Ditch at Lake; double layer
Excavate existing sediment	350	cy	$74	$25,900	In the wet by landside equipment; 2-ft cut
Install LLDPE Liner and Sand Layer	4,610	sf	$3.40	$15,674	In the wet by landside equipment; 2-ft thick
Grading of excavated sediments	350	cy	$4.00	$1,400	
Upper Ditch A (NMC)					
Rehabilitation of Culvert by CIP Pipe	700	lf	$150	$105,000	Cleaning and Lining
		SUBTOTAL (rounded):		**$155,000**	
NMCSG Unit Groundwater Recovery/ North Shore Seep Collection					
Install NMCSG Unit Recovery Wells					
Install 4-inch diameter recovery well to 50-ft	5	ea	$33,300	$166,500	In. casing, screen, development, manhole and pump
Install 4-inch diameter recovery well to 75-ft	2	ea	$46,400	$92,800	In. casing, screen, development, manhole and pump
Install electrical service	400	lf	$46	$18,400	Exc., backfill, conduit, hand holes and cable.
Electrical Service; connection and equipment	1	ls	$7,000	$7,000	
Transport and Grading of trench spoils	1,068	cy	$20	$21,360	Handling on-site to eastern shoreline
Install North Shore Seep Collection					
Erosion Control	200	lf	$3.30	$660	Double layer silt fence and hay bales
Install Seep Collection Apron	390	cy	$46	$17,940	2.5 ft thick, 65-ft square; Inc. 6-inch slotted pipe
Install Manhole (6-ft depth)	1	ea	$3,150	$3,150	5-ft diameter
Install Pump and Controls	1	ea	$4,900	$4,900	Inc. above-ground controls enclosure
Install electrical service	4,150	lf	$46	$190,900	Excavation, backfill, conduit, hand holes and cable.
Electrical Service; connection and equipment	1	ls	2,000	$2,000	
Directional drill 2-inch HDPE discharge piping	1,800	lf	$70	$126,000	
Decommission Weir Box	9	ea	$15,000	$135,000	grout (by tremie) by track mounted drilling rig
		SUBTOTAL (rounded):		**$787,000**	*Utilizes SMU3/SMU4 const. roadways*
Eastern Shoreline Cover System (14.4 ac.; El. 365 to El. 370)					
General Conditions	10	mo	$2,080	$20,800	
Clearing	10	acre	$4,900	$48,020	Clearing, grubbing and chipping
Install Cover Base layer	23,233	cy	$29	$673,757	Stone; 1-ft thick
Install engineered components	627,300	sf	$1.00	$627,300	Inc. geocomposite, geogrid
Install Cover Vegetated layer	46,466	cy	$34	$1,579,844	Sand and topsoil, 2-ft thick
Hydroseeding	627,300	sf	$0.12	$75,276	
Live Plantings (10% cap area)	314	ea	$5.00	$1,568	1 planting/200 sf
		SUBTOTAL (rounded):		**$3,027,000**	
TOTAL DIRECT CAPITAL COST (rounded)				**11,491,000**	
Indirect Costs			**18%**	**2,068,380**	
Engineering/Design/Oversight			**11%**	**1,264,010**	
Contingency			**20%**	**2,298,200**	
TOTAL ALTERNATIVE CAPITAL COST (rounded)				**17,122,000**	

Table 10
Wastebeds 1-8 Focused Feasibility Study
Alternative 3

Vegetated Cover and Lakeshore Groundwater Collection

	QTY	UNIT	UNIT COST	TOTAL COST	Notes
OPERATION AND MAINTENANCE COSTS					
Annual Costs					
Inspection/Operation					
Site Inspection	96	mh	$100	$9,600	24 hrs x 2 Persons per 6 Months
Pump Station Operations/Oversight	1,040	mh	$50	$52,000	Assumes two persons 10 hours weekly.
Maintenance					
Cleaning of Eastern Shore Main Trench	30	day	$3,000	$90,000	Approx. 500-lf per day; 2x annually
Cleaning of Eastern Shore Seep Trench	18	day	$3,000	$54,000	Approx. 500-lf per day; 2x annually
Cleaning of Northern Shore Seep Collection	2	day	$3,000	$6,000	Approx. 500-lf per day; 2x annually
Cleaning of NMC Seep Trench	8	day	$3,000	$24,000	Approx. 500-lf per day; 2x annually
Spot repair of vegetation	31,365	sf	$0.12	$3,764	5% of cover area annually
Power/Treatment Costs[2]					
Power for Eastern Shoreline PS	49,275	kwh	$0.046	$2,267	1 (3 HP) pump at 80% efficiency
Power for NMCSG Unit Recovery Wells	57,488	kwh	$0.046	$2,644	7 (0.5 HP) pumps at 80% efficiency
Power for North Shore PS	12,319	kwh	$0.046	$567	1 (0.75 HP) pump at 80% efficiency
Power for NMC Seep collection PS	24,638	kwh	$0.046	$1,133	1 (1.5 HP) pump at 80% efficiency
Operation of Willis-Semet WWTP (incremental cost)	37,843,200	gal	$0.0237	$896,884	Actual Cost Jan-April, 2009 (OMI by email 6-5-09)
OPERATION AND MAINTENANCE COSTS (continued)					
Reporting	1	yr	$10,000	$10,000	Annual report
			SUBTOTAL (rounded):	**$1,153,000**	
Contingency			**20%**	**$230,600**	
Technical Support			**10%**	**$115,300**	
TOTAL ANNUAL O&M COST (rounded)				**$1,499,000**	
Periodic Costs (Year 5)					
Maintenance of Roadway; General	57,525	SY	$10.00	$575,250	Place and grade 6-inch resurface; 25% total area
			SUBTOTAL (rounded):	**$575,000**	
Contingency			**20%**	**$115,000**	As directed by NYSDEC (letter 11-6-09)
Technical Support			**10%**	**$57,500**	
TOTAL PERIODIC O&M COST (rounded)				**$748,000**	

Present Worth Analysis (Years 1-5)				
Cost Type	**Total Cost**	**DF (7%)**	**Cost Per Yr**	**Present Value**
Capital Cost - Year 0	$17,122,000	1.000	$17,122,000	$17,122,000
Annual O&M - Years 1-5	$7,495,000	4.100	$1,499,000	$6,145,900
Periodic Costs - 5 yr	$748,000	0.713	$748,000	$533,324
TOTAL PROJECT PRESENT WORTH (rounded)				**$23,801,000**

Notes
1) "Install" costs include the costs to purchase and deliver materials, excavation, installation of materials and backfill as appropriate.
2) Pump power estimate doubled as an allotment for controls and misc. power consumption within the PS.
3) DF = Discount Factor
4) O&M Costs for this IRM are included for a 5-yr period. Costs for O&M of these components for years 6-30 will be included as part of the Sitewide FS
5) Manhole and Passive well depths are based on the proposed grade after capping (equal to 3-ft greater than existing grade)

Table 11
Wastebeds 1-8 Focused Feasibility Study
Alternative 4

Excavation and Groundwater Collection

	QTY	UNIT	UNIT COST	TOTAL COST	Notes
DIRECT CAPITAL CONSTRUCTION COSTS[1]					
Eastern Shoreline Groundwater and Seep Collection					
General Conditions, Surveys, & Permits	8	mo	$2,080	$16,640	Trailer, electrical and maintenance
Surveys, & Permits	1	ls	$6,000	$6,000	Applies to entire site
Clearing	8.0	ac	$4,900	$39,200	Clearing, grubbing and chipping
Erosion Control	15,840	lf	$2.00	$31,680	Double layer silt fence and hay bales
Install Construction Roadway (25-ft width)	7,000	lf	$140	$980,000	Graded gravel, geogrid and fabric; 2-ft thick
Install Eastern Shoreline Shallow/Intermediate Groundwater Collection					
Install Collection Trench (12-ft depth)	6,800	lf	$90	$612,000	6-inch slotted pipe and fittings
Install Manholes (12-ft depth)	32	ea	$5,900	$188,800	4-ft dia structure
Install Passive Wells (20-ft spacing)	11,600	vf	$22	$255,200	34-ft average depth; flushmount with box
Install seep collection apron (20-ft width)	84,000	sf	$2.30	$193,200	Stone, topsoil and geosynthetic; 2-ft thick
Hydroseeding (seep coll. apron area El. 370+)	84,000	sf	$0.12	$10,080	
Install Eastern Shoreline Pump Station					
Install wet well (18-ft depth)	1	ea	$216,200	$216,200	10-ft dia; inc sheeting for installation
Install Pre-cast pump station building	1	ea	$15,000	$15,000	Slab on grade; Inc. piping, fittings and valves
Install above-ground pumps	2	ea	$11,800	$23,600	
Install Pump Control	2	ea	$2,700	$5,400	
Electrical Service; connection and equipment	1	ls	$90,000	$90,000	
Electrical Service; conduit	500	lf	$46	$23,000	Excavation, backfill, conduit, hand holes and cable.
Install Transmission Force Main					
Install force main (4-ft depth)	4,200	lf	$85	$357,000	4-ft wide; 4-inch solid pipe; Inc discharge connection
Install clean outs	21	ea	$1,500	$31,500	200-ft spacing
Grading of trench spoils	16,771	cy	$6.00	$100,626	
Dewatering	75	day	$1,000	$75,000	Pumps, piping; temp. tanks; discharge to WS GWTP
		SUBTOTAL (rounded):		**$3,270,000**	
SMU 3/SMU 4 Shoreline Stabilization					
General Conditions	2	mo	$2,080	$4,160	Trailer, electrical and maintenance
Clearing	4.6	ac	$4,900	$22,540	Clearing, grubbing and chipping
Turbidity Curtain	3,580	lf	$35	$125,300	Low areas of SMU-4 and Crib Walls (SMU-3/-4)
Install Construction Roadway (13-ft width)	3,000	lf	$56	$168,000	Gravel, geogrid, geocomp; 2-ft thick
Place crib wall sub-base	965	cy	$55	$53,075	18-inch thick stone, geogrid; El. 364 top of sub-base
Install and back fill Crib walls	2,170	lf	$103	$223,510	Inc. topsoil backfill; 8-ft width 4-ft avg height
Plant crib wall vegetation	5,400	sf	$5.00	$27,000	As live branches
Install gravel toe protection (El. 360 to El. 362.5)	4,570	cy	$47	$214,790	6-inch thick; 130-ft x 1,900-lf
Install gravel toe protection (El. 362.5 to El. 365)	1,580	cy	$18	$28,440	12-inch thick; 30-ft x 1,420-lf
Install Live Stakes/Fascines/Bundles	1,420	lf	$24	$34,080	within gravel toe protection area (> El. 362.5)
		SUBTOTAL (rounded):		**$901,000**	
Ninemile Creek Seep Collection					
General Conditions	5	mo	$2,080	$10,400	Trailer, electrical and maintenance
Clearing	1.5	acre	$4,900	$7,350	Clearing, grubbing and chipping
Erosion Control	3,600	lf	$2.00	$7,200	Double layer silt fence and hay bales
Install NMC Seep Collection System					
Install Collection Trench (13-ft depth)	1,800	lf	$103	$185,400	6-inch slotted pipe and fittings
Install Manholes (13-ft depth)	5	ea	$6,300	$31,500	4-ft dia structure
Install Passive Wells (20-ft spacing)	3,100	vf	$22	$68,200	34-ft average depth; flushmount with box
Install Slope Seep Collection layer					
Place seep collection components and topsoil	60,600	sf	$2.80	$169,680	Geogrid, geonet and topsoil; 1-ft thick
Hydroseeding (slope area)	60,600	sf	$0.12	$7,272	
NMC Pump Station					
Install wet well (18-ft depth)	1	ea	$216,200	$216,200	10-ft dia; Inc sheeting for installation
Install Pre-cast pump station building	1	ea	$15,000	$15,000	Slab on grade; Inc. piping, fittings and valves
Install above-ground pumps	2	ea	$9,500	$19,000	
Install Pump Control	2	ea	$2,700	$5,400	Inc. above-ground controls enclosure
Electrical Service; connection and equipment	1	ls	$90,000	$90,000	
Electrical Service; conduit	7,000	lf	$46	$322,000	Excavation, backfill, conduit, hand holes and cable.
Directional drill 2-inch HDPE discharge piping	2,700	lf	$70	$189,000	

Table 11
Wastebeds 1-8 Focused Feasibility Study
Alternative 4

Excavation and Groundwater Collection

	QTY	UNIT	UNIT COST	TOTAL COST	Notes
Ninemile Creek Seep Collection (continued)					
Transport and Grading of trench spoils	3,689	cy	$20	$73,780	Handling on-site to eastern shoreline
Dewatering	17	day	$1,000	$17,000	Pumps, temp. tanks; discharge to WB-B system
		SUBTOTAL (rounded):		**$1,434,000**	
Ditch A Limited Containment /Ditch A Pipe Rehabilitation					
Lower Ditch A (Lake)					
Turbidity Curtain	200	lf	$35.00	$7,000	Across mouth of Ditch at Lake; double layer
Excavate existing sediment	350	cy	$74	$25,900	In the wet by landside equipment; 2-ft cut
Install LLDPE Liner and Sand Layer	4,610	sf	$3.40	$15,674	In the wet by landside equipment; 2-ft thick
Grading of excavated sediments	350	cy	$4.00	$1,400	
Upper Ditch A (NMC)					
Rehabilitation of Culvert by CIP Pipe	700	lf	$150	$105,000	Cleaning and Lining
		SUBTOTAL (rounded):		**$155,000**	
NMCSG Unit Groundwater Recovery/ North Shore Seep Collection					
Install NMCSG Unit Recovery Wells					
Install 4-inch diameter recovery well to 50-ft	5	ea	$33,300	$166,500	In. casing, screen, development, manhole and pump
Install 4-inch diameter recovery well to 75-ft	2	ea	$46,400	$92,800	In. casing, screen, development, manhole and pump
Install electrical service	400	lf	$46	$18,400	Exc., backfill, conduit, hand holes and cable.
Electrical Service; connection and equipment	1	ls	$7,000	$7,000	
Transport and Grading of trench spoils	1,068	cy	$20	$21,360	
Install North Shore Seep Collection					
Erosion Control	200	lf	$3.30	$660	Double layer silt fence and hay bales
Install Seep Collection Apron	390	cy	$46	$17,940	2.5 ft thick, 65-ft square; Inc. 6-inch slotted pipe
Install Manhole (6-ft depth)	1	ea	$3,150	$3,150	5-ft diameter
Install Pump and Controls	1	ea	$4,900	$4,900	Inc. above-ground controls enclosure
Install electrical service	4,150	lf	$46	$190,900	Excavation, backfill, conduit, hand holes and cable.
Electrical Service; connection and equipment	1	ls	$2,000	$2,000	
Directional drill 2-inch HDPE discharge piping	1,800	lf	$70	$126,000	
Decommission Weir Box	9	ea	$15,000	$135,000	grout (by tremie) by track mounted drilling rig
		SUBTOTAL (rounded):		**$787,000**	*Utilizes SMU3/SMU4 const. roadways*
Eastern Shoreline Removal					
General Conditions	66	mo	$2,080	$137,280	
Install Temporary Storage Area (10 ac)					
Clearing storage area	10.0	ac	$4,906	$49,056	
Install working platform	10.0	ac	$100,000	$1,000,000	1-ft thick sand with geotextile and geogrid
Temporary Geotextile Cover	435,600.0	sf	$0.50	$217,800	2 layers geotextile
Remove Eastern Shoreline Material					
Clearing balance of Eastern Shoreline	18.4	ac	$4,906	$90,264	Clearing, grubbing and chipping
Install Sheetpiling	612,000	sf	$42	$25,704,000	Cut off at new mudline
Dewatering (pumps, tankage and trucking)	1,460	day	$2,000	$2,920,000	
Excavate existing Solvay Waste	439,464	cy	$13	$5,713,032	In the dry
Transport/Place at temporary storage On-site	149,418	cy	$25	$3,735,450	
Transportation to Off-site Disposal	290,046	cy	$75	$21,753,450	Disposed as Non-Hazardous material
Place In-lake cover	111,800	cy	$36	$4,024,800	3.5-ft sand, 0.67-ft stone; conforms to prop. lake cover
		SUBTOTAL (rounded):		**65,345,000**	
TOTAL DIRECT CAPITAL COST (rounded)				**71,737,000**	
Indirect Costs			**18%**	**12,912,660**	
Engineering/Design/Oversight			**11%**	**7,891,070**	
Contingency			**20%**	**14,347,400**	
TOTAL ALTERNATIVE CAPITAL COST (rounded)				**106,888,000**	

Table 11
Wastebeds 1-8 Focused Feasibility Study
Alternative 4

Excavation and Groundwater Collection

	QTY	UNIT	UNIT COST	TOTAL COST	Notes
OPERATION AND MAINTENANCE COSTS					
Annual Costs					
Inspection/Operation					
Site Inspection	96	mh	$100	$9,600	24 hrs x 2 Persons per 6 Months
Pump Station Operations/Oversight	1,040	mh	$50	$52,000	Assumes two persons 10 hours weekly.
Maintenance					
Cleaning of Eastern Shore Main Trench	28	da	$3,000	$84,000	Approx. 500-lf per day; 2x annually
Cleaning of Northern Shore Seep Collection	2	da	$3,000	$6,000	Approx. 500-lf per day; 2x annually
Cleaning of NMC Seep Trench	8	da	$3,000	$24,000	Approx. 500-lf per day; 2x annually
Power/Treatment Costs[2]					
Power for Eastern Shoreline PS	49,275	KWH	$0.046	$2,267	1 (3 HP) pump at 80% efficiency
Power for NMCSG Unit Recovery Wells	57,488	kwh	$0.046	$2,644	7 (0.5 HP) pumps at 80% efficiency
Power for North Shore PS	12,319	kwh	$0.046	$567	1 (0.75 HP) pump at 80% efficiency
Power for NMC Seep collection PS	24,638	kwh	$0.046	$1,133	1 (1.5 HP) pump at 80% efficiency
Operation of Willis-Semet GWTP (incremental cost)	37,843,200	gal	$0.0237	$896,884	Actual Cost Jan-April, 2009 (OMI by email 6-5-09)
Annual Costs (continued)					
Reporting	1	yr	$10,000	$10,000	Annual report
			SUBTOTAL (rounded):	**$1,089,000**	
Contingency			**20%**	**$217,800**	
Technical Support			**10%**	**$108,900**	
TOTAL ANNUAL O&M COST (rounded)				**$1,416,000**	
Periodic Costs (Year 5)					
Maintenance of Roadway; General	62,500	SY	$6.00	$375,000	Place and grade 6-inch resurface; 25% total area
			SUBTOTAL (rounded):	**$375,000**	
Contingency			**20%**	**$75,000**	
Technical Support			**10%**	**$37,500**	
TOTAL PERIODIC O&M COST (rounded)				**$488,000**	

Present Worth Analysis (Years 1-5)

Cost Type	**Total Cost**	**DF (7%)**	**Cost Per Yr**	**Present Value**
Capital Cost - Year 0	$106,888,000	1.000	$106,888,000	$106,888,000
Annual O&M - Years 1-5	$7,080,000	4.100	$1,416,000	$5,805,600
Periodic Costs - 5 yr	$488,000	0.713	$488,000	$347,944
TOTAL PROJECT PRESENT WORTH (rounded)				**$113,042,000**

Notes
1) "Install" costs include the costs to purchase and deliver materials, excavation, installation of materials and backfill as appropriate.
2) Pump power estimate doubled as an allotment for controls and misc. power consumption within the PS.
3) DF = Discount Factor
4) O&M Costs for this IRM are assessed for a 5-yr period. Costs for O&M of these components for years 6-30 will be assessed as part of the Sitewide FS

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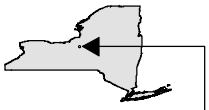

QUADRANGLE LOCATION

HONEYWELL
WASTEBEDS 1 - 8
GEDDES, NEW YORK

SITE LOCATION

N

0 1,000 2,000 4,000 6,000 8,000

Feet

1:24,000

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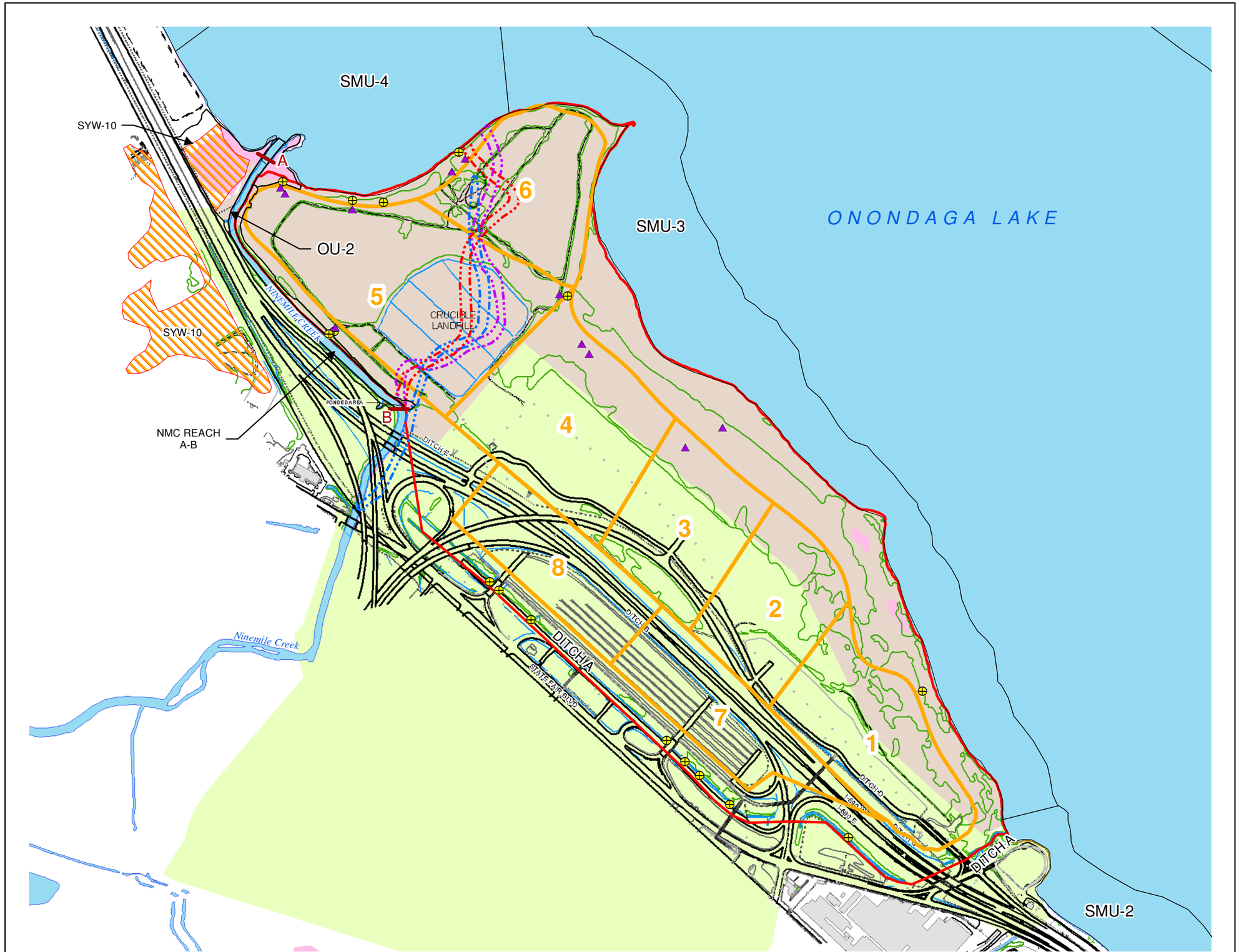
FIGURE 2



N

LEGEND

- WEIR BOX
- PIPE
- DELINEATED WETLANDS
- NYS FRESHWATER WETLAND
- APPROXIMATE WASTEBED BOUNDARY
- WASTEBEDS 1-8 SITE

PROPERTY BOUNDARY

- STATE OF NEW YORK
- COUNTY OF ONONDAGA

FORMER NINEMILE CREEK CHANNEL

- USGS TOPO MAP 1898
- THOMSEN ASSOCIATES 1982
- ALLIED DRAWING 1937

HONEYWELL
WASTEBEDS 1 - 8
FOCUSED FEASIBILITY STUDY
GEDDES, NEW YORK

SITE PLAN

0 400 800 1,600
Feet

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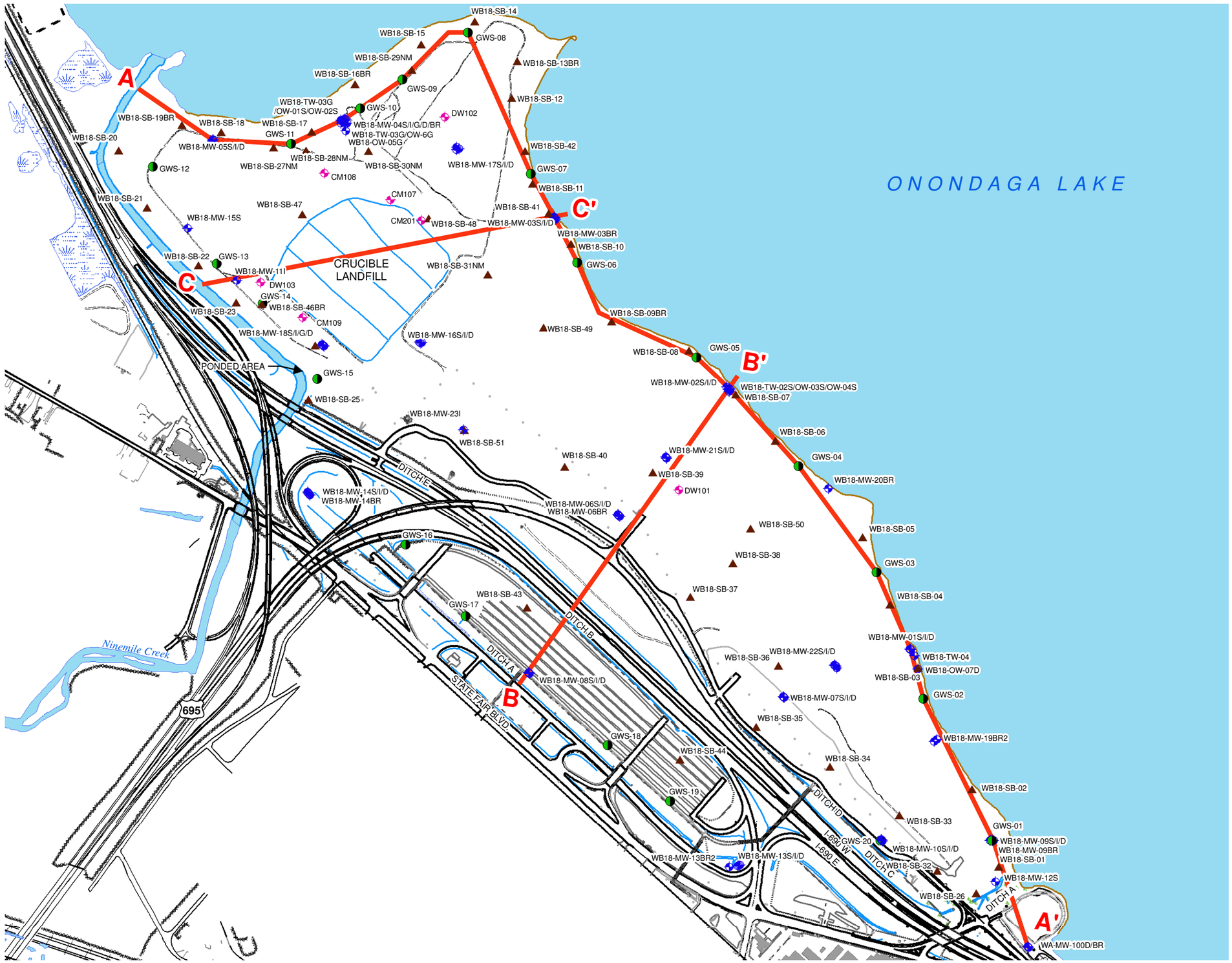
FIGURE 3



LEGEND

- CROSS SECTION LOCATION
- MONITORING WELL
- SOIL BORING
- GROUNDWATER SCREENING
- CRUCIBLE WELL

HONEYWELL
WASTEBEDS 1 - 8
FOCUSED FEASIBILITY STUDY
GEDDES, NEW YORK

CROSS SECTION LOCATIONS

0 350 700 1,400
Feet

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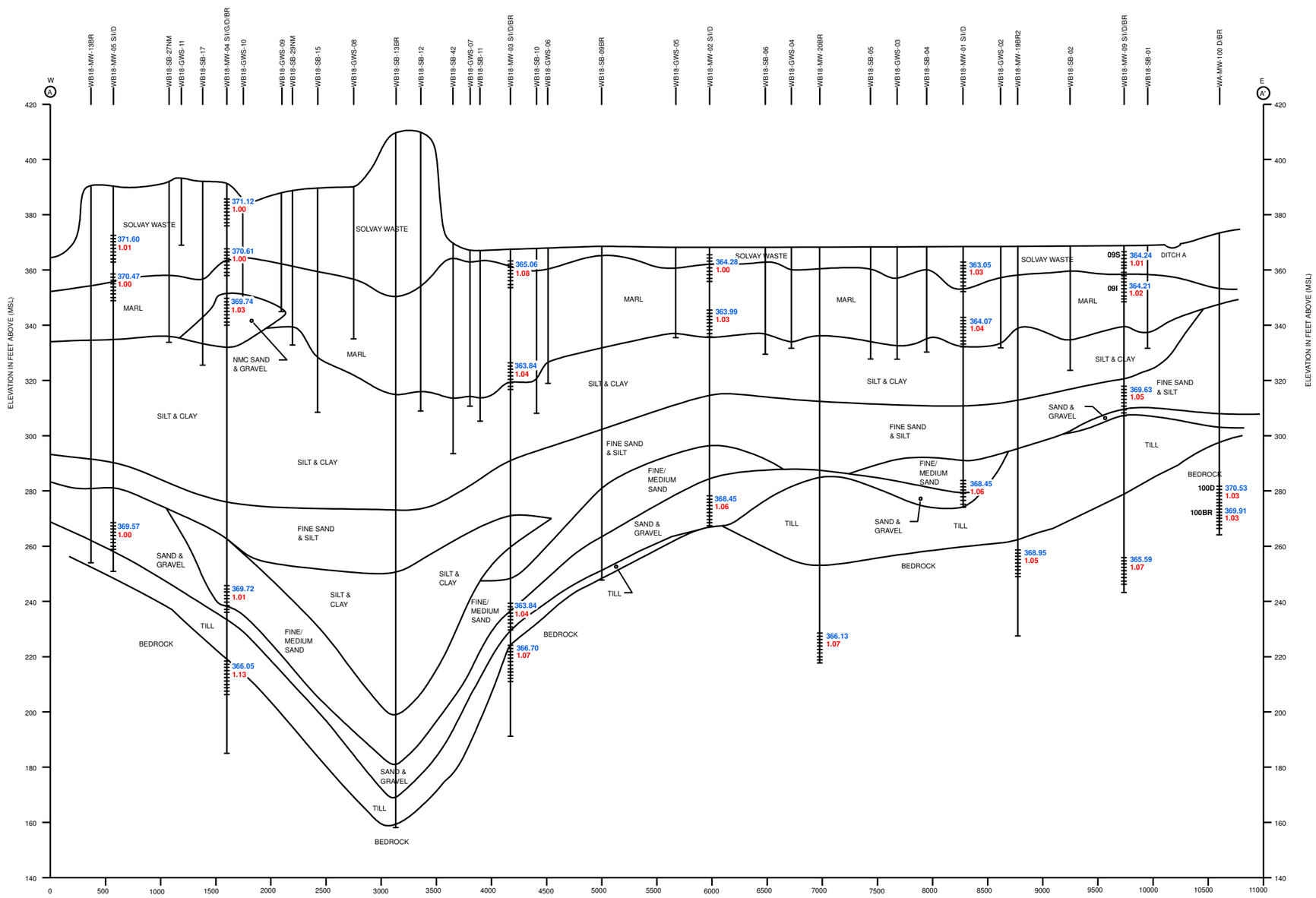
FIGURE 4



LEGEND

MW	MONITORING WELL
SB	SOIL BORING
GWS	GROUNDWATER SCREENING
NM	NINEMILE CREEK
S/I/D/BR	SHALLOW/INTERMEDIATE/DEEP/ BEDROCK
	SCREENED INTERVAL
364.21	GROUNDWATER ELEVATION (FEET ABOVE MSL) (6/25/08)
1.02	DENSITY BY HYDROMETER (6/25/08)

NOTE: WELL CLUSTERS SHOWN AS ONE LOCATION WITH MULTIPLE SCREENS.

HONEYWELL
WASTEBEDS 1- 8
FOCUSED FEASIBILITY STUDY
GEDDES, NEW YORK

GEOLOGIC CROSS SECTION A-A'

HORIZONTAL SCALE

0 500 1,000 2,000

Feet

VERTICAL EXAGGERATION = 10x

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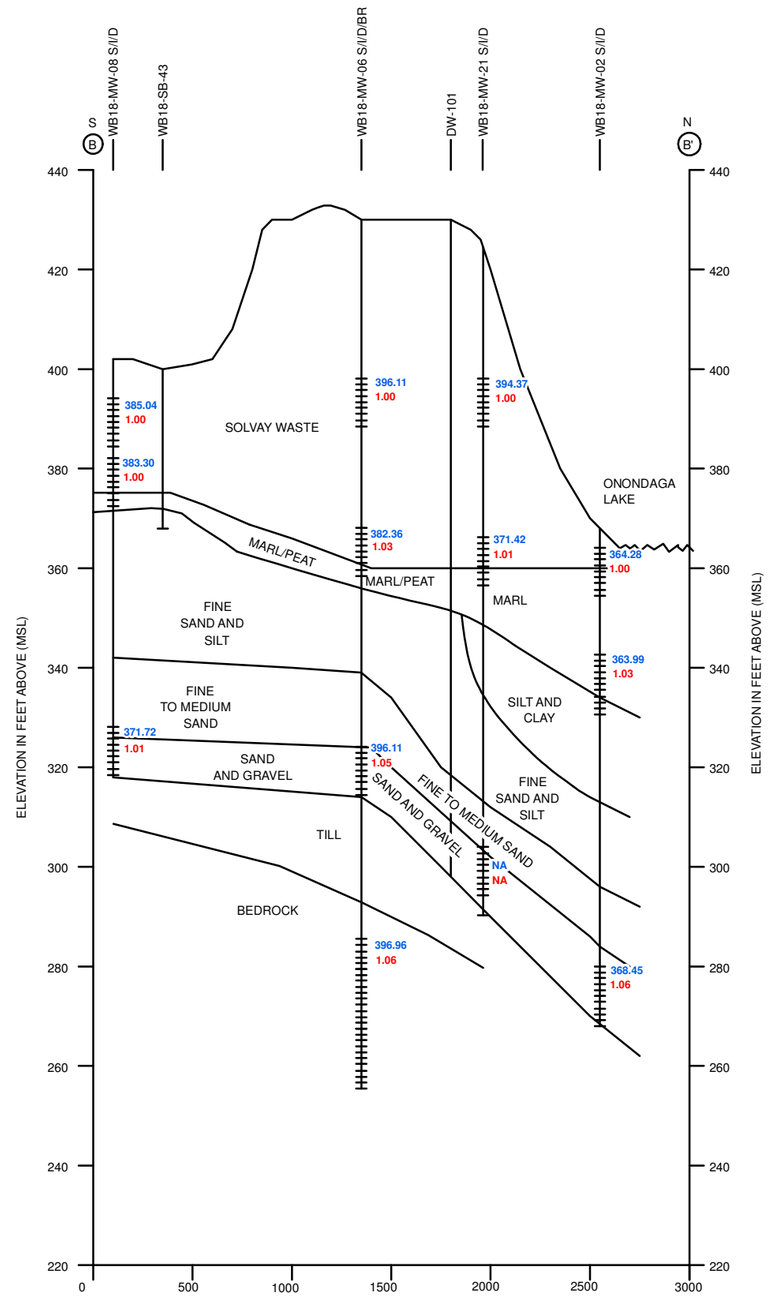
FIGURE 5



LEGEND

MW	MONITORING WELL
SB	SOIL BORING
GWS	GROUNDWATER SCREENING
NM	NINEMILE CREEK
S/I/D/BR	SHALLOW/INTERMEDIATE/DEEP/ BEDROCK
	SCREENED INTERVAL
364.21	GROUNDWATER ELEVATION (FEET ABOVE MSL) (6/25/08)
1.02	DENSITY BY HYDROMETER (6/25/08)

NOTE: WELL CLUSTERS SHOWN AS ONE LOCATION WITH MULTIPLE SCREENS.

HONEYWELL
WASTEBEDS 1 - 8
FOCUSED FEASIBILITY STUDY
GEDDES, NEW YORK

GEOLOGIC CROSS SECTION B-B'

HORIZONTAL SCALE

0 500 1,000 2,000
Feet

VERTICAL EXAGGERATION = 10x

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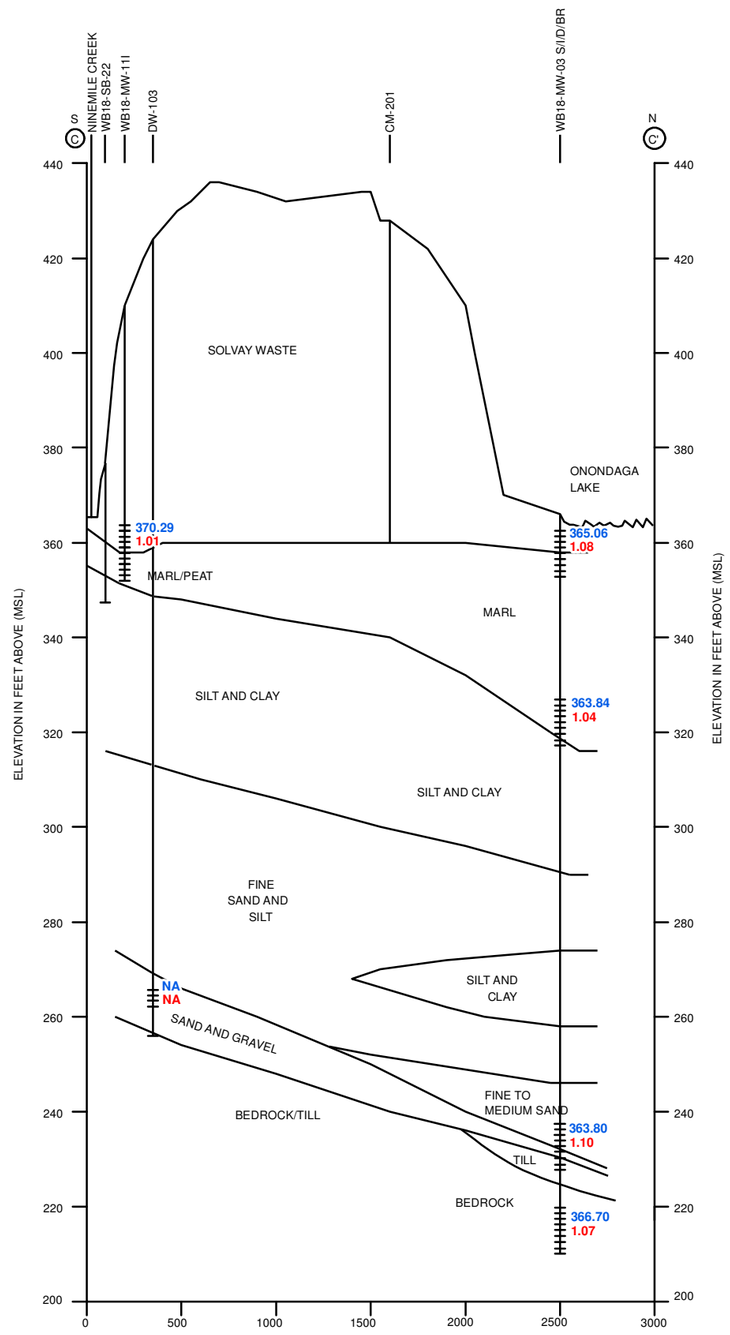
FIGURE 6



LEGEND

MW	MONITORING WELL
SB	SOIL BORING
GWS	GROUNDWATER SCREENING
NM	NINEMILE CREEK
S/I/D/BR	SHALLOW/INTERMEDIATE/DEEP/ BEDROCK
|||||||	SCREENED INTERVAL
364.21	GROUNDWATER ELEVATION (FEET ABOVE MSL) (6/25/08)
1.02	DENSITY BY HYDROMETER (6/25/08)

NOTE: WELL CLUSTERS SHOWN AS ONE LOCATION WITH MULTIPLE SCREENS.

HONEYWELL
WASTEBEDS 1 - 8
FOCUSED FEASIBILITY STUDY
GEDDES, NEW YORK

GEOLOGIC CROSS SECTION C-C'

HORIZONTAL SCALE

0 400 800 1,600
Feet

VERTICAL EXAGGERATION = 10x

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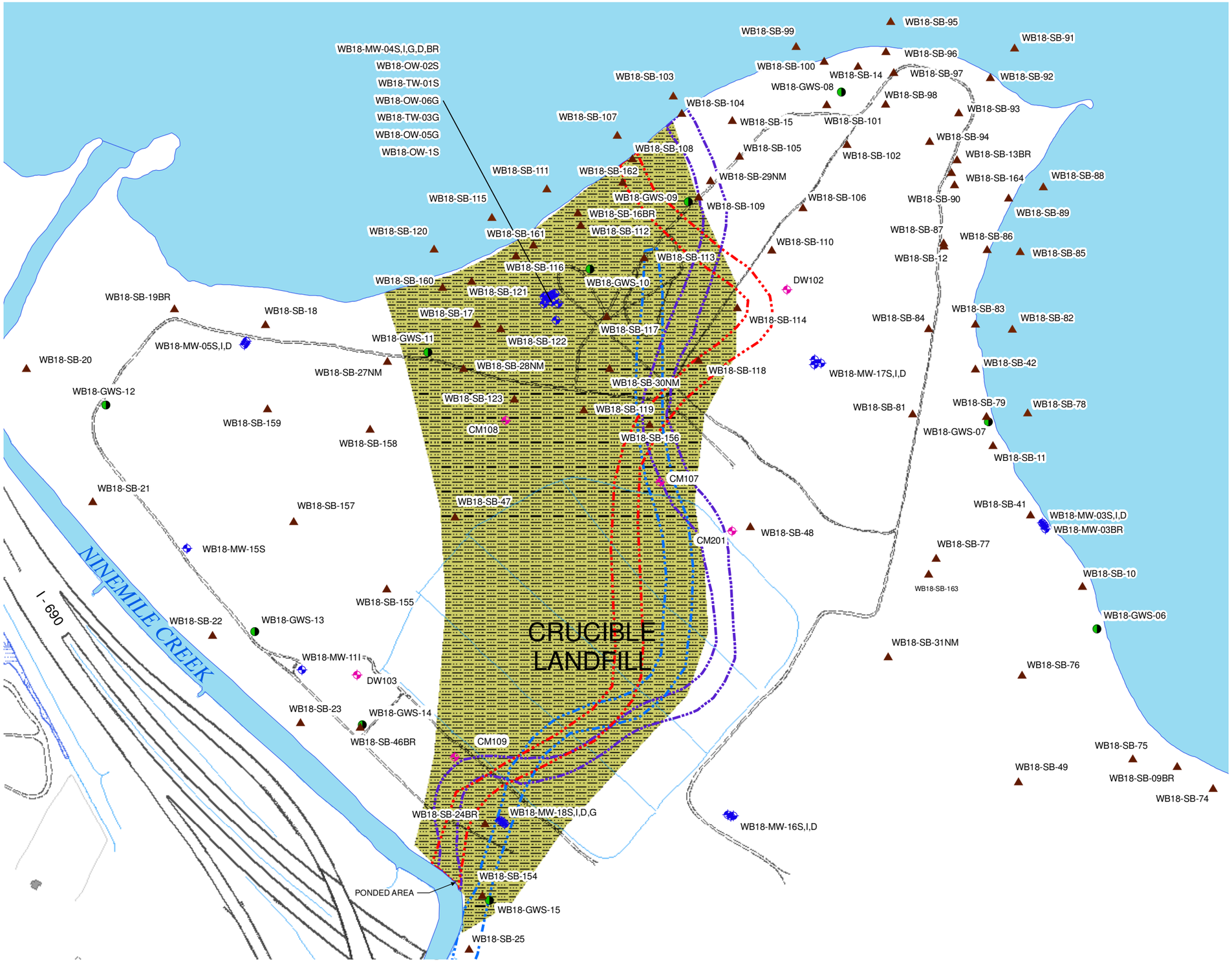
FIGURE 7



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N

LEGEND

SAMPLE LOCATIONS

- MONITORING WELL
- GROUNDWATER SCREENING
- SOIL BORING
- CRUCIBLE WELL

FORMER NINEMILE CREEK CHANNEL

- USGS TOPO MAP 1898
- ALLIED DRAWING 1937
- THOMSEN ASSOCIATES 1982
- APPROXIMATE EXTENT OF NINEMILE CREEK RELATED SAND AND GRAVEL DEPOSITS

HONEYWELL
WASTEBEDS 1 - 8
FOCUSED FEASIBILITY STUDY
GEDDES, NEW YORK

APPROXIMATE EXTENT OF NINEMILE CREEK SAND AND GRAVEL DEPOSITS

0 150 300 600
Feet

JUNE 2010
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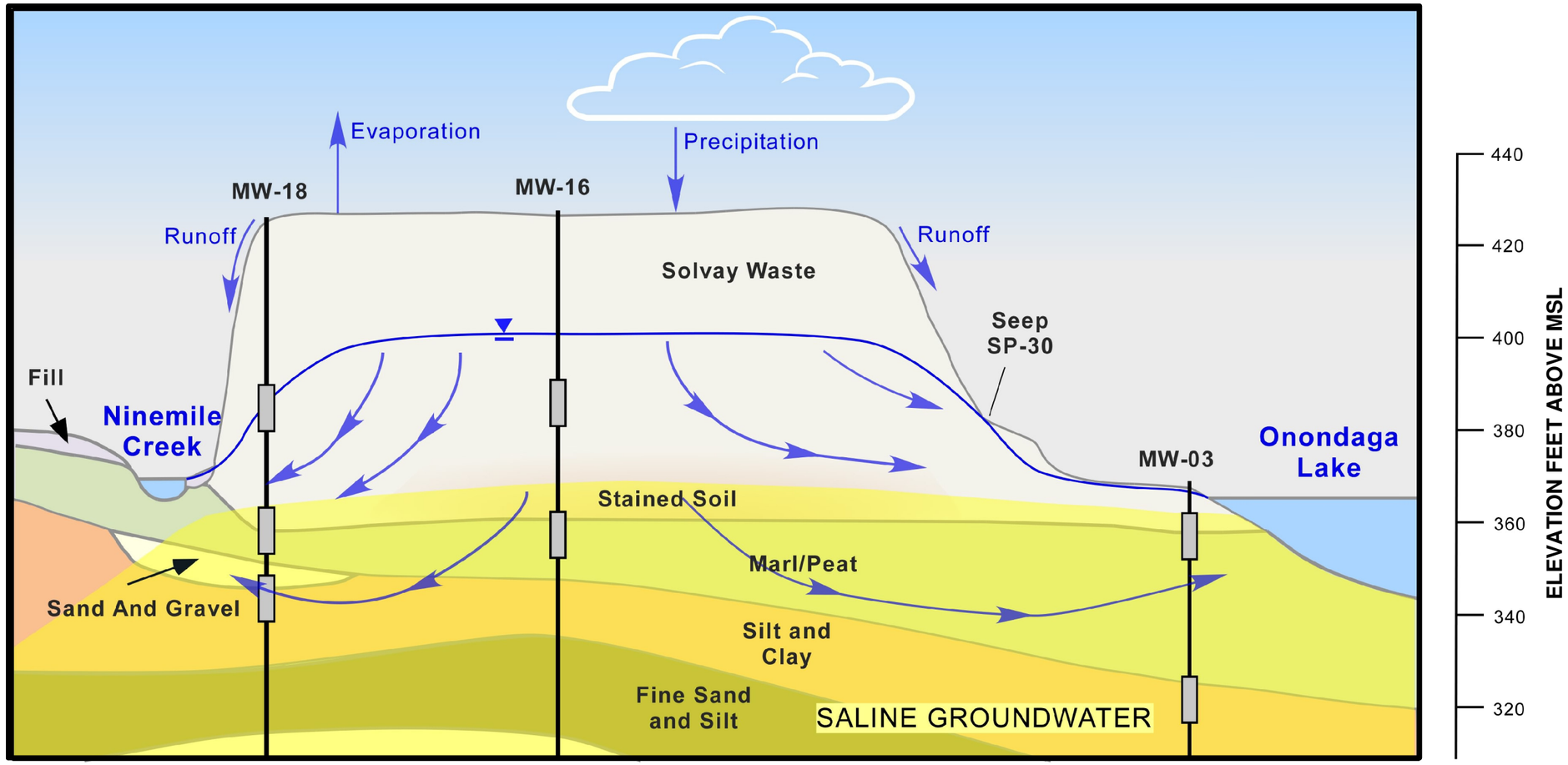
FIGURE 8



LEGEND

- SCREEN INTERVAL
- WELL CASING
- SALINE GROUNDWATER
- GROUNDWATER FLOW DIRECTION

HONEYWELL
WASTEBEDS 1-8
FOCUSED FEASIBILITY STUDY
GEDDES, NEW YORK

CONCEPTUAL GROUNDWATER FLOW

JUNE 2010
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O'BRIEN & GERE

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