DRAFT ONONDAGA LAKE
SEDIMENT CONSOLIDATION AREA (SCA)
CIVIL AND GEOTECHNICAL
FINAL DESIGN

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LIST OF ACRONYMS

AADT	Annual Average Daily Traffic
ACAP	Alternative Cover Assessment Program
ARAR	Applicable or relevant and appropriate requirement
ASTM	American Society for Testing and Materials
BOD	Basis of design
cm/sec	centimeter per second
CPP	Citizen Participation Plan
CQAP	Construction Quality Assurance Plan
CSM	Cross-section settlement model
CY	Cubic yards
EPDM	Ethylene propylene diene monomer
ft	feet
gpm	gallon per minute
HDPE	High density polyethylene
HELP	Hydraulic Evaluation of Landfill Performance
IDS	Initial Design Submittal
LLDPE	Linear low density polyethylene
MNR	Monitored Natural Recovery
NAPL	Non-aqueous phase liquid
NPL	National Priorities List
NYSDEC	New York State Department of Environmental Conservation
NYSDOT	New York State Department of Transportation
OM&M	Operation, maintenance, and monitoring
OU	Operable unit
PP	Polypropylene
PRG	Preliminary remedial goals
RAO	Remedial action objectives
RDWP	Remedial Design Work Plan
ROD	Record of Decision

LIST OF ACRONYMS (CONTINUED)

SCA	Sediment consolidation area
SMU	Sediment management unit
SOW	Statement of work
SPDES	State Pollution Discharge Elimination System
SSM	Surface settlement model
SUNY ESF	State University of New York College of Environmental Science and Forestry
USACE	U.S. Army Corps of Engineers
USEPA	United States Environmental Protection Agency
WTP	Water treatment plant

EXECUTIVE SUMMARY

Honeywell continues the progress toward achieving the goals of the Record of Decision (ROD) and the community's vision for a restored Onondaga Lake with the development of this Draft Sediment Consolidation Area (SCA) Civil and Geotechnical Final Design (Final Design). The lake remediation plan, which was selected by the New York State Department of Environmental Conservation (NYSDEC) and the U.S. Environmental Protection Agency (USEPA), calls for a combination of dredging and capping – standard environmental cleanup methods that will address the contamination in lake sediments and water. This Final Design presents the civil and geotechnical design components of the SCA, which is the location where the dredge material will be contained.

Honeywell's remedial design effectively restores Onondaga Lake while ensuring long lasting protection of health and the environment by meeting the design and performance criteria consistent with the requirements set forth in the ROD and associated Consent Decree Statement of Work (SOW). This design is the culmination of work from more than 100 local engineers and scientists working with nationally recognized experts from various universities, research institutions, and specialty engineering firms, with input from community stakeholders. Included here are aspects of the SCA design such as location and layout, composite liner system, slope stability, settlement, liquids management, surface water management, final cover design, monitoring, and construction phasing. This Final Design incorporates comments received from the NYSDEC on the SCA Initial Design Submittal (IDS) and further develops the civil and geotechnical design.

Community input remains a vital component of Honeywell's design for the restoration of Onondaga Lake. Honeywell is committed to working with community leaders, interested stakeholders, and citizens to include input, recommendations, comments, and perspectives into the design process. Community members have the opportunity to participate in the design, construction, and post-construction periods as detailed in the NYSDEC's Citizen Participation Plan (CPP) (NYSDEC, 2009). Decisions for this SCA civil and geotechnical design reflect integration of public comments received on several issues, including:

- SCA location;
- buffer zones to reduce visual impacts to the community; and
- dewatering method (i.e., control of potential odors).

Onondaga Lake Design Process

SCA containment is just one portion of the entire lake remedy. The selected remedy outlined in the ROD issued by USEPA and NYSDEC calls for the dredging and SCA containment of up to an estimated 2,653,000 cubic yards (CY) of contaminated sediments, construction of an isolation cap over an estimated 425 acres in the shallower areas of the lake, construction of a thin-layer cap over an estimated 154 acres in the lake's deeper areas, construction and operation of a hydraulic control system along part of the shoreline, completion of a pilot study to evaluate methods to prevent formation of methyl mercury, wetland and habitat restoration, monitored natural recovery, as well as long-term maintenance and monitoring.

The Remedial Design Work Plan (RDWP) describes how the designs for all the various components of the remedy will be developed and distributed. As detailed in the RDWP, the remedial design will include the preparation of four IDSs, each of which will be submitted separately, and will address various elements of the remedy. Separating the design into four initial submittals has allowed for a streamlined schedule associated with critical path activities. The four IDSs include the following:

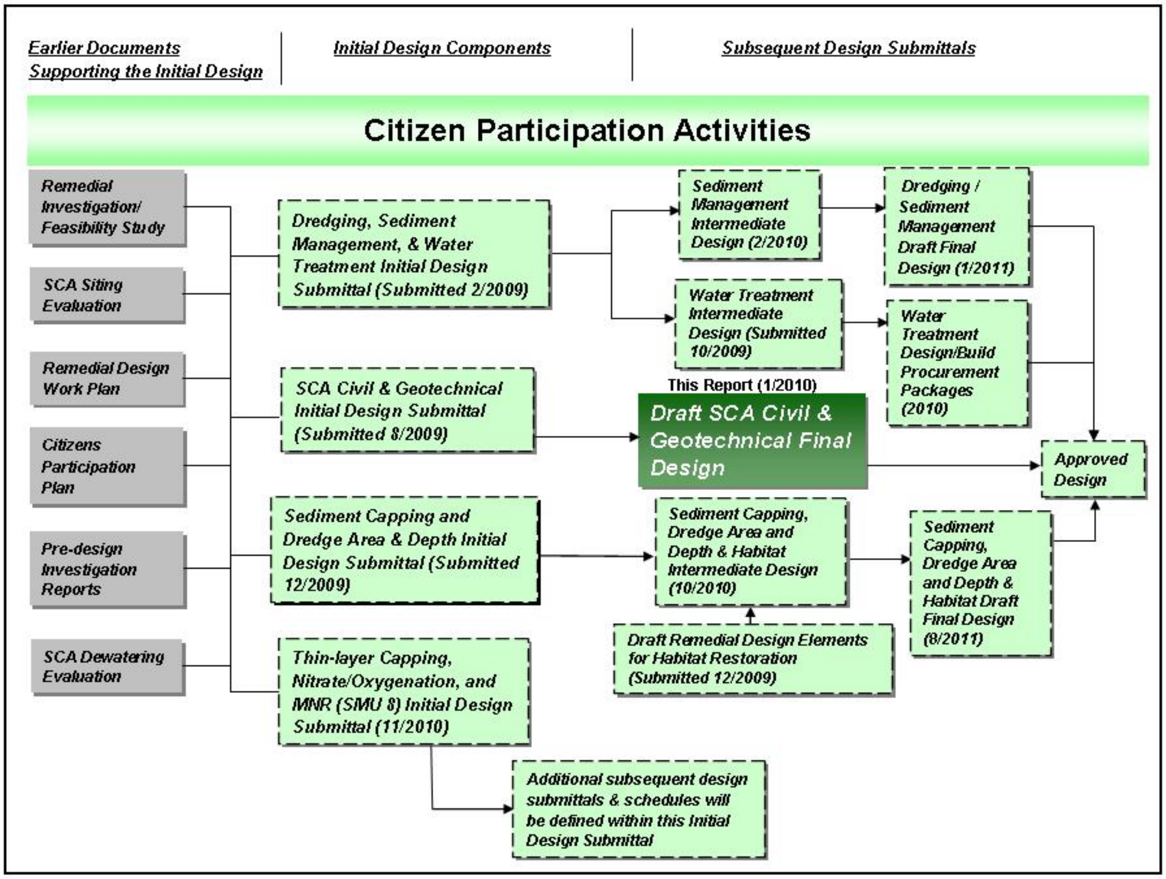
- Dredging, Sediment Management, and Water Treatment IDS (Parsons *et al.*, February 2009);
- Sediment Consolidation Area Civil and Geotechnical IDS (Parsons and Geosyntec, August 2009);
- Capping and Dredge Area and Depth IDS (Parsons and Anchor QEA, December 2009); and
- Thin-Layer Capping, Nitrate Addition/Oxygenation, and MNR IDS (scheduled for submittal November 2010).

The following graphic illustrates how this Final Design fits in with these four IDS documents and the overall Onondaga Lake design process. Combined, the four IDS documents will provide the initial design level details for all components of the Onondaga Lake remedy. Citizen participation activities are integrated throughout the design and continue to be an important component in the overall process.

The design team will continue to work with the community to ensure that the health and safety of the surrounding community and environment are maintained throughout the execution of the remedy. Work plans relevant to SCA civil construction activities that will be developed include:

- Site Security & Community Health and Safety Plan;
- Traffic Management Plan; and
- Noise Abatement Plan.

Honeywell is also committed to minimizing the carbon footprint of remedial construction activities. Wherever practicable, Honeywell will specify the use of renewable energy sources, use of locally produced/sourced materials and supplies, reduction/ elimination of waste, and efficient use of resources and energy during all aspects of the remediation.



Onondaga Lake Design Process

SCA Location and Layout

According to the ROD, Wastebed 13 is the preferred SCA location based on accessibility, estimated capacity, current and future site use, geotechnical considerations, and distance from the community. The layout, as shown on the following figure, was developed to maintain the buffer zones requested from the community (i.e., a 500-ft buffer along the western boundary of Wastebed 13) and an additional 200-ft buffer zone from the northern boundary of Wastebed 13.

SCA Location on Wastebed 13

SCA Design Process

Evaluations confirm that overall stability of the SCA will be maintained during construction, operations, and post-closure. The data required to perform these evaluations were obtained through a variety of field and laboratory tests including:

- approximately 180 cone penetration test locations to establish Solvay waste thickness in Wastebed 13 for the SCA settlement calculations;
- approximately 60 borings (not including piezometer installations) to obtain samples for hundreds of index tests (e.g., moisture content, grain-size, Atterberg limits) and dozens of performance laboratory tests (i.e., strength and consolidation tests) to generate data for the SCA stability and settlement calculations;
- approximately 50 piezometer installations to obtain water level data for use in the SCA stability and settlement evaluations; and
- a 1-acre field settlement pilot study, which included installation of instruments (i.e., settlement plates, piezometers, and inclinometers), placement of 10 ft of fill material over the 1-acre area, and monitoring of the instrumentation, to obtain data for the SCA settlement evaluations.

National experts used the results from these testing activities to understand how Wastebed 13 will perform under the full-scale SCA loading. These results included thickness and engineering properties of the Solvay waste contained within the wastebed, and the geometry and properties of the existing perimeter dikes. The results of these investigations, including data summary reports, are available in the public document repositories.

Honeywell performed numerous detailed evaluations to develop an SCA design that will provide safe and protective containment of the material dredged as part of the Onondaga Lake remediation. In addition to the investigations and design evaluations, Honeywell will monitor the performance of the SCA during construction, operations, and post-closure.

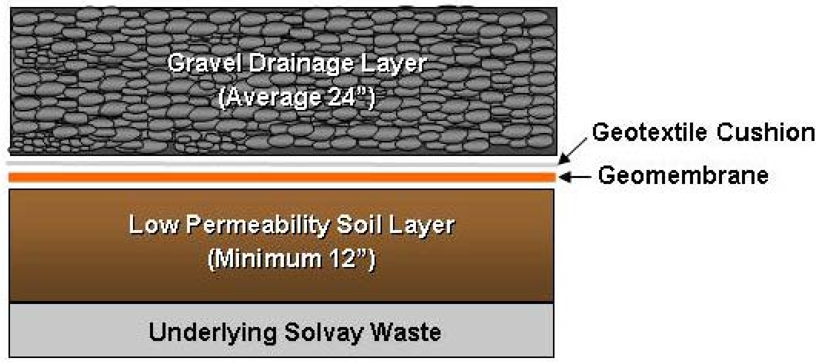
SCA Design Components

The major components and considerations of the SCA civil and geotechnical design presented in this report are as follows:

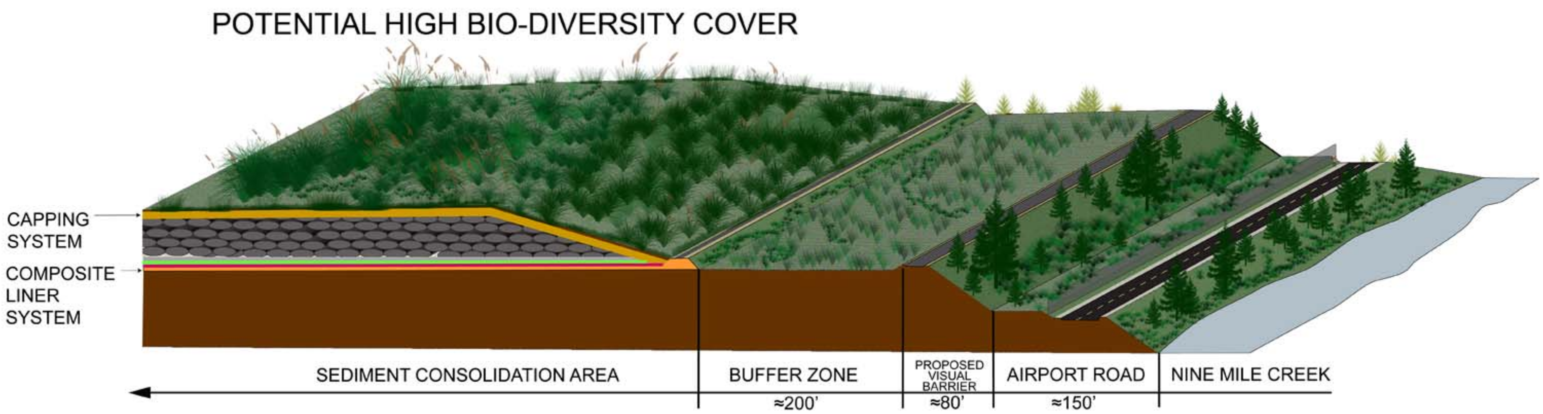
- SCA capacity;
- slope stability;
- settlement;
- composite liner and liquid collection system design;
- surface water control system design;
- final cover system design;
- construction phasing; and
- monitoring.

Figures showing the components of the composite liner system, which will effectively protect the site groundwater and final cover system, which will effectively provide long-term isolation of the dredged sediment, are shown below. In addition, a cross section showing the post-closure condition is provided.

Final Cover System



Composite Liner System



Post-Closure Cross Section

Long-Term Effectiveness and Protectiveness

Honeywell has also developed a monitoring and maintenance plan that will be implemented to ensure that the SCA continues to perform as intended following completion of remedial activities. Based on sound science and detailed engineering evaluations completed by a design team consisting of nationally recognized technical experts, the SCA design provides long-term secure containment of the dredged material.

SECTION 1

BACKGROUND AND DESIGN PROCESS OVERVIEW

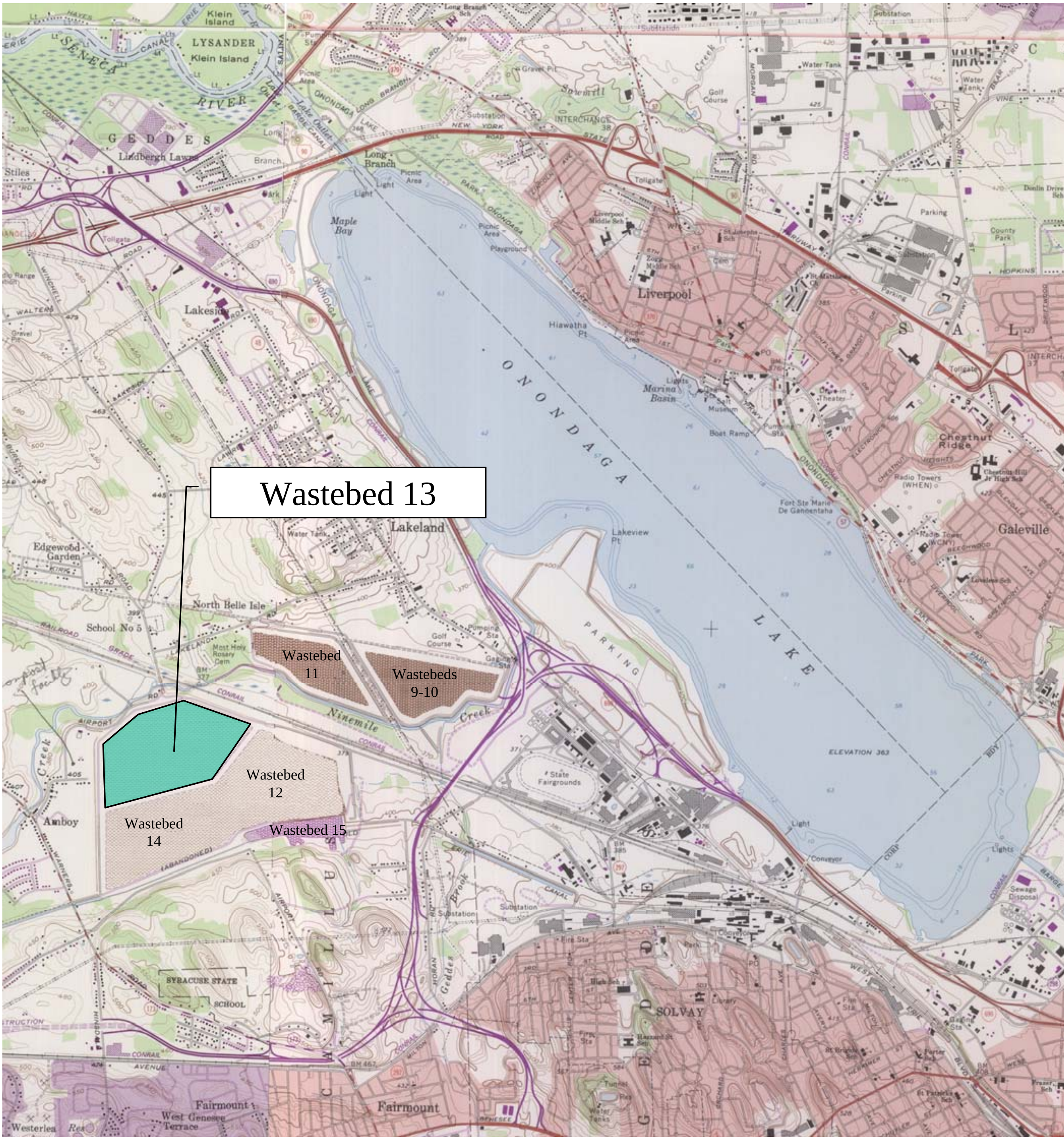
This Draft Onondaga Lake Sediment Consolidation Area (SCA) Civil and Geotechnical Final Design (Final Design) Report has been prepared on behalf of Honeywell International Inc. (Honeywell). The lake bottom is on the New York State Registry of Inactive Hazardous Waste Sites and is part of the Onondaga Lake National Priorities List (NPL) Site. Honeywell entered into a Consent Decree (United States District Court, Northern District of New York, 2007) (89-CV-815) with the New York State Department of Environmental Conservation (NYSDEC) to implement the selected remedy for Onondaga Lake as outlined in the Record of Decision (ROD) issued on July 1, 2005. The following documents are appended to the Consent Decree: ROD, Explanation of Significant Differences, Statement of Work (SOW), and Environmental Easement.

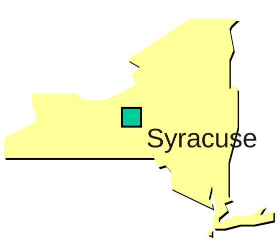
This report is based on extensive information and data gathered during design-related investigations. It provides a final design for the civil and geotechnical components of the SCA and further develops the SCA Initial Design Submittal (IDS) (Parsons and Geosyntec, 2009) that was prepared in accordance with the Remedial Design Work Plan (RDWP) for the Onondaga Lake Bottom Subsite (Parsons, 2009c). This report also addresses comments received from the NYSDEC on October 18, 2009.

1.1 BACKGROUND

Onondaga Lake is a 4.6 square mile (3,000 acre) lake located in Central New York State immediately northwest of the City of Syracuse (Figure 1.1). As specified in the ROD, a component of the selected lake remedy includes the dredging and onsite consolidation of sediments removed from the lake. Honeywell evaluated potential locations for building and operating an SCA to contain sediment removed from Onondaga Lake during the remedial action, as documented in the Onondaga Lake SCA Siting Evaluation (Parsons, 2006). Each of Honeywell’s Solvay Wastebeds was evaluated as a potential location for an SCA based on accessibility, estimated capacity, current and future site use, geotechnical considerations, and distance from residences. Based on the evaluation results, and as documented in the SOW of the Consent Decree, Wastebed 13 was selected for building and operating the SCA (Figure 1.1).

Wastebed 13 is located in the Town of Camillus and encompasses approximately 163 acres. It is bordered to the north by Ninemile Creek and the CSX Railroad tracks; to the west by an Onondaga County Garage property and a former gravel excavation owned by Honeywell; and to the east and south by Wastebeds 12 and 14, respectively. Wastebed 13 was originally designed as a settling basin for the disposal of Solvay waste and has recently been used by the State University of New York College of Environmental Science and Forestry (SUNY ESF) and Honeywell for willow/evapotranspiration cover pilot test plots. These test plots now occupy several acres along the southern border of the wastebed (Figure 1.2).





New York Quadrangle

LATITUDE: N 43° 5' 57"
LONGITUDE: W 76° 10' 41"

N

SOURCE: U.S.G.S. SYRACUSE WEST QUADRANGLE

FIGURE 1.1

Honeywell

Sediment Consolidation Area
Onondaga Lake Bottom Subsite
Remedial Design

SITE LOCATION MAP

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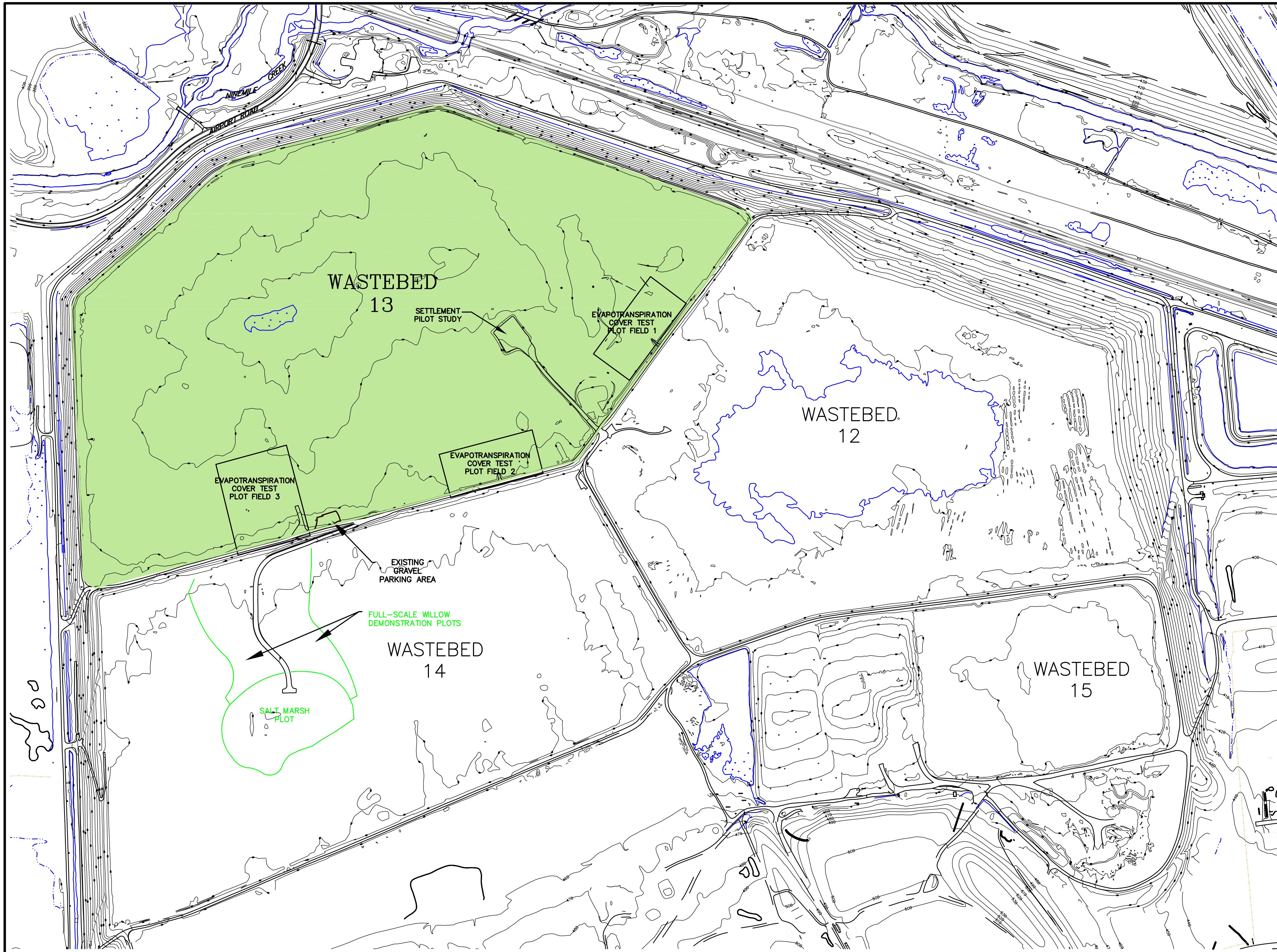
P:\Honeywell -SYR\444853 - Lake Detail Design\09 Reports\9.6 SCA IDS\Figures\Figure 1 (Site Map).ppt



NOTE:

1. BASE MAP PROVIDED BY D.W.HANNIG L.S., P.C.; SURVEYED 6/10/08

FIGURE 1.2

Honeywell

SEDIMENT CONSOLIDATION AREA
ONONDAGA LAKE BOTTOM SUBSITE REMEDIAL DESIGN
CAMILLUS, NEW YORK

WASTEBEDS 12–15
EXISTING SITE PLAN

PARSONS
301 PLAINFIELD ROAD * SUITE 350 * SYRACUSE, NEW YORK 13212 315-451-9560

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1.2 REMEDIATION OBJECTIVES AND GOALS

Activities associated with the Onondaga Lake remediation, including construction of the SCA, are designed to ensure the health and safety of the surrounding community, the environment, and onsite workers from potential hazards associated with the execution of the remedy. The ROD also provides more specific objectives—referred to as remedial action objectives (RAOs)—and goals (referred to as preliminary remedial goals [PRGs]) for the lake remedy. Honeywell's specific objectives related to the SCA design include the following:

- Design the SCA for the efficient and secure containment of sediments dredged as part of the Onondaga Lake remedy in a manner that ensures the health and safety of the community and the environment;
- Incorporate dredging, SCA operations, and water treatment into the SCA civil and geotechnical design; and
- Incorporate stakeholder (i.e., regulatory agencies and the community) input in the process to identify design criteria (i.e., odor mitigation, redundancy of operations, leachate containment, dewatering, traffic, beneficial use, groundwater monitoring, etc.).

These objectives are also presented in the Basis of Design (BOD), which is included as Attachment A of the SCA Civil and Geotechnical Technical Memorandum (Parsons, 2009d) in Appendix A of this document and has been approved by the NYSDEC.

1.3 REMEDY OF RECORD

The ROD for the lake bottom describes the remedy selected by NYSDEC and the United States Environmental Protection Agency (USEPA). The SOW, presented as Appendix C of the Consent Decree, further describes design-related elements for the implementation of the remedy, such as the development of dredging areas and volumes, and isolation cap areas, models and components; design of the profundal zone (sediment management unit [SMU] 8) remedy; management of dredged sediments; design of the water treatment system; and development of the design and construction schedule. According to the ROD and SOW (United States District Court, 2007 – appendices to the Consent Decree), the components of the selected remedy relevant to the civil and geotechnical aspects of the SCA design, which is the focus of this report, are summarized as follows:

- "Dredging of as much as an estimated 2,653,000 CY of contaminated sediment/ waste …."
- Placing the majority of "dredged sediment … in one or more SCAs, which will be constructed on one or more of Honeywell's Solvay wastebeds that historically received process wastes from Honeywell's former operations. The containment area will include, at a minimum, the installation of a liner, a cap, and a leachate collection and treatment system."
- "Implementation of institutional controls including the notification of appropriate governmental agencies with authority for permitting potential future activities which could impact the implementation and effectiveness of the remedy."

- "Implementation of a long-term operation, maintenance, and monitoring (OM&M) program to monitor and maintain the effectiveness of the remedy."

The Consent Decree also states that "Honeywell shall design, operate, and maintain the SCA in accordance with the substantive requirements of NYSDEC Regulations Part 360, Section 2.14(a) (industrial monofills). The SCA shall have the following elements:"

- "*Impermeable Liner* – Honeywell shall design and install an impermeable liner system. The grading design for the SCA shall utilize the existing surface topography of Wastebed 13 as much as possible so as to limit wastebed cut and fill requirements and the associated need for a large volume of imported soil fill. Preloading and stabilization of the wastebed shall only be required to the extent necessary to ensure the integrity of the SCA components and underlying Solvay waste foundation, based upon the remedial design."
- "*Leachate Collection* – The impermeable liner shall be overlain by a leachate collection system. The type of system will be determined during Remedial Design. A laterally-transmissive sand or geosynthetic liquid collection layer may be considered by DEC for inclusion in the system. The system shall convey leachate by gravity drainage to collection sumps where the leachate will be pumped via force main to a water treatment plant."
- "*SCA Cover* - The SCA cover shall be designed pursuant to applicable regulations and guidance including the USEPA Alternative Cover Assessment Program ("ACAP"). If appropriate based upon the Remedial Design, the SCA cover may utilize a soil layer and ecological plant community to produce evapotranspiration rate sufficient to reduce precipitation infiltration rates to acceptably low levels."
- "*NAPL Collection and Offsite Treatment and/or Disposal* – Dredged material that may contain non-aqueous phase liquids (NAPLs) shall pass through an oil/water separator. NAPLs that collect on the water surface within the oil/water separator, or that are otherwise collected, will be separated and collected for offsite treatment and/or disposal. In addition, the SCA liner and leachate collection system shall be designed and operated to collect for offsite treatment and/or disposal any NAPL present in the SCA leachate."

The first three design elements listed above are addressed in Section 4 of this document. The last one (i.e., NAPL Collection and Offsite Treatment and/or Disposal) will be addressed by removing or treating NAPL encountered or collected as part of the water treatment process. Details will be included as part of the Water Treatment Plant (WTP) Design.

1.4 DESIGN PROCESS OVERVIEW

This document focuses on the civil and geotechnical aspects of the SCA design, which is just one element of the Onondaga Lake remedy. The design overview that follows is provided to put the SCA design in context with the rest of the remedy.

The primary elements of the selected Onondaga Lake remedy, as documented in the ROD, include the following:

- sediment removal (dredging) and transport to the SCA;
- SCA construction, operation, and closure;
- sediment capping (isolation and thin-layer) including remedial area determination and definition of dredge areas, depths, and volumes;
- water treatment system;
- oxygenation of the hypolimnion;
- monitored natural recovery (MNR);
- habitat restoration and enhancement;
- institutional controls; and
- long-term operation, maintenance, and monitoring.

For most of the remedial elements listed above, design-related investigations, engineering assessments, and evaluation reports have already been completed to assess specific elements of the remedy, advance design decisions, and to obtain NYSDEC and USEPA approval on critical path components (through a series of work group meetings, conference calls, and previous design submittals). A summary of the documents pertinent to this report that are available in the document repositories is included as Table 1.1.

Due to interaction between the various remedial elements and varying design durations associated with specific components, it was necessary to separate the design into four initial design reports that, collectively, address all of the remedial elements listed above, as follows:

- The *SCA Civil & Geotechnical IDS* (Parsons and Geosyntec, 2009) includes the civil and geotechnical design elements (e.g., composite liner system) required for construction of the SCA. This IDS was submitted to the NYSDEC in August 2009 and is in the public document repositories.
- The *Dredging, Sediment Management, and Water Treatment IDS* (Parsons *et al.*, 2009) provides initial design-level information pertaining to operational components of the remedy including the dredging, transportation, and dewatering of impacted lake sediments, and treatment of construction water generated during the process. This IDS was submitted to the NYSDEC in February 2009 and is in the public document repositories.
- The *Capping and Dredge Area and Depth IDS* (Parsons and Anchor QEA, 2009) includes the proposed, conceptual-level design detail for the sediment cap component of the remedy. This submittal also includes the design details pertaining to habitat restoration, and provides dredging volumes and removal areas/depths. This IDS was submitted to the NYSDEC in December 2009.
- The *Thin-Layer Capping, Nitrate Addition/Oxygenation, and MNR (SMU 8) IDS* focuses on the deep water areas of the lake, and will provide initial design-level details pertaining to thin-layer capping (including locations, extent, materials, and sequencing), nitrate addition and/or oxygenation for the purposes of inhibiting the formation of methylmercury within the lake, and the approach to monitoring natural recovery in specific areas of the lake. This IDS will be submitted to the NYSDEC in November 2010.

TABLE 1.1

ONONDAGA LAKE HISTORICAL DOCUMENTS

Date	Name of Document
2009, December	Draft Onondaga Lake Capping and Dredge Area and Depth Initial Design Submittal
2009, October	Onondaga Lake Remedial Design SCA Water Treatment Plant Intermediate Design Submittal
2009, September	Onondaga Lake Pre-Design Investigation: Phase III Data Summary Report
2009, August	Draft Onondaga Lake SCA Civil & Geotechnical Initial Design Submittal
2009, August	Onondaga Lake Pre-Design Investigation: Phase II Data Summary Report
2009, July	Wastebed 13 Settlement Pilot Study Monitoring Data - Year 3
2009, March	Remedial Design Work Plan for the Onondaga Lake Bottom Subsite
2009, March	Onondaga Lake PDI: Phase IV Work Plan, Addendum 6
2009, March	Citizen Participation Plan for the Onondaga Lake Bottom Subsite Remedial Design Program
2009, February	SCA Dewatering Evaluation Report
2009, February	Draft Onondaga Lake Dredging, Sediment Management, and Water Treatment Initial Design Submittal
2008, December	Wastebed 13 Settlement Pilot Study Monitoring Data - Year 2
2008, June	Onondaga Lake PDI: Wastebed 13 Settlement Pilot Study Data Summary Report
2007, October	Onondaga Lake Phase III Pre-Design Investigation Work Plan, Addendum 4
2007, July	Onondaga Lake Phase III Pre-Design Investigation Work Plan, Addendum 1
2007, May	Onondaga Lake Pre-Design Investigation: Phase I Data Summary Report
2007, May	Onondaga Lake Phase III Pre-Design Investigation Work Plan
2007, January	Consent Decree between the State of New York and Honeywell International Inc.
2006, September	Onondaga Lake Pre-Design Investigation: Phase II Work Plan
2006, September	Onondaga Lake Sediment Consolidation Area (SCA) Siting Evaluation
2005, August	Onondaga Lake Pre-Design Investigation: Wastebed 13 Settlement Pilot Study Work Plan
2005, July	Record of Decision: Onondaga Lake Bottom Subsite of the Onondaga Lake Superfund Site
2004, November	Onondaga Lake Feasibility Study Report. Draft Final

Separating the design into the four components shown above has allowed for accelerated design submittals, as well as agency review and approval for critical path activities (e.g., SCA and water treatment design) to facilitate the schedule for starting and completing the remedial action consistent with the Consent Decree. Figure 1.3 illustrates the relationships between the various submittals and the Remedial Design Components for the Onondaga Lake project and the importance of citizen participation throughout the entire design process. As shown on this figure, three out of the four IDS reports have been submitted, along with the Intermediate WTP Design (O'Brien & Gere, 2009). The designs submitted to date include details about future design documents and their associated schedules.

1.5 FINAL DESIGN SUBMITTAL ORGANIZATION

This report is organized into eight sections and 15 appendices.

- Section 1: Background and Design Process Overview – Presents background information, site description, remedial goals, and a summary of the overall design process.
- Section 2: Community Participation, Community Health and Safety, and General Project Requirements – Highlights Honeywell's incorporation of community considerations into the design and presents general requirements applicable to many aspects of the project, including various federal, state, and local requirements, ordinances, and regulations applicable to the design.
- Section 3: Summary of Previous Investigations – Presents and summarizes data collected as part of design-related investigations, and describes the existing conditions at Wastebed 13, including subgrade properties.
- Section 4: Engineering Analysis and Design – Presents the technical evaluations and design for the civil and geotechnical aspects of the SCA design.
- Section 5: Plans – Presents the plans that will be required during SCA construction, operation, and closure.
- Section 6: Subcontracting Strategy – Summarizes the anticipated work scope packaging and anticipated subcontracting strategy for each work package.
- Section 7: Design Submittal and Construction Schedule – Presents the anticipated design submittal and construction schedule.
- Section 8: References – Lists the references used to prepare this report.

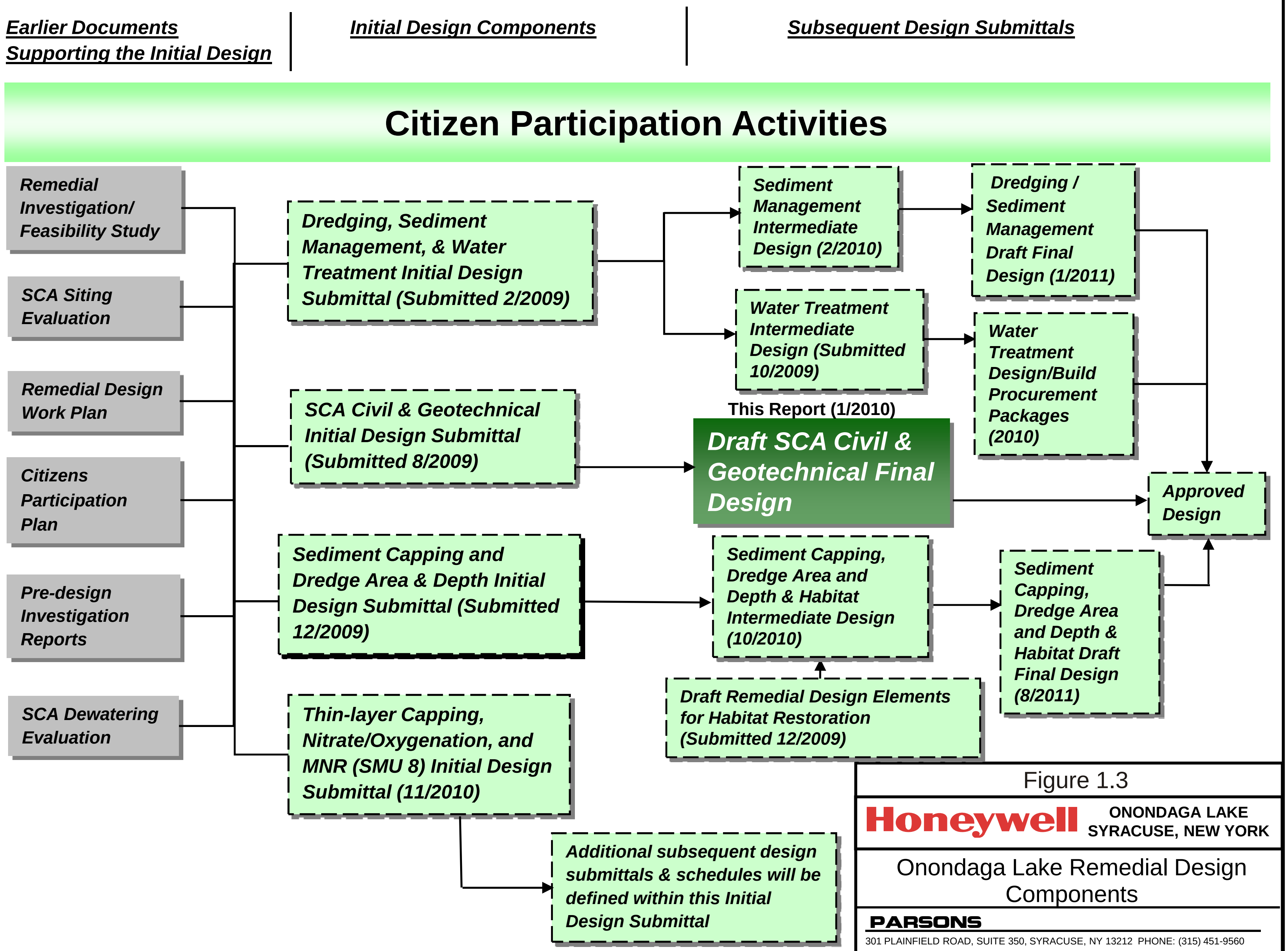

Figure 1.3

Honeywell ONONDAGA LAKE SYRACUSE, NEW YORK

Onondaga Lake Remedial Design Components

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SECTION 2

COMMUNITY PARTICIPATION, COMMUNITY HEALTH AND SAFETY, AND GENERAL PROJECT REQUIREMENTS

The health and safety of members of the community and consideration of community input are of paramount importance in designing the lake remedy. Honeywell is continuing a Community Outreach Program designed to ensure transparency of the design process, incorporate community ideas and feedback, and to maintain awareness of remedial progress and milestones. This outreach was designed in recognition of the importance of the lake as a natural resource to the surrounding area, and the level of community interest in the progress of the Onondaga Lake remediation.

Section 2.1 of the Dredging, Sediment Management, and Water Treatment IDS (Parsons *et al.*, 2009) and the Capping and Dredge Area and Depth IDS (Parsons and Anchor QEA, 2009) provide detailed discussions of community considerations and project requirements relevant to those aspects of the Onondaga Lake remedy. The Onondaga Lake Citizen Participation Plan (CPP) (NYSDEC, 2009) provides details regarding community involvement for the entire Onondaga Lake Bottom Subsite remedial program.

2.1 COMMUNITY PARTICIPATION AND HEALTH AND SAFETY

Community feedback continues to be an important component of the remedy design. Public feedback received through the community participation process has influenced design-level decisions associated with the SCA. Specific examples, which are discussed in more detail in Section 2.1.1, include:

- SCA location;
- buffer zones to reduce visual impacts to the community; and
- dewatering method (i.e., control of potential odors).

Honeywell is working with community leaders to develop work plans specifically designed to ensure the health and safety of the surrounding community and environment is maintained throughout the execution of the remedy. These work plans will be reviewed by, and ultimately approved by, NYSDEC and USEPA. The work plans directly applicable to the SCA construction are discussed in Section 2.1.2. Work plans applicable to other aspects of the design will be discussed in the other design submittals outlined in Section 1.

2.1.1 Community Participation

The NYSDEC and Honeywell are required and committed to informing and involving the public during the remedial design and construction phases of the Onondaga Lake project. The CPP provides a formal, yet flexible plan for communication with the public during the remediation of the Onondaga Lake bottom.

Community input was a major consideration in the selection of geotextile tubes for the sediment dewatering method to be used within the SCA. The dewatering method presumed during the issuance of the ROD was a large open settling basin; however, the local community raised valid concerns pertaining to potential odor generation of this dewatering method. Based on these community concerns and a recommendation by NYSDEC, Honeywell performed an extensive evaluation comparing the geotextile tube and settling basin dewatering methods based on ten site-specific dewatering objectives.

Based on this evaluation, Honeywell determined that there are some site-specific benefits of using geotextile tubes as compared to settling basins. These benefits include the following:

- potential for odor is significantly reduced;
- primary containment of the dredged sediments within the geotextile tubes;
- reduction in required berm height and preloading requirements as compared to an open settling basin, thereby reducing scale of construction activities and associated truck traffic and noise levels;
- reduction in required footprint as compared to an open settling basin because of lower SCA perimeter dike height; thereby reducing the visibility of the SCA and related construction activities; and
- reduction in time to closure.

Details of the comparison between dewatering methods and the decision to use geotextile tubes are documented in the SCA Dewatering Evaluation (Parsons, 2009a), which has been approved by the NYSDEC and is available at the public document repositories. The document is also provided herein as Appendix B.

Another component of the remedy that was based heavily on community input was the selection of the SCA location on Wastebed 13. The location was selected with careful consideration for minimizing impacts on the local community and provides the maximum buffer distance from nearby residential areas and public facilities. In addition, Wastebed 13 was selected based on the size of the area and storage capacity required for dredged sediment management, and the geographical layout of the wastebeds.

Another example of how input from the community influenced the final SCA design is the request from the community for a 500-ft wide buffer zone between sediment dewatering activities and the Wastebed 13 western boundary. The design, as presented in Section 4, in response to those concerns, includes a 500-ft buffer zone from the western boundary to provide further protection to the community from nuisance impacts (i.e., light, noise, or odors) associated with the operation of the SCA. In addition, Honeywell has incorporated in the design a 200-ft buffer zone from the northern boundary of Wastebed 13 to the SCA.

2.1.2 Community Health and Safety

As part of the remedial design process, the design team will continue to work with the community as they develop various performance criteria and work plans specifically designed to ensure that the health and safety of the surrounding community and environment are maintained. The community plans relevant to the SCA civil construction will include, but are not necessarily limited to:

- Site Security & Community Health and Safety Plan – This plan will outline health and safety considerations including provisions for physical security for the site to minimize risks to persons, property, and the environment. Physical security planning will include remedial activities at the SCA. A vulnerability assessment will be included to identify potential security challenges, prioritize those challenges, and describe appropriate control measures. The plan will specify security measures to be implemented. These may include fences, gates, signs, remote cameras, security patrols, and lighting. Other methods to protect members of the public from accidentally accessing the site will be described in the plan and may include posting requirements for appropriate warning signs and barricades.
- Traffic Management Plan – A Traffic Management Plan will be created to specify traffic patterns to route construction vehicles to appropriate roads because vehicles will be necessary for the delivery of material, equipment, and supplies to the SCA.
- Noise Abatement Plan – A Noise Abatement Plan will be established to outline equipment requirements and hours and areas of required noise reduction, in accordance with local ordinances.
- In addition, a Navigation Protection Plan, Spill Contingency Plan, and Volatile and Odor Emissions Monitoring and Mitigation Plan will be prepared, as detailed in other design documents.

2.2 GENERAL PROJECT REQUIREMENTS

Details of specific requirements pertaining to the SCA design are provided in the BOD (Attachment A of Appendix A, "SCA Civil and Geotechnical Technical Memorandum"). General requirements pertaining to the civil and geotechnical aspects of SCA design and construction are discussed in the subsections that follow.

2.2.1 Sustainability

Honeywell is committed to minimizing the carbon footprint of construction activities. During the lake remedy design phases, evaluations are being conducted to identify opportunities to incorporate sustainability concepts, including those presented in the *Clean and Green Policy* (USEPA, 2009), into all aspects of the Onondaga Lake remediation. To the extent practicable, use of renewable energy sources, utilization of locally produced/sourced materials and supplies, reduction/elimination of waste, efficient use of resources and energy, and other practices are specified in the design and will be implemented during remedial construction.

2.2.2 Applicable Regulations

Compliance with federal, state, and local Applicable or Relevant and Appropriate Requirements (ARARs) will ensure that existing resources are protected during operations and provide for overall protection of human health and the environment. A comprehensive list of chemical-specific, action-specific, and location-specific ARARs are included in the ROD.

Compliance with federal, state, and local ARARs frequently involve formal permit application and approval processes. Details pertaining to these processes applicable to Onondaga Lake are outlined in the Consent Decree (United States District Court, 2007).

2.2.3 Health and Safety Requirements

The health and safety of site personnel, visitors, and members of the public are considered paramount. Written safety plans will be developed for SCA construction and they will be developed and updated as needed to address changing activities and site conditions. The health and safety record of all bidding contractors will be evaluated as part of the bidding process. At a minimum, selected Remedial Contractors will be required to prepare Project Safety Plans which will address potential safety issues associated with the specific tasks the contractor will be performing. Specific requirements, including audit procedures, employee drug and alcohol screening programs, and near-miss reporting protocols will also be specified within these safety plans.

2.2.4 Property and Site Access and Right-of-Way Entry

SCA construction and operation are not expected to require the use of non-Honeywell owned property.

SECTION 3

SUMMARY OF PREVIOUS INVESTIGATIONS

Honeywell used a phased approach to completing design-related investigation activities. This approach allowed the data from one phase to be interpreted and used to develop the appropriate scope for the next phase of investigation. This process also improves the overall quality and usefulness of the data and ensures that data gaps are identified and filled. Phase I, Phase II, Phase III, and Phase IV design-related investigation field efforts were conducted from 2005 to 2009, and were performed in accordance with NYSDEC-approved work plans.

This section provides a summary of the field investigations and laboratory testing performed for the design and construction of the SCA. Referenced documents are available at the public document repositories outlined in the Consent Decree.

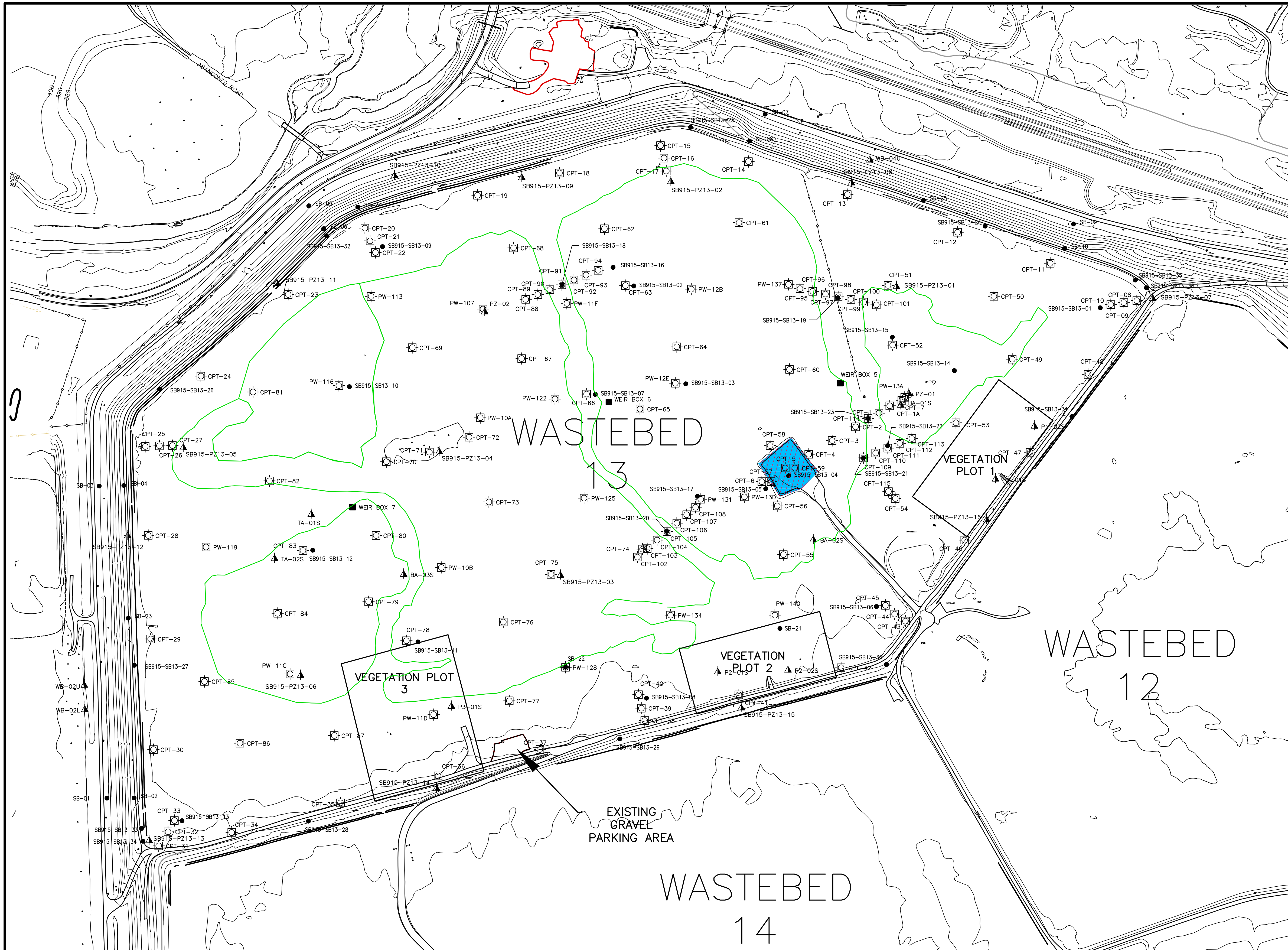
3.1 PRE-DESIGN INVESTIGATIONS AND SUBSURFACE CONDITIONS

Data related to subsurface conditions were collected during the Phase I, II, and III design-related investigation activities at Wastebed 13 and included the following (Figure 3.1):

- approximately 180 cone penetration test locations to establish Solvay waste thickness in Wastebed 13 for the SCA settlement calculations;
- approximately 60 borings (not including piezometer installations) to obtain samples for hundreds of index tests (e.g., moisture content, grain-size, Atterberg limits) and dozens of performance laboratory tests (i.e., strength and consolidation tests) to generate data for the SCA stability and settlement calculations;
- approximately 50 piezometer installations to obtain water level data for use in the SCA stability and settlement evaluations; and
- a 1-acre field settlement pilot study, which included installation of instruments (i.e., settlement plates, piezometers, and inclinometers), placement of 10 ft of fill material over the 1-acre area, and monitoring of the instrumentation, to obtain data for the SCA settlement evaluations.

The data obtained from the investigation activities listed above were used to develop a Data Package titled “Subsurface Stratigraphy Model of Wastebed 13 for the Design of SCA,” which has been approved by the NYSDEC and is included herein as Attachment B to Appendix A, “SCA Civil and Geotechnical Technical Memorandum.” This Data Package includes the following:

- a summary of the site investigation activities conducted in Wastebed 13 to date;
- interpretation of material characteristics and subsurface stratigraphy in Wastebed 13 based on the results of the site investigations;



NOTE:

1. BASE MAP PROVIDED BY D.W.HANNIG L.S., P.C.; SURVEYED 6/10/08

LEGEND:

- SETTLEMENT PILOT STUDY (2005)
- CPT LOCATIONS
- BORING LOCATIONS
- PIEZOMETER LOCATIONS
- EXISTING WEIR BOX LOCATIONS
- APPROXIMATE DELINEATION OF PITS (1972/ 1973)

400 200 0 400 800

SCALE: 1"=400'

FIGURE 3.1

Honeywell

SEDIMENT CONSOLIDATION AREA
ONONDAGA LAKE BOTTOM SUBSITE REMEDIAL DESIGN
CAMILLUS, NEW YORK

WASTEBED 13
INVESTIGATION ACTIVITIES

PARSONS

301 PLAINFIELD ROAD • SUITE 350 • SYRACUSE, NEW YORK 13212 315-451-9560

FILE NAME: P:\HONEYWELL -SYR\444853 - LAKE DETAIL DESIGN\10 TECHNICAL CATEGORIES\10.1 CAD\SCA RDI\441598SK002.DWG
PLOT DATE: 1/11/2010 11:48 AM PLOTTED BY: RUSSO, JILL

- interpretation of material properties (i.e., index properties, shear strength, and compressibility) based on the results of laboratory tests, the field settlement pilot test, and empirical correlations;
- recommendations on material properties to be used for the SCA design; and
- verification of the interpreted subsurface model and compressibility of Solvay waste using the field settlement test results.

In addition to providing this information in the Data Package, Honeywell has prepared summary reports for each of these investigations that have been submitted to NYSDEC. These reports have been approved by the NYSDEC and are in the public document repositories (Parsons and Geosyntec, 2008; Parsons, 2009e; Parsons, 2009f).

3.2 COMPATIBILITY AND INTERFACE TESTING

Compatibility tests were performed to monitor the physical properties of potential geotextile tube and geomembrane materials immersed in sediment from the lake, as described in the Phase IV Work Plan – Addendum 6 Bulk Sediment Collection And Dewatering Treatability Study (Parsons, 2009b). Based on these tests, Honeywell selected a high strength geotextile and thread for the geotextile tubes, and a linear low density polyethylene (LLDPE) geomembrane for the composite liner system.

Interface direct shear testing was also performed on the geotextile tube material and potential composite liner system options, and the results were used to establish reasonable strength values to be used in slope stability analyses, which are discussed in Section 4. During the compatibility testing, the condition of the materials was monitored as a function of cumulative exposure time by means of dimensional measurements and physical property tests. Compatibility tests were performed on the polypropylene (PP) geotextile tube material in accordance with American Society for Testing and Materials (ASTM) D6389. Geomembrane compatibility tests were performed in accordance with ASTM D5747 on materials that were considered for construction of the SCA composite base liner, including high density polyethylene (HDPE), linear low density polyethylene (LLDPE), ethylene propylene diene monomer (EPDM), and PP (polypropylene) liner materials.

Results of the compatibility testing are presented in Appendix C, "Compatibility Test Results." All four geomembrane types performed well; however, the LLDPE and HDPE performed the best. The PP and EPDM absorbed the most extractables and volatiles which resulted in variation in strength properties. Based on the results of the testing and engineering judgment, a LLDPE geomembrane was selected for the composite liner system. Both the high strength geotextile and the thread for the geotextile tubes performed well and are considered suitable for the project.

Strength parameters from the interface direct shear tests were used in the slope stability analyses, which are presented in Section 4. The direct shear testing, in accordance with ASTM D5321, was performed on the geotextile tube material to evaluate the strength (both peak and residual) of the interface between two tubes. This testing was also performed on the composite liner system to establish a reasonable interface strength value (both peak and residual) for the composite liner system.

For the direct shear test on the composite liner system, the following components layered from top to bottom were used for modeling purposes:

- concrete sand;
- non-woven geotextile;
- geomembrane; and
- compacted clay (from source anticipated for construction).

Testing was performed for each type of geomembrane (i.e., smooth HDPE, textured HDPE, EPDM, and PP). Based on this testing, the results for the non-woven geotextile to geomembrane interface will be used in the calculations. The complete test results are provided in Appendix D, “Direct Shear Interface Test Results.” Site-specific interface direct shear testing will be performed during construction, as part of the construction quality control and assurance requirements, to confirm that the actual construction materials meet the interface strength requirements specified in this design.

3.3 DATA GAPS

Based on the data evaluations performed during preparation of the Data Package and review of the compatibility and interface test results, no additional data needs for the SCA design have been identified. Therefore, no additional field work associated with the SCA design will be performed.

SECTION 4

ENGINEERING ANALYSIS AND DESIGN

The analyses presented in this section indicate that the SCA is designed to provide sufficient capacity and to perform as necessary for containment of the dredged sediment. In addition, the drainage layer of the liquids management system will maintain an adequate slope towards the sump areas during construction, operations, and post-closure. Finally, the composite liner system will effectively protect groundwater quality, and the final cover system will provide isolation of the dredged sediment and maintain adequate slopes for surface water management during post-closure. Monitoring will be performed during construction, operations, and post-closure to confirm the SCA is performing as designed.

The SCA design drawings and specifications that were developed using the engineering evaluations presented in this section are provided in Appendix E, "Drawings and Specifications." The key assumptions (e.g., dredge volume) required to proceed with the SCA layout design and engineering analyses are presented first in this section. After the key assumptions, the SCA layout and the basis for that layout are presented, followed by a discussion of the engineering analyses performed on that layout and the impact of those results on the design. Since the overall objectives for the SCA design are discussed in Section 1.2, and the detailed requirements and criteria of the civil and geotechnical aspects of the design are provided in the BOD (Attachment A of Appendix A, "SCA Civil and Geotechnical Technical Memorandum"), they are not repeated here; however, as applicable, they are incorporated into the discussions of the engineering analyses. The engineering analyses in this section focus on slope stability, settlement, the composite liner and liquid management system, the surface water control system, and final cover design. Finally, the anticipated base composite liner system construction phasing, preloading, and construction material transportation and placement are discussed.

4.1 KEY ASSUMPTIONS

The two key assumptions that were required for the development of the SCA design are associated with the dredge volume and the dewatering process. The assumptions associated with these issues are discussed in the following subsections.

4.1.1 Dredge Volume

The design volume stated in the BOD (Attachment A of Appendix A, "SCA Civil and Geotechnical Technical Memorandum") and the design presented herein are based on a dredge volume of up to 2,653,000 CY, which is consistent with the Onondaga Lake ROD (NYSDEC and USEPA, 2005). The flexibility included in the design to accommodate a change in final volume is described in Section 4.2.2.

4.1.2 Slurry Dewatering

The volume to be contained in the SCA is expected to be approximately equal to or less than the *in situ* volume prior to dredging, which is consistent with a 1.0 bulking factor that is assumed in the BOD (Attachment A of Appendix A, "SCA Civil and Geotechnical Technical Memorandum"). The Onondaga Lake Dredging, Sediment Management, and Water Treatment IDS (Parsons *et al.*, 2009) presented a baseline operational scenario for dredging and sediment dewatering that includes hydraulic dredging followed by a potential dredged slurry conditioning system prior to geotextile tube dewatering in the SCA. Whether or not slurry conditioning is performed, it is anticipated that the slurry will return to near *in situ* (pre-dredging) solids content by weight once it has undergone at least initial dewatering in the geotextile tubes. If gravel and sand-size particles are removed from the slurry during a slurry conditioning step, they will be stockpiled and periodically transferred to the SCA. These particles would also be at or above their *in situ* solids content by weight.

The geotextile tubes will be arranged in a series of rows and columns to most efficiently use the SCA and meet loading restrictions. Based on the required dredge rate, total sediment volume, and experience with similar applications, it is anticipated that geotextile tubes approximately 80 to 90 ft in circumference with a maximum length of 300 ft will be used. For modeling purposes, each geotextile tube is assumed to be 300 ft by 40 ft by 6 ft after initial dewatering (i.e., dredge material is at or near pre-dredging solids content by weight).

4.2 SCA LAYOUT

In addition to the dredge volume and slurry dewatering assumptions discussed previously, there are several other factors that were considered in the development of the SCA layout (i.e., footprint), which is shown on Drawing C-002. These factors included the following:

- proximity to the community;
- capacity for the required dredge volume;
- Wastebed 13 surface and subsurface characteristics;
- minimizing excavation and import of fill into Wastebed 13; and
- operational requirements.

A discussion of each of these factors and how it was incorporated into the SCA layout design is provided in the subsections that follow.

4.2.1 Proximity to Community

A minimum buffer zone of 500 ft to the western dike and 200 ft to the northern dike of Wastebed 13 was maintained in the SCA layout (see Figure 4.1 and Section 2.1.1 for details). The footprint of the SCA was designed to be large enough so that the geotextile tube height and the resulting final elevation of the SCA will be consistent with the surrounding terrain (i.e., Wastebeds 12, 14, and 15). Specifically, the highest anticipated elevation of the SCA (including the final cover) will be at least 20 ft lower than the Camillus Construction and Demolition

Pole Locations for Visual Assessment

Note: Locations and dimensions are approximate and will be finalized at later stage of the remedial design.

N W E S

New York State Digital Orthoimagery from 2003

490 245 0 490
Feet

FIGURE 4.1

Honeywell
Onondaga Lake
Camillus, New York

Wastebed 13 Support Areas and Accessibility

PARSONS
301 Plainfield Road, Suite 350; Syracuse, NY 13212
Phone:(315)451-9560

Landfill on Wastebed 15 after settlement. The anticipated final grades after settlement are discussed in more detail in Section 4.3.2.

To the extent practical, existing trees and other vegetation around the perimeter of Wastebed 13 will be left in place during SCA construction and operation to provide a visual barrier. Upon completion of dredging and dewatering activities, a vegetated cover will be constructed on the SCA.

To further reduce SCA visibility during construction and operations, a visual barrier consisting of a mix of native and naturalized evergreen conifers and native grasses will be planted along the northern and western Wastebed 13 dikes starting in the spring of 2010 (see Figure 4.1). The extent of this barrier was established based on an assessment that was performed during the spring of 2009. This assessment included installing poles at the four corners (top and toe of sideslope) of the proposed SCA footprint (i.e., footprint presented in the IDS), as shown on Figure 4.1. Flags were attached to the top of the poles (top of sideslope only) at elevations of between 452 and 458 ft, which is the approximate post-settlement elevation of the SCA after final closure. After the poles were in place, members of the design team assessed whether the flags could be seen from offsite areas. The results of this visual assessment indicate that the buffer zones discussed previously and the existing vegetation around Wastebed 13 effectively minimize the visibility of the SCA from most offsite areas, and additional plantings along the northern and western dikes will further reduce visibility.

4.2.2 SCA Capacity

The SCA is designed to contain up to the ROD volume of 2,653,000 CY of dredged sediment. As indicated in Section 4.1.2 and the BOD (Attachment A of Appendix A, "SCA Civil and Geotechnical Technical Memorandum"), a bulking factor of approximately 1.0 is anticipated following self-weight consolidation; therefore, the dredge volume is approximately equal to the required capacity. However, it should be recognized that there are several other considerations that could affect the final SCA required capacity. As discussed in the Onondaga Lake Dredging, Sediment Management, and Water Treatment IDS (Parsons *et al.*, 2009) and the Onondaga Lake Sediment Capping and Dredge Area & Depth IDS (Parsons and Anchor QEA, 2009), further characterization of dredging areas has indicated that the extent and depth of impacted material are less than were previously assumed. As a result, the actual volume of sediment dredging needed to accomplish the remedial goals will be less than 2,653,000 CY. In addition, the contaminated soils and sediment from Ninemile Creek may be placed in either the containment system at the LCP Bridge Street site or the SCA according to the ROD for Geddes Brook/Ninemile Creek Site Operable Unit (OU) 1 (NYSDEC and USEPA, 2009a) and the ROD for Geddes Brook/Ninemile Creek Site OU2 (NYSDEC and USEPA, 2009b). The estimated volumes to be excavated from Ninemile Creek are 59,000 CY for OU1 and 58,000 CY for OU2, for a total of 117,000 CY.

As discussed in Section 4.4 and shown on Drawing C-003, flexibility in the SCA capacity is included in the design through a phased construction approach. The calculations provided in Appendix F, "Volume Calculations for SCA Design" indicate the Phase I footprint, which is approximately 25 acres, would be sufficient to contain more than one year's dredge volume (i.e., 660,000 CY), if the geotextile tubes are stacked three high (i.e., approximately 18 ft). As shown in the drawings, the sump areas, which are located near the center of the wastebed, are within the Phase I footprint. If it is operationally advantageous and settlement and pore water monitoring of the underlying materials indicate it is acceptable, tubes may be stacked up to five high (i.e., approximately 30 ft) during the first year of operation.

Phase II construction, approximately 24 acres, would be constructed to the south of the Phase I area. The combined footprint of Phases I and II (i.e., 49 acres) would provide sufficient area for the second year of dredged material to be placed in tubes stacked three high (i.e., approximately 18 ft) across the entire area and approximately 1,900,000 CY in tubes stacked five high (i.e., approximately 30 ft) across the entire area.

If it is determined that a larger footprint is required, Phase III of the SCA would be constructed. This Phase III area, up to 16 acres, would be located to the north of the Phase I area (Drawing C-003). The combined footprint of Phases I, II, and III could contain up to 2,653,000 CY with geotextile tubes stacked five high (i.e., approximately 30 ft).

4.2.3 Wastebed 13 Surface and Subsurface Conditions

The SCA location within Wastebed 13 was selected because the existing grades already slope to low areas where liquids (i.e., filtrate and consolidation water from dewatering sediment and surface water) can be collected, and these slopes can be maintained even after settlement is taken into consideration. In addition, the location and footprint of the SCA were selected to preserve existing surface water flows outside of the SCA, as discussed in Section 4.3.4. This location selection is based on the information in the Data Package (Attachment B of Appendix A, "SCA Civil and Geotechnical Technical Memorandum") that indicates the potential for settlement varies across Wastebed 13 due to subsurface characteristics, including thickness and properties of underlying Solvay waste, and buried dikes.

4.2.4 Excavation and Import of Fill into Wastebed 13

The SCA layout minimizes the amount of excavation and fill placement that will be required during construction because it is located in an area of Wastebed 13 that already slopes to two low points. Minimizing the need for excavation and importing of fill were both considerations in the development of the SCA layout to reduce impacts to the community (e.g., truck traffic). Additionally, the minimization of excavation and import of fill is a requirement that is stated in Section 5 of the SOW, as follows, "The grading design for the SCA shall utilize the existing surface topography of Wastebed 13 as much as possible so as to limit wastebed cut and fill requirements and the associated need for a large volume of imported soil fill. Preloading and stabilization of the wastebed shall only be required to the extent necessary to ensure the integrity of the SCA components and underlying Solvay waste foundation, based upon the remedial design."

4.2.5 Operational Requirements

Geotextile tubes will be used to dewater the dredged slurry within the SCA. The slope of the area to be used for geotextile tube placement, the anticipated geotextile tube stacking height, and the control of liquids within the SCA are aspects of operations that were taken into consideration in developing the SCA layout. An area at Wastebed 13 with fairly uniform, gentle slopes towards two low points was selected for the SCA. This area achieves a balance between the requirements for operating the geotextile tubes and the drainage layer underlying the tubes. Specifically, geotextile tubes are typically operated on drainage areas that are relatively flat; however, the drainage system underlying the tubes is required to slope to two low points.

Tube stacking height is mostly a consideration under capacity; however, it is also important in terms of operations. As presented in Section 4.3.1, slope stability analyses were conducted using strength properties of the subsurface materials in Wastebed 13, potential geomembrane and geotextile tube materials, and dredge material that were established through analysis of laboratory and field test results. Results from the slope stability analyses indicate that geotextile tubes can be safely stacked five high in a given year; however, depending on the monitoring results (e.g., settlement and porewater pressures) and general observations during construction, it may be operationally advantageous to adjust the number of tubes stacked in a year and/or the active dewatering area. This operational flexibility was taken into consideration when developing the layout and the phased construction that is discussed in Section 4.4.

Other operational considerations when designing the SCA layout include the SCA dike height and the size and location of stormwater basins. The SCA dikes are required to contain the filtrate water from the geotextile tubes. In addition, the SCA dikes combined with the stormwater basins are required to prevent surface water from running onto or off of the SCA (see Figure 4.1 for basin locations). Specifically, the ability to contain a 25-year, 24-hour storm without overtopping the SCA dikes or stormwater basins was evaluated. The selection of dike height and stormwater basin size are discussed in more detail in Section 4.3.4.

The potential need for a temporary staging area was an additional consideration in terms of operations and the layout design (see Figure 4.1 for anticipated location). Some debris will be removed from the lake prior to dredging. Portions of that debris will be recycled (as practical), and other portions of the debris may be placed in a temporary staging area on Wastebed 13. In addition, slurry conditioning (which may be conducted prior to slurry transfer to the SCA) may include gravel and sand-sized particle separation with the resulting materials also being placed in the temporary staging area. During operations, these materials would be transferred to the SCA for permanent containment. The placement of this staging area to handle these temporary stockpiles was considered in developing the layout. These operational issues will be discussed in more detail in the Sediment Management Intermediate and/or Final Design.

4.3 ENGINEERING ANALYSES

The following subsections present the engineering analyses required to develop the drawings and specifications included in Appendix E. These design elements include slope stability, settlement, composite liner, liquids management, surface water control, and final cover.

4.3.1 Slope Stability Analyses

The SCA, as designed, is stable. Detailed slope stability analyses of the SCA under both interim (i.e., during SCA construction and operation) and long-term (i.e., post-closure) conditions are provided in Appendix G, "Slope Stability Analyses for SCA Design." The following subsections provide a summary of this evaluation.

4.3.1.1 Design and Performance Criteria

The stability of a slope is reported in geotechnical engineering terms as the "factor of safety." A factor of safety of 1.0 or greater is required for a slope to be stable. Due to the inherent variability in the engineering properties of soils, slopes are typically designed with a factor of safety greater than 1.0. Appropriate factors of safety for a given set of conditions were developed for the SCA considering the importance of the facility, and guidance provided by:

- U.S. Army Engineer Waterways Experiment Station Technical Report D-77-9 (Hammer and Blackburn, 1977); and
- U.S. Army Corps of Engineers (USACE) Engineering Manual EM 1110-2-1902 (USACE, 2003).

As discussed in the BOD (Attachment A of Appendix A, "SCA Civil and Geotechnical Technical Memorandum"), based on these guidance documents, a factor of safety of 1.3 was selected as an appropriate value to be used for interim static conditions (i.e., during construction and operation). In addition, a factor of safety of 1.5 was selected as an appropriate value to be used for long-term static conditions (i.e., post-closure). This factor of safety for long-term static conditions is consistent with NYSDEC Regulations Section 360-2.7(b)(6), which indicates a factor of safety of 1.50 for the final cover system under long-term static conditions. The site is not located in a seismic impact zone; therefore, a seismic slope stability analysis is not required.

4.3.1.2 Methodology

Slope stability analyses were performed using Janbu's and Spencer's method in the computer program SLIDE version 5.039 (Rocscience, 2006). Four potential slip modes were evaluated in the analyses: (i) block slip mode along geotextile tube interfaces, (ii) block slip mode along the composite liner system; (iii) circular slip surfaces through dredge material contained in geotextile tubes and Wastebed 13 foundation materials; and (iv) circular slip surfaces through existing Wastebed 13 perimeter dikes.

Information required for the static slope stability analyses included the slope geometry, the subsurface soil stratigraphy, the groundwater table elevation, the material properties of the subsurface soils, dredge material, liner and cover system materials, and the external surface loading, if any, at the selected cross section locations. Material properties obtained from previous investigations (as discussed in Section 3.1) and the results from interface testing on potential liner materials (as described in Section 3.2) were used in the analyses. In terms of geometry, it was assumed typical geotextile tube practices would be employed, which include stacking tubes such that each successive layer of tubes is approximately 20 ft shorter in total length than the tubes in the layer below, and the tubes in upper layers straddle the underlying tubes.

4.3.1.3 Results

Four potential slope stability slip modes were evaluated, and two cross sections were analyzed for each slip mode (i.e., one running perpendicular and one running parallel to the long direction of the geotextile tubes - see Figure 2 of Appendix G, "Slope Stability Analyses for SCA Design"). These cross sections were selected to represent the critical (i.e., worst) case cross sections. Interim conditions were analyzed for each slip mode, with up to five layers of geotextile tubes and a final cover. Final conditions were also analyzed for each slip mode for five layers of geotextile tubes with a final cover.

The calculated factors of safety for all four slip modes met or exceeded the appropriate values under both interim and long-term conditions (see Tables 2, 3, and 4 of Appendix G). Consolidation of the underlying Solvay waste will be monitored during construction, operation, and post-closure (if needed) to confirm that the SCA is performing as anticipated. Section 5.3 provides a summary of the geotechnical instrumentation monitoring plan.

The overall Wastebed 13 perimeter dike has an appropriate factor of safety for potential slip surfaces that pass through the proposed SCA. Since the stability of the Wastebed 13 perimeter dike is directly linked to the water level within the dike (i.e., porewater pressure), the water levels within the dike will be monitored during SCA operations. Details regarding this monitoring are provided in Section 5.3.

Slope stability analyses were performed using strength properties for the geotextile tubes and the geosynthetics in the composite liner system that were established based on laboratory testing of representative materials. Prior to installation, samples will be tested to confirm that the actual materials to be installed meet the range of acceptable liner system and geotextile tube to geotextile tube interface strength parameters (both peak and residual) that are provided in Appendix G.

4.3.2 Settlement Analysis

The composite liner system will perform properly during operations, closure, and post-closure, as designed. Detailed settlement analyses of the SCA under both interim (i.e., during SCA construction and operation) and long-term (i.e., post-closure) conditions are provided in Appendix H, "Settlement Analyses for SCA." The following subsections provide a summary of this evaluation.

4.3.2.1 Design and Performance Criteria

As detailed in the BOD (Attachment A of Appendix A, "SCA Civil and Geotechnical Technical Memorandum"), settlement calculations were required to evaluate the magnitude of settlement in the Solvay waste underlying the SCA and in the dredged material inside the geotextile tubes. Based on these settlement calculations, tensile strain was evaluated and compared to the maximum recommended tensile strain of 5% for the geomembrane liner (Berg and Bonaparte, 1993). In addition, the effect of settlement on grading was evaluated. In particular, the focus was on maintaining the composite liner grading towards the sumps and positive cover grading under operation and post-closure conditions.

4.3.2.2 Methodology

Conventional one-dimension (1-D) primary consolidation settlement and secondary compression settlement calculation methods were used to estimate the settlement due to SCA perimeter dike, composite liner, geotextile tube, and final cover placement. The foundation and dredged material settlement was calculated at the time of closure (i.e., at the end of year 4 or the fourth year of dredging) and 30 years after closure.

For purposes of the foundation settlement calculations, it was assumed that geotextile tubes containing all four years of dredged material were placed at the beginning of operations (i.e., year 1). For the dredged material settlement analyses, it was assumed that the loading was increased incrementally (i.e., geotextile tubes containing the first year of dredged material were placed at the beginning of year 1, etc. for subsequent years). Thus, the loading from subsequent years of tubes was included in the settlement calculations for the dredged material in the bottom tubes.

For the post-cover settlement calculations, the deformed geometry of the composite liner system, SCA perimeter dike, and the geotextile tubes estimated from the settlement analyses at closure (i.e., before cover placement) became the initial geometry. The proposed final cover system loading was assumed to be placed at the beginning of year 5.

Foundation and cover settlements were calculated using two different models, the surface settlement model (SSM) and the cross-section settlement model (CSM). The SSM produced post-settlement elevation and settlement contour maps for a deformed surface using approximately 2,300 settlement calculation points. The CSM produced similar results along a cross section. The main difference between SSM and CSM is that the CSM considered the load-induced stress distribution within the foundation Solvay waste and the dredge material in the geotextile tubes, while the SSM did not. The post-settlement contour maps produced using the SSM were used to evaluate whether positive drainage was maintained in the composite liner system and the final cover system. The post-settlement section figures produced using the CSM were used to evaluate the maximum strain in the geosynthetic components.

4.3.2.3 Results

Based on the settlement analysis, the liquids management system (i.e., the gravel layer) is anticipated to maintain an adequate slope to the sump areas (i.e., no slope reversals or local ponding) during the closure and post-closure periods. In addition, the proposed final cover is expected to perform properly during the post-closure period by maintaining positive drainage.

Using the SSM, the foundation settlement during the operations period was calculated to be 9 to 11 ft, and the settlement of dredge material in the geotextile tubes during the operations period was calculated to be 2 ft on average with a maximum of 4 ft. As compared to during operations, relatively small settlements were calculated for the post-closure period. The additional foundation settlement during the post-closure period was calculated to be 1 to 2 ft. The additional settlement of dredge material in the geotextile tubes during the post-closure period was calculated to be 1.5 ft on average with a maximum of 3 ft. Contour maps of the calculated post-settlement grades for these cases are provided in Appendix H, "Settlement Analyses for SCA." Any long-term development of local low points will be addressed during maintenance.

Using the CSM, the maximum tensile strain on the liner system was calculated to be 2.2% during the closure and post-closure periods, which is less than the maximum allowable tensile strain of 5% for geomembrane (see the Results Section of Appendix H for a more detailed explanation of this calculation). According to the analyses, liner tensile strains were typically in the sideslope and the SCA perimeter dike areas, not in the areas where the loading is more uniform. The maximum liner tensile strains typically occurred on the inner side of the dike sideslope area.

4.3.3 Composite Liner and Liquids Management System Design

The base composite liner system, which is designed to effectively protect site groundwater and is shown in Drawing C-009, consists of the following components from top to bottom:

- 24-inch (average) drainage layer (24-inch minimum in truck traffic areas);
- geotextile cushion;
- 60-mil LLDPE geomembrane liner; and
- 12-inch minimum (18-inch minimum at the sumps) low-permeability soil component with top 6 inches compacted to achieve a permeability less than or equal to $1x10^{-6}$ centimeters per second (cm/sec).

The liquids management system includes the drainage layer (which is also part of the base composite liner system), pumps, sumps, and risers, which are designed to handle the appropriate design flows. The design and performance criteria for these systems and the assumptions made and calculations performed to develop the liquid management system design are discussed in the subsections that follow.

4.3.3.1 Design and Performance Criteria

As indicated in the BOD (Attachment A of Appendix A, “SCA Civil and Geotechnical Technical Memorandum”), the composite liner and liquids management system is designed in accordance with the requirements of NYSDEC Regulations Part 360, Section 2.14(a). Since the efficiency (i.e., leakage relative to precipitation) of the SCA with the composite liner system defined above and the efficiency of the SCA with a Part 360 liner are both greater than 99.99%, it can be demonstrated that the proposed system will effectively protect groundwater quality at the site. These efficiency calculations are provided in Appendix I, “Evaluation of Hydraulic Performance for SCA Design.”

Because of the existing site conditions, a “landform”-type grading design was used. Specifically, the existing site topography was used, to the extent possible, in designing the grading of the composite liner and liquids management system. Therefore, the system is designed so that the drainage layer maintains a positive slope toward the sumps during operations and post-closure.

The intent of the composite liner and liquid collection system is to achieve a head no greater than 1 ft on the liner during operations and post-closure; however, consistent with Part 360, Section 2.14(a), heads greater than 1 ft in the sump areas and for some interim periods during operations may occur. Storm events and geotextile tube failures are examples of when there is a potential for temporarily exceeding 1 ft of head on the liner. As discussed in Section 4.3.4, temporary pumping (with the use of stormwater basins, as necessary) will be used to supplement the permanent sump pumps to control these exceedances. The details associated with the liquids management strategy under operational conditions will be included in the Sediment Management Intermediate and/or Final Design submittal.

The volume of liquids to be handled by the liquids management system will change significantly as the SCA transitions from operation to closure. Therefore, the liquids management system will have operational and post-closure phases. During operation, the liquids management system will collect filtrate and consolidation water from the geotextile tubes and precipitation that comes into contact with the tubes. For purposes of this discussion, “filtrate” refers to the water released from the tubes during the first 24 hours after filling, and “consolidation water” refers to the water released from the tubes after 24 hours. After SCA closure, the liquids management system will handle remaining consolidation water that is generated by the continuing dewatering of the dredge material within the tubes and precipitation that infiltrates through the SCA cover.

4.3.3.2 Liquids Management System Design

The liquids management system is designed for post-closure conditions, and it is designed to handle operational flows and precipitation when augmented with temporary pumps. Operational volumes will vary depending on precipitation events, dredge rate, dredge work schedule, and operation of the geotextile tubes. An estimate of the operational flow rates was provided in Appendix G of the Onondaga Lake Dredging, Sediment Management, and Water Treatment IDS (Parsons *et al.*, 2009). The location, in addition to the intensity, of these flows will vary throughout the four year operational period. Therefore, in order to maintain a head no greater than 1 ft in the drainage layer, a temporary pumping system with flexible hoses, in combination with the liquids management system, will be used to handle large flows on a temporary basis. Since stormwater is a major component of the flows that need to be managed during the operations phase, additional discussion regarding handling operational flows is provided in Section 4.3.4.

As presented in Appendix I, the Hydraulic Evaluation of Landfill Performance (HELP) software (Version 3.07 developed by the USEPA) was used to calculate a design inflow rate of 0.4 gallons per minute (gpm) for the entire SCA under post-closure conditions. To calculate the design inflow under these conditions, the final cover design discussed in Section 4.3.5 was assumed, along with the hydraulic conductivity of the dredge material and composite liner system components, SCA cover geometry, and local weather data (adjusted to include a 25-year, 24-hour rainfall). The calculated average and peak liquid head on the composite liner system under these conditions meets the 1 ft or less requirement.

As discussed in Appendix I, since placement of the final cover system (geomembrane in particular) will likely not occur immediately following the completion of tube filling, a target inflow rate of 15 gpm has been selected for the sump and riser design. The HELP analysis under these conditions also results in a calculated average and peak liquid head on the composite liner system that meets the 1 ft or less requirement.

Using the inflow assumption from above, Appendix J, "Sump and Riser Calculations for SCA Design" presents the detailed analyses required for the design of the pumps, risers, and sumps. Based on an inflow of 15 gpm and the composite liner grading, inflow values of 10 gpm towards the western sump area and 5 gpm towards the eastern sump area were assumed. The following calculations were performed as part of this design: (i) evaluation of the hydraulic requirements for the riser pipe perforations; (ii) evaluation of the structural stability of the riser pipe; and (iii) calculation of liquid storage volume and filling time for the sump area.

Based on these calculations, the recommended riser pipe is 5 ft in diameter, and the required sump excavation depth is 8 ft into the Solvay waste. The sump area design includes two separate riser pipes with pumps (a main and a backup) and a 10-ft offset between each riser pipe. Drawings C-005 and C-010 in Appendix E provide the detailed design of the sump grading, pumps, and risers of the liquids management system.

4.3.4 Surface Water Control System Design

The surface water control system design presented herein assumes that the surface water generated from the SCA will be handled separately from the surface water generated by the rest of the wastebed. The following sections describe the management of, and design for, the surface water to be generated by the SCA during construction, operations, and post-closure.

The surface water from the areas outside the SCA will be handled by the existing weir boxes, topographic features, and existing leachate collection system. The long-term effectiveness of the current leachate collection system will be evaluated as part of the closure of Wastebeds 9 through 15.

4.3.4.1 Design and Performance Criteria

The design and performance criteria for surface water management are provided in the BOD (Attachment A of Appendix A, "SCA Civil and Geotechnical Technical Memorandum"). In summary, the surface water management system will be designed to meet the project requirements for both temporary (i.e., during construction, operations, and closure of the SCA) and long-term conditions (i.e., after closure of the SCA). Furthermore, calculations for temporary and permanent surface water control structures will be performed using the 25-year, 24-hour storm event, as indicated in NYSDEC Regulations Section 360-2.7(b)(8)(ii). Finally, the "New York State Standards and Specifications for Erosion and Sediment Control" (NYSDEC, 2005) will be the guidance document used for this design.

4.3.4.2 Surface Water Management During Construction

Erosion and sediment control during SCA construction, operation, and winter shutdown will be addressed in a Stormwater Pollution Prevention Plan that will be provided as a pre-construction submittal. This plan will be consistent with the NYSDEC guidance document mentioned previously.

As part of the initial construction activities, Weir Box 6, which is located approximately in the center of Wastebed 13, will be abandoned by removing the wooden weir box structure down to a depth of 15 ft below the surface of the wastebed and then filling the entire weir box with slurry fill. A detail is provided on Drawing C-019 of Appendix E.

The integrity of Weir Boxes 5 and 7, which are located on the east and west sides of the SCA, respectively, should not be impacted by SCA loading based on a stress distribution analysis. This analysis indicated that the stress increase should not be significant.

Surface water that comes into contact with the surface of Wastebed 13 will be managed similarly to the existing management practices (i.e., surface water infiltrates and is collected by the existing leachate collection system). During construction of the SCA, surface water that has contacted the surface of Wastebed 13 and perched groundwater from sump excavations will be conveyed to the existing leachate pond through a temporary pumping and piping system. The requirements for this system are dependent upon the weather and construction phasing; therefore, the sizing of this temporary system depends on construction procedures and will be designed prior to construction.

After liner construction is complete and prior to geotextile tube placement, surface water generated from lined areas within the SCA will be non-contact water. This non-contact water will be directed off the wastebed into the existing surface water drainage system at the outside of Wastebed 13 and out through the existing State Pollution Discharge Elimination System (SPDES) discharge points. The SCA perimeter berms, pumps, and/or temporary aboveground piping will be used to convey the non-contact water to the existing surface water drainage system. Prior to construction, the amount of non-contact water to be generated will be estimated, and the impact of this water on the existing surface water drainage system's capacity and permit limitations will be evaluated. As with the temporary system for conveyance of contact water, this temporary system will be sized prior to construction.

4.3.4.3 Surface Water Management During Operations

Surface water within the active dewatering area (i.e., area where tubes have been placed) during operations and winter shutdown will be collected in the liquids management system and directed to the SCA WTP for treatment. Non-contact water from lined areas will be directed off the wastebed and out through the existing SPDES discharge points, as described in the previous subsection. Temporary stationary pumps, mobile pumps, and stormwater basins will be used to augment the liquids management system to provide adequate capacity to remove the precipitation, filtrate, and consolidation water from the SCA. At a minimum, the liquids management system during operations will have a pumping capacity equal to the expected generation rate (i.e., the design dredge rate) of filtrate and consolidation water which, when combined with the surge capacity provided in the stormwater basins, will meet the design objectives for managing liquids in the SCA. More details regarding this temporary system will be provided in the Sediment Management Intermediate and/or Final Design. Since the overall anticipated approach for this temporary system is the basis for the SCA berm height design, a general description is provided below.

During normal operations, a combination of temporary operational pumps located near the low-points of the north/south SCA perimeter berms and in the sump areas, along with the permanent sump pumps, will be used to remove water from the SCA and pump it directly to the

SCA WTP. Additional mobile pumps and aboveground piping will likely be deployed around the SCA to move ponded water to the temporary operational pumps for conveyance to the WTP. As necessary during and following precipitation events, the stormwater basins shown on Figure 4.1 will be used to manage the additional liquids that will be generated. The use of these basins will depend on the storm severity, the lined area, and the area covered with geotextile tubes.

Given the approach described above, the SCA perimeter berm height and the stormwater basin size and berm height were optimized so that a 25-year, 24-hour storm could be contained within the SCA and stormwater basins without overflowing onto the rest of Wastebed 13. This optimization was performed for the condition where the entire lined area (i.e., 65 acres) has been constructed and covered with at least one layer of geotextile tubes, which is expected to be the case that requires the most storage. More details regarding this design are provided in Appendix K, "Operations and Final Cover Surface Water Management System Design." The stormwater basin designs will be provided in the Sediment Management Intermediate and/or Final Design.

4.3.4.4 Surface Water Management Post-Closure

Under the post-closure condition, the SCA will be covered and all surface water runoff will be non-contact water. A surface water management system has been designed to route surface water off the SCA to Wastebed 13 in a controlled manner. Appendix K provides the analyses required to develop the surface water management system for the SCA under this condition. This conceptual surface water management system (Drawing C-014), which was developed for a 25-year, 24-hour design storm, includes the following features:

- diversion berms;
- riprap chutes;
- toe drainage channels; and
- perimeter culverts.

The analyses presented in Appendix K use the post-settlement grades at closure calculated in Appendix H, "Settlement Analyses for SCA," as a basis for this design. Settlement measurements obtained using the geotechnical monitoring system (see Section 5.3), will be used to update the surface water management design prior to construction of the final cover.

As stated above, the non-contact water handled by the surface water management system described above will be directed off the SCA to Wastebed 13. The management of this water, along with the surface water from the remainder of the wastebed, will be handled in a manner consistent with the closure of the other wastebeds.

4.3.5 Final Cover Design

The SCA final cover system components and slopes are designed to account for settlement of the subgrade material, to promote positive drainage, to provide stable slopes, and to minimize erosion. In accordance with the SOW, the cover system is designed per NYSDEC Regulations Part 360, Section 2.14(a), which allows modifications to the subpart requirements on a case-specific basis. The specific components of the system are as follows from top to bottom (see detail on Drawing C-017):

- 6-inches of topsoil;
- 24-inches of barrier protection soil; and
- 40-mil LLDPE geomembrane.

In addition, the sideslope cover system will include a geocomposite drainage layer between the protection soil and the geomembrane. The type of vegetation (e.g., grasses, shrubs, etc.) that will be planted after topsoil placement is completed will be established when the final cover design is finalized.

Veneer stability analyses on this final cover configuration indicate that the cover system will be stable (i.e., have an adequate factor of safety). These analyses are provided in Appendix L, “Final Cover Veneer Stability Analyses for SCA Design.”

Drawing C-012 in Appendix E shows the estimated grades (average 0.5% slope) of the top of geotextile tube surface prior to final cover placement. These grades were estimated using the settlements calculated in Appendix H, “Settlement Analyses for SCA,” for the end of year 4 (i.e., after operations have been completed). As geotextile tube placement proceeds during operations, settlements will be monitored. These settlement data will be used to finalize the cover design after completion of geotextile tube operations.

As shown in Drawing C-012, a “landform” type design was selected for the final cover. The process for selecting this approach required consideration of several different cover slope alternatives. This selection process is discussed in the following paragraphs.

First, a cover system with 4% slopes was evaluated and eliminated from consideration. Based on the grades shown on Drawing C-012 in Appendix E, it is estimated that approximately 35 ft of material would be required in the center of the SCA to create a 4% slope from the center to the edge. This system was not selected because the additional height would increase the visual impact of the SCA on the community, and the larger fill volume would significantly increase truck traffic and require several years to place on the SCA to avoid loading the underlying subgrade too quickly. Increasing the footprint and using tubes to achieve the slopes would be another option to create greater slopes; however, as discussed in Section 4.2, the footprint was developed based on a rigorous evaluation that took into consideration construction, operation, and post-closure conditions. Therefore, 4% slopes were not considered further.

Second, a saw-tooth pattern was evaluated and eliminated from consideration. Significantly less material is required for this option as compared to the previous one; however, the variation in loading across the SCA could result in grade reversals in the base composite liner system because of the highly compressible nature of the Solvay waste foundation. Because of this concern and the importance of maintaining drainage towards the sumps, this option was not considered further.

Finally, maintaining (in general) the grades that develop due to placement of the geotextile tubes was considered (i.e., a "landform" type design) and selected as the preferred approach. Under this option, the final cover will generally follow the top of the geotextile tube surface, which will be established by the initial base composite liner grading (gentle sloping grades to two low points), geotextile tube placement, and settlements due to liner and geotextile tube placement. Since the base composite liner grades at the end of year 4 are sufficient to maintain positive drainage toward the sumps, placement of a relatively uniform final cover will achieve relatively consistent settlement across the SCA, thus maintaining the positive slope. In addition, this method minimizes the amount of required fill material and associated loading.

For the preferred approach, the predicted settlement of the cover system shows positive drainage through the 30-year post-closure period that was evaluated. These settlement analyses were performed assuming the final cover system proposed above, as indicated in Section 4.3.2. The results also indicate that compared to the settlement that occurs prior to final cover placement, the settlement during the post-closure period is relatively small. Therefore, the settlement analyses indicated that average slopes of 0.5% at closure are sufficient to achieve long-term positive drainage. In addition, it is also assumed that low spots due to differential settlement will be regraded prior to completion of the cover, and the Post-Closure Care Plan will address issues related to cover maintenance.

4.4 SCA CONSTRUCTION

The SCA design that was developed based on the calculation packages presented in the previous sections is provided in Appendix E, "Drawings and Specifications." The following sections describe certain aspects of the design in detail, specifically, the proposed SCA base composite liner construction phasing, the appropriateness of preloading, the material sources for SCA liner and cover construction, material staging and support areas, and traffic routes. Operational considerations associated with the geotextile tubes (e.g., stability during filling, tube placement sequence) will be addressed in the Sediment Management Intermediate and/or Final Design.

4.4.1 Composite Liner Construction Phasing

The SCA composite liner system will be constructed in phases, which will minimize impacts to the community each year and best allow for the work to be performed within the capabilities of the local construction and material markets. The phased construction will also allow flexibility in total and yearly volume needs, as described in Section 4.2.2. The phasing plan for the SCA construction is presented in Drawings C-003, C-004, and C-006.

4.4.2 Operation Support Areas

In addition to the SCA, the Wastebed 13 area may also be used for siting of a slurry conditioning operation, temporary staging area (i.e., staging of debris and/or gravel- and sand-sized particles), WTP facility, water storage facilities, and necessary support facilities for these operations. Figure 4.1 presents potential areas for these facilities. The actual areas required for these operations will be established in the Sediment Management Intermediate and/or Final Design.

4.4.3 Preloading

Preloading and stabilization under the SCA or its berms are not required. The SCA is designed to accommodate settlement of the underlying materials of Wastebed 13 and will provide secure containment and a functioning liquids management system during operations and post-closure. If specific preloading is required for WTP or processing equipment, it will be included in the Sediment Management Intermediate and/or Final Design. Stockpiling SCA low-permeability soil, engineered fill, and/or gravel will be considered for support area preloading, if needed.

4.4.4 Material Sources

Materials to be used in SCA construction include low-permeability soil, geomembrane, geotextile, gravel, and engineered fill for the SCA perimeter berms. The engineered fill, low-permeability soil, and gravel are expected to be available locally and will be delivered to the site by truck. Approximately 87,000 CY of berm material (i.e., engineered fill), 271,000 CY of low-permeability soil, and 204,000 CY of gravel will be required (see Appendix F, "Volume Calculations for SCA Design"). Geomembrane and geotextile will be obtained from yet-to-be determined sources and will also be delivered to the site via truck. Approximately 2,800,000 SF of geomembrane and geotextile will be required. The quantities provided are for the 65-acre footprint that corresponds to a SCA capacity of 2,653,000 CY and would be phased over three separate construction periods.

4.4.5 Traffic Routes

The impact on the community because of increased truck traffic will be minimal, and all the proposed routes discussed below will be considered in the development of a Traffic Management Plan prior to construction. Truck traffic within the Wastebed 12 through 15 area will follow the existing gravel roads around, and in-between, the wastebeds so only minimal modifications to those existing gravel roads are expected to be required. The Traffic Management Plan will also address delivery of materials to the appropriate locations within the Wastebed 12 through 15 area.

Off-site traffic to and from the Wastebed 12 through 15 area will be via the existing access points as shown on Figure 4.2. Traffic routes that will potentially be utilized to get to and/or from the site are:

- Gere Lock Road (west of 695);
- Warners Road, Belle Isle Road;
- Milton Avenue, Warners Road, Belle Isle Road;
- Airport Road, Armstrong Road, State Fair Blvd; and
- Bridge Street (via LCP site).

Table 4.1 presents the Annual Average Daily Traffic (AADT) on the proposed existing roads mentioned previously, as documented by Syracuse Metropolitan Transportation Council (http://www.smtcmpo.org/data/TrafficCounts):

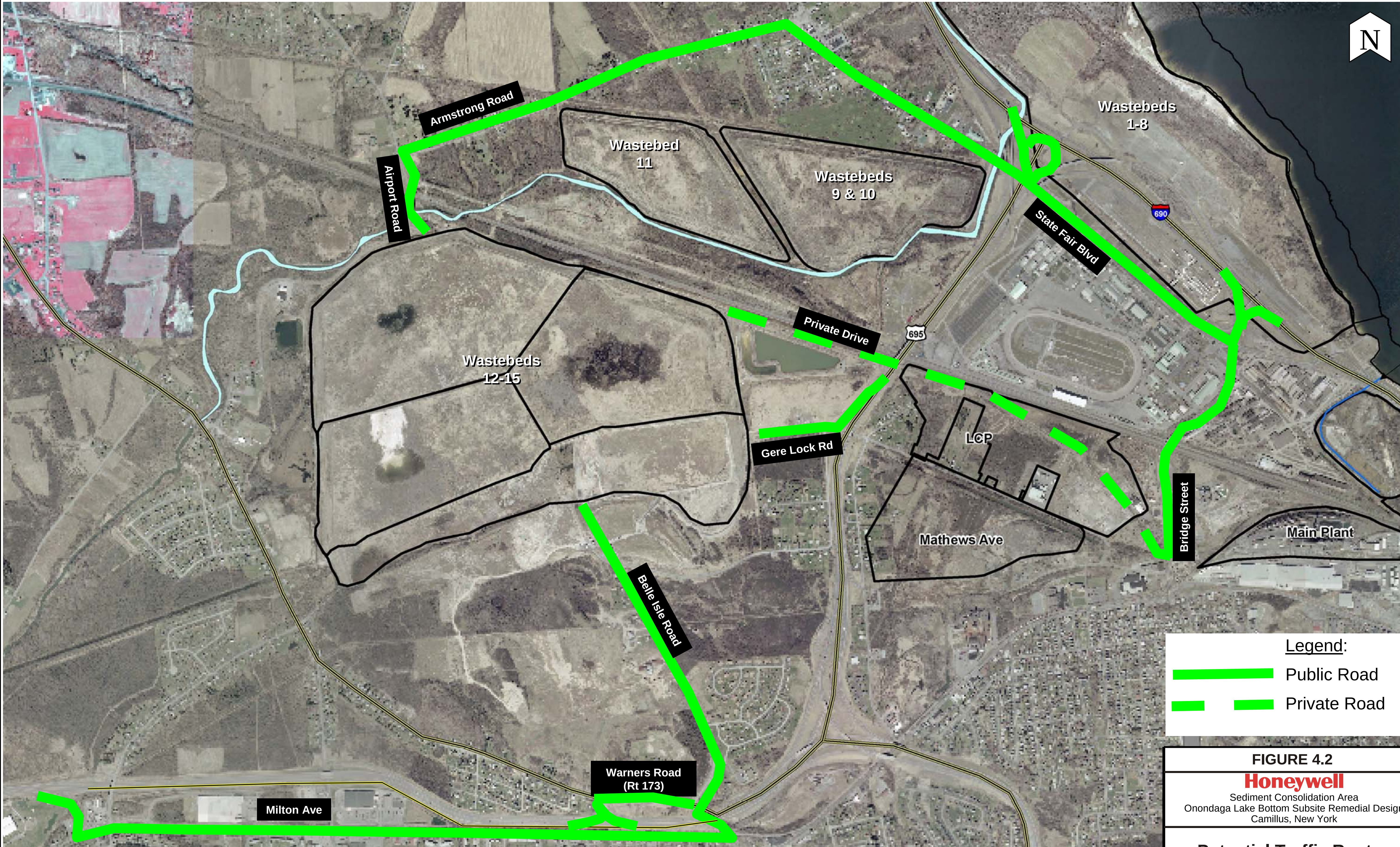


FIGURE 4.2

Honeywell

Sediment Consolidation Area
Onondaga Lake Bottom Subsite Remedial Design
Camillus, New York

Potential Traffic Routes

PARSONS

301 Plainfield Road * Suite 350 * Syracuse, NY 13212 * Phone: (315) 451-9560

P:\Honeywell-syr\444853\10\10.9\figure 4.2.ppt

TABLE 4.1

ANNUAL AVERAGE DAILY TRAFFIC

Road	Segment	Average Annual Daily Traffic (AADT)
Gere Lock Road	Thomas Avenue Ext - Solvay Village Line	1,147
Warners Road	Belle Isle - Rte 695 On/Off Ramps	5,997
Belle Isle Road	Warners - Thomas Ave	1,839
Milton Avenue	Hinsdale – Warners	7,606
Airport Road	Airport Road - 2.2 Mi SSE Of Int 39 - Cr 100/106 Over Conrail	2,900
Armstrong Road	Armstrong Road - Town Ln - Cr 80	1,750
State Fair Blvd	State Fair Boulevard - Rt 690 On Ramps - NY State Fairground Entrance	6,600
Bridge Street	Bridge Street - State Fair Boulevard - Matthews Avenue	8,950

New York State Department of Transportation (NYSDOT) data show that the percentage of heavy trucks to the total vehicle count was 7% and 11%, for Warners Road and State Fair Boulevard, respectively. These traffic counts by vehicle type data were obtained from the following website: http://gis.nysdot.gov/tdv/main.asp. For this comparison, heavy vehicles are defined as buses and trucks with 2 or more axles. Based on the AADTs presented above, this is equivalent to 420 and 726 heavy vehicle trips per day for Warners Road and State Fair Boulevard, respectively.

As indicated previously, approximately 2,800,000 SF of geomembrane and geotextile will be required. In addition, the total volume of dike and liner earthen materials is 562,000 CY. At a truck volume of 15 CY, this is 37,500 truckloads. As stated in Section 4.4.1, construction is expected to occur in three phases (i.e., three different construction seasons); therefore, the average trucks per day are 70 for three 180-day construction seasons.

Based on the above calculations, the expected average daily truck traffic due to SCA construction is significantly lower than the AADT for each of the proposed traffic routes and also significantly lower than the measured daily heavy vehicle traffic (on routes with data available).

SECTION 5

PLANS

5.1 SCA PLANS

Plans have been prepared to ensure proper construction of the SCA, to monitor stability, settlement, and water levels during SCA construction and operation, to monitor groundwater quality, and to provide post-closure monitoring of the SCA.

5.2 CONSTRUCTION QUALITY ASSURANCE PLAN

The Construction Quality Assurance Plan (CQAP) presents the procedures and protocols that will ensure the construction of the SCA will be executed in accordance with the approved design documents. The CQAP, which was developed in accordance with NYSDEC Regulations Part 360, Sections 2.8 and 2.13, is provided in Appendix M.

5.3 GEOTECHNICAL INSTRUMENTATION AND MONITORING PLAN

The Geotechnical Instrumentation and Monitoring Plan is provided in Appendix N and includes the procedures for installing, monitoring, and maintaining vibrating wire piezometers, settlement cells, inclinometers, and settlement profilers, which are shown on Drawing C-007. These instruments will be used to monitor water levels, settlement, and stability during construction, operations, and post-closure, as needed.

5.4 GROUNDWATER MONITORING PLAN

The SCA is designed to contain the dredged material on Wastebed 13, which is a portion of the Wastebeds 9 through 15 site. Therefore, the detailed groundwater monitoring plan for the SCA will be included as part of the Wastebeds 9 through 15 Groundwater Monitoring Plan. The plan for the SCA will include monitoring wells installed on approximately 500-ft spacing downgradient of the SCA (i.e., along the northern perimeter of Wastebed 13) and 1,500-ft spacing upgradient of the SCA (i.e., in between Wastebeds 12 and 13 and Wastebeds 13 and 14) for a total of approximately 16 monitoring wells, some of which are existing wells. All the wells will be screened in native material. One year of baseline monitoring will be performed prior to dredge material placement in the SCA.

5.5 POST-CLOSURE CARE PLAN

The Post-Closure Care Plan is provided in Appendix O and includes the site monitoring requirements associated with the final cover, liquid management system, surface water control, and geotechnical instrumentation. In addition, the required documentation for the inspection, operation, and maintenance activities that will occur during the post-closure period is provided, along with details regarding citizen participation and site access.

SECTION 6

SUBCONTRACTING STRATEGY

An integrated team of in-house resources, teaming partners, and key subcontractors will execute the final design and implementation of the entire remedial action. The design team will interact with the personnel that will execute the construction and operations to ensure that the final design components are complete, implementable, and meet the project objectives. In addition, key members of the design team will have functional quality assurance/quality control responsibilities during the construction efforts.

The design and subcontracting strategy for the SCA construction component of the remedy will be a design-bid-build approach. The design under this approach has incorporated agency review with public input into this final design. It is anticipated that subcontractor selection will be completed after approval of the final design. The construction of the SCA will be accomplished in conjunction with surface water controls for the site. Operations of the SCA during sediment dewatering will be subcontracted separately from the SCA construction.

SECTION 7

DESIGN SUBMITTAL AND CONSTRUCTION SCHEDULE

Critical to the success of the lake remedial action is the sequencing of events and interrelations of design and construction activities to ensure the process is efficient and completed within the appropriate timeframe. A logical progression of the decisions, analysis, and planning needed to execute the work was established during the initial design phase. This section outlines the schedule milestones established to accomplish the SCA civil and geotechnical design aspects of the remedial action consistent with the Consent Decree schedule requirements. The schedule is based on receipt of NYSDEC comments within 60 calendar days of submittal.

SCA CIVIL & GEOTECHNICAL DESIGN & CONSTRUCTION MILESTONES	
Submit SCA Civil & Geotechnical Final Design to NYSDEC	5/31/2010
Mobilize/Start Site Preparation	8/15/2010
Start Phase I SCA Construction	5/31/2011
Complete Phase I SCA Construction	12/31/2011
Start Dredging	5/31/2012
Start Phase II SCA Construction	5/31/2012
Complete Phase II SCA Construction	12/31/2012
Start Phase III SCA Construction (if needed)	TBD (based on need)
Start SCA Cover Construction (phased approach)	TBD (based on sediment consolidation rates)

SECTION 8

REFERENCES

Berg R.R. and Bonaparte R., "*Long-Term Allowable Tensile Stresses for Polyethylene Geomembranes,*" Geotextile and Geomembranes, Vol. 12, 1993, pp. 287-306.

Hammer, D.P., and Blackburn, E.D., "*Design and Construction of Retaining Dikes for Containment of Dredged Material*", Technical Report D-77-9, U.S. Army Engineer Water Experiment Station, Vicksburg, Mississippi, August 1977, pp. 93.

New York State Department of Environmental Conservation. *New York State Standards and Specifications for Erosion and Sediment Control.* 2005.

New York State Department of Environmental Conservation and United States Environmental Protection Agency Region 2. 2005. Record of Decision. *Onondaga Lake Bottom Subsite of the Onondaga Lake Superfund Site*. July 2005.

New York State Department of Environmental Conservation Region 7. 2009. *Citizen Participation Plan for the Onondaga Lake Bottom Subsite Remedial Design Program.* March 2009.

New York State Department of Environmental Conservation and United States Environmental Protection Agency Region 2. 2009a. Record of Decision. *Operable Unit 1 of the Geddes Brook/Ninemile Creek Site, Operable Unit of the Onondaga Lake Bottom Subsite, Onondaga Lake Superfund Site*. April 2009.

New York State Department of Environmental Conservation and United States Environmental Protection Agency Region 2. 2009b. Record of Decision. *Operable Unit 2 of the Geddes Brook/Ninemile Creek Site*. October 2009.

O'Brien & Gere. 2009. *Onondaga Lake Remedial Design SCA Water Treatment Plant Intermediate Design Submittal.* Prepared for Honeywell. October 2009.

Parsons and Anchor QEA. 2009. *Draft Onondaga Lake Capping and Dredge Area and Depth Initial Design Submittal*. Prepared for Honeywell. December 2009.

Parsons and Geosyntec. 2008. *Onondaga Lake Pre-Design Investigation: Wastebed 13 Settlement Pilot Study Data Summary Report.* Prepared for Honeywell. June 2008.

Parsons and Geosyntec. 2009. *Draft Onondaga Lake Sediment Consolidation Area Civil and Geotechnical Initial Design Submittal.* August 2009.

Parsons in association with O'Brien & Gere and Anchor. 2009. *Draft Onondaga Lake Dredging, Sediment Management, and Water Treatment Initial Design Submittal.* Prepared for Honeywell. February, 2009.

Parsons. 2006. *Onondaga Lake Sediment Consolidation Area (SCA) Siting Evaluation*. Prepared for Honeywell, Syracuse, New York. September 2006.

Parsons. 2009a. *SCA Dewatering Evaluation Report*. Prepared for Honeywell, Morristown, NJ. February 2009.

Parsons. 2009b. *Onondaga Lake Pre-Design Investigation Phase IV Work Plan, Addendum 6.* Prepared for Honeywell, Morristown, NJ. March, 2009.

Parsons. 2009c. *Remedial Design Work Plan for the Onondaga Lake Bottom Subsite*. Prepared for Honeywell, Morristown, NJ. March 2009.

Parsons. 2009d. *Sediment Consolidation Area Technical Memorandum.* Prepared for Honeywell. August, 2009.

Parsons. 2009e. *Onondaga Lake Pre-Design Investigation: Phase II Data Summary Report.* Prepared for Honeywell. August 2009.

Parsons. 2009f. *Onondaga Lake Pre-Design Investigation: Phase III Data Summary Report.* Prepared for Honeywell. September 2009.

Rocscience, "*SLIDE – 2-D Limit Equilibrium Slope Stability for Soil and Rock Slopes,*" User's Guide, Rocscience Software, Inc., Toronto, Ontario, Canada, 2006.

United States District Court, Northern District of New York. 2007. State of New York and Denise M. Sheehan against Honeywell International, Inc. Consent Decree Between the State of New York and Honeywell International, Inc. Senior Judge Scullin. Dated October 11, 2006. File January 4, 2007.

United States Environmental Protection Agency Region 2. 2009. *Clean and Green Policy.* March 17, 2009.

U.S. Army Corps of Engineers (USACE), "Engineering and Design – Slope Stability", Engineering Manual EM 1110-2-1902, October 2003, pp. 3-2.

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