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September 30, 2014

Mr. Tracy A. Smith
Project Manager
NYSDEC Div. of Environmental Remediation
Remedial Bureau D - 12th floor
625 Broadway
Albany, NY 12233-7013

RE: Upper Harbor Brook IRM Construction Completion Report Response to Comments
Town of Geddes, Onondaga County, New York
Order on Consent: Index # D7-0008-01-09

Dear Mr. Smith:

Attached please find responses to the Department's July 3, 2014 comment letter on the *Upper Harbor Brook IRM Construction Completion Report* along with the revised completion report, which were prepared by O'Brien & Gere on behalf of Honeywell.

Please contact Marc Dent at O'Brien & Gere (315-956-6258; marc.dent@obg.com) or me if you have any questions.

Sincerely,

John P. McAuliffe by CCC

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

Enc. (2 copies, 2 CDs)

cc:	Mark Sergott	NYSDOH (1 CD)
	Harry Warner	NYSDEC (1 copy, 1 CD)
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	Margaret A. Sheen, Esq.	NYSDEC, Region 7 (ltr only)
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UPPER HARBOR BROOK IRM CONSTRUCTION COMPLETION REPORT RESPONSE TO COMMENTS

Listed below are responses to the Department's July 3, 2014 comment letter on the *Upper Harbor Brook IRM Construction Completion Report* (CCR). For ease of review, the Department's comments are provided below, followed by our responses. The response includes an explanation of how details have been incorporated into the revised CCR or corresponding attachments, as applicable.

GENERAL COMMENTS

Comment 1. *Page 2, Bullet 4, Section 2.2. This bullet should be revised to state "Installation of two groundwater collection trenches..."*

Response 1: The IRM consisted of the installation of three groundwater collection trenches: Harbor Brook-1 collection trench, Harbor Brook-2 collection trench, and I-690 Drainage Ditch collection trench. Bullet 1 was revised to state "Installation of three groundwater collection trenches..."

Comment 2. *Page 5, Table 2-1. It is indicated here that wetland area WRR-2 was expanded to compensate for the lost wetland acreages on the Penn-Can property. However, as noted elsewhere in the report, the mitigation included expansion of wetland areas WRR-1, WRR-3, and WRR-4, as well as WRR-2. Please revise accordingly.*

Response 2: Table 2-1 summarizes formal field modifications. WRR1, WRR3, and WRR4 were expanded incidentally during construction (prior to the removal of the Penn-Can wetlands), but not as a result of a formal NYSDEC-approved field modification. As such, we do not propose to modify table 2-1.

Comment 3. *Section 3.8.1. A discussion of where NAPL was observed (e.g., open water areas, collection trenches, drainage ditches), how it was managed (e.g., left in place, collected and disposed of off-site), and why the NAPL collection sumps were installed in the open water areas where they were should be included.*

Response 3: Section 3.5 has been revised to include a discussion regarding NAPL observations and management and the installation of NAPL collection sumps.

Comment 4. *Page 20, Paragraph 1, Section 3.13.1. In this paragraph it states that 12 waste characterization samples were collected. However, only 11 sample results are included in the Table 2 series. Please revise.*

Response 4: The text has been revised to state that 11 waste characterization samples were collected.

Comment 5. *.Page 27, Paragraph 7, Section 7. Consistent with the information on wetland construction presented in Section 3.9, the discussion on mitigation of the Penn-Can wetlands should include increased acreage at WRR-1. Please revise accordingly.*

Response 5: The text has been revised to include a discussion of the additional wetland acreage at WRR1.

Comment 6. *Page 27, Paragraph 7, Sentence 4, Section 7. In order to be consistent with the wetland designations used elsewhere in this report, "WLRR3" and "WLRR4" should be replaced with "WRR3" and "WRR4", respectively. Please revise accordingly.*

Response 6: The text has been revised for consistency, as requested.

Comment 7. *Figure 4. The figure should show the staging areas/characterization pile areas in more detail.*

Response 7: Figure 4 has been updated to show the staging areas/characterization pile areas in more detail.

Comment 8. *Table 2 series. In these tables, sample results should be compared to the appropriate levels (e.g., TCLP, Part 375 industrial levels). Please revise.*

Response 8: The table 2 series has been revised to include Regulatory and Restricted Use Limits, as appropriate.

Comment 9. *Table 2 series. A description of the sampling locations should be included (e.g., include a table that states where the samples were collected from).*

Response 9: As requested, a new table (2H), including a description of the waste characterization sampling locations has been added.

Comment 10. *Table 2C. The table title indicates "TCLP Volatile Organic Compound Data"; however, the table provides results for inorganic parameters. Please revise.*

Response 10: The title of Table 2C has been revised to read: "Method 6010/7470 TCLP Inorganic Data."

Comment 11. *Table 3C. As we discussed on July 1, 2014, the mercury concentrations for samples UHB-DH-13 through UHB-DH-17 are incorrect and will need to be revised.*

Response 11: Table 3C has been revised to show the correct mercury concentrations.

COMPLETION REPORT

Upper Harbor Brook IRM Construction Completion Report

Honeywell

September 2014

O'BRIEN & GERE

CERTIFICATIONS

I, **Brian E. White**, certify that I am currently a New York State registered professional engineer. I had primary direct responsibility for the implementation of the remedial program activities, and I certify that the Remedial Design was implemented and that construction activities were completed in substantial conformance with the Department of Environmental Remediation-approved Remedial Design Report and subsequent modifications.

072730	9/30/14	Brian E White
NYS Professional Engineer #	Date	Signature

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LIST OF ACRONYMS

Acronym	Definition
AQM	Air Quality Monitoring
CAMP	Community Air Monitoring Plan
CCR	Construction Completion Report
CCTV	Closed Circuit Television
cm/sec	Centimeters Per Second
CPP	Citizen Participation Plan
CQAPP	Construction Quality Assurance Project Plan
CMP	Corrugated Metal Pipe
FRP	Fiberglass Reinforced Plastic
GWTP	Groundwater Treatment Plant
HASP	Health and Safety Plan
IRM	Interim Remedial Measure
LLDPE	Linear Low Density Polyethylene
MMP	Materials Management Plan
NAPL	Non-Aqueous Phase Liquid
NYSDEC	New York State Department of Environmental Conservation
NYSDOT	New York State Department of Transportation
O&MM	Operation and Maintenance Manual
OIT	Operator Interface Terminal
OMI	Operations Management International
OP	Observation Port
OU	Odor Unit
OW	Open Water
P&ID	Process and Instrumentation Diagram
PAH	Polycyclic Aromatic Hydrocarbon
PPM	Parts Per Million
ROD	Record of Decision
SVOC	Semivolatile Organic Compound
SWPPP	Storm Water Pollution Prevention Plan
TCLP	Toxicity Characteristic Leaching Procedure
TVOC	Total Volatile Organic Compound

µg/L	Micrograms Per Liter
µg/m^3	Micrograms Per Cubic Meters
USGS	United States Geological Survey
VFD	Variable Frequency Drives
VOC	Volatile Organic Compound
VV	Valve Vault
WMP	Water Management Plan

1. INTRODUCTION

This Construction Completion Report (CCR) documents the Interim Remedial Measure (IRM) for the Upper Harbor Brook Site (the Site) in Geddes and Syracuse, New York. This report has been prepared in accordance with the requirements of the DER-10 Technical Guidance for Site Investigation and Remediation (NYSDEC, 2010) by O'Brien & Gere on behalf of Honeywell International, Inc.

This CCR provides a summary of the Upper Harbor Brook portion of the Wastebed B/Harbor Brook IRM at the Site as set forth in the Order of Consent (Index # D7-0008-01-09) between Honeywell International, Inc (Honeywell) and the New York State Department of Environmental Conservation (NYSDEC) issued in December, 2003 (NYSDEC, 2003). For the purposes of this document, the Upper Harbor Brook activities will be referred to as "the IRM".

1.1 SITE LOCATION, DESCRIPTION, AND HISTORY

Harbor Brook originates southwest of Syracuse, New York, in the Town of Onondaga and flows through the western side of Syracuse prior to discharging to the southwest corner of Onondaga Lake. Harbor Brook drains a watershed of approximately 13.2 square miles (Blasland & Bouck, 1989). According to United States Geological Survey (USGS) data, the 10-year and 20-year average flow rate is approximately 11.5 cubic feet per second. The NYSDEC classifies Harbor Brook as a Class C stream, designating it as a water body that supports fisheries and is suitable for non-contact activities.

The Site is located on the border of the City of Syracuse and the Town of Geddes, and is proximate to Onondaga Lake's southwest shoreline as shown in **Figure 1.** The IRM project includes the following areas (refer to **Figure 2**):

- Harbor Brook from Culvert-1 upstream to Open Water (OW)-5
- I-690, Penn-Can, and Wastebed D/E Drainage Ditches
- Railroad Ditches-1 and -2
- Six wetland areas
- Sections of the I-690 storm sewer system

The Site is located within several properties with multiple owners. A list of the owners is provided below and a property map is included as **Figure 3**.

- Honeywell International Inc.
- CSX Transportation
- New York, Susquehanna & Western Railway
- City of Syracuse
- New York State Department of Transportation
- Onondaga County Industrial Development Agency
- Onondaga County
- Duke Malavenda Realty LLC
- Hiawatha Associates LLC (Romano)
- Powder Mill Corporation (Lamar Advertising)

Surveys, maps, metes, and bounds for properties associated with the permanent structures installed as part of this IRM are included in **Exhibit 1**.

2. SITE REMEDY SUMMARY

This section includes a summary of the IRM objectives, a description of the selected remedy, governing documents, and field modifications. **Table 1** provides a summary of the chronology of events from submitting the design documents through completion of construction. **Table 2-1** summarizes field modifications that document changes to the IRM design.

2.1 IRM OBJECTIVES

The Record of Decision (ROD) for the Onondaga Lake Bottom Site (NYSDEC and USEPA, 2005) notes that "the control of contamination migrating from…upland sub-sites to Onondaga Lake is an integral part of the overall remediation of Onondaga Lake." The objectives of the IRM were described in the NYSDEC-approved Upper Harbor Brook IRM Final Design Report (O'Brien & Gere, 2012a). The objectives are to eliminate, to the extent practicable:

- the discharge of impacted ground water and non-aqueous phase liquid (NAPL) into Harbor Brook and Onondaga Lake,
- the potential human health and ecological impacts associated with Site's constituents of concern,
- the potential impacts to fish and wildlife resources associated with on-going discharges of contaminants of concern from the Site.

2.2 DESCRIPTION OF SELECTED REMEDY

To achieve the IRM objectives, the remedial design included:

- Installation of three groundwater collection trenches with slotted piping, two pump stations, and force mains adjacent to Harbor Brook for hydraulic control of impacted groundwater discharging to Harbor Brook. Discharge from the pump stations enters the East Wall force main at valve vault 6A (VV-6A) and is treated at the Willis Avenue Groundwater Treatment Plant (GWTP)
- Excavation of sediments, installation of a geomembrane liner or concrete, and restoration of the substrate in OW areas -1, -2, -3, and -4 in Harbor Brook
- Cleaning and sealing of Culverts-2, -3 (east and west), -4, and -5 in Harbor Brook and two culverts in Railroad Ditches-1 and -2, as required
- Excavation of sediments from the I-690 Drainage Ditch, Penn-Can Drainage Ditch, Wastebed D/E Drainage Ditch, Railroad Ditches-1 and -2, and restoration of the ditch substrate
- Installation of a geomembrane liner and groundwater collection trench beneath the I-690 drainage ditch
- Installation of 150 feet of geomembrane liner under the downstream section of the Wastebed D/E drainage ditch (starting at OW-3)
- Excavation of sediment and restoration of substrate in wetland areas WRR1, WRR2, WRR3, WRR4, WRR5, and WL6 to provide storm water detention, improved water quality, and improved habitat. As approved by NYSDEC, areas WPC1, WPC2, and WPC3 were not restored as wetlands but the excavation of sediment and the restoration of substrate were conducted. To provide compensatory acreage, wetlands WRR1, WRR2, WRR3, and WRR4 were expanded. Cleaning and televising of sections of the I-690 storm sewer conveyance system that discharge to the I-690 drainage ditch
- Installation of a passive NAPL collection system in OW-1, -3, and -4

Details of the groundwater collection systems and pump stations are presented in the Record Drawings in **Appendix A** and in the Upper Harbor Brook IRM Final Design Report (O'Brien & Gere, 2012a).

2.3 GOVERNING DOCUMENTS

2.3.1 Contractor Governing Documents

O'Brien & Gere served as the Contractor for construction of this IRM. O'Brien & Gere developed plans (listed below) and submittals, and reviewed Subcontractor submittals for compliance with the design documents. Work was performed in general compliance with the following plans and subsequent NYSDEC-approved field modifications to the design:

- *Health and Safety Plan*. The Health and Safety Plan (HASP) described the approach and implementation of health and safety procedures (O'Brien & Gere, 2012b).
- *Construction Work Plan*. The NYSDEC-approved Upper Harbor Brook IRM Construction Work Plan, dated May 2012, outlined means and methods of construction, project schedule, project organization, and project directory (O'Brien & Gere, 2012c). NYSDEC approved this plan on August 21, 2012.
- *Construction Quality Assurance Project Plan*. The Construction Quality Assurance Plan (CQAPP) was developed as Appendix J of the NYSDEC-approved Upper Harbor Brook IRM Final Design Report dated March 2012 (O'Brien & Gere, 2012a). The CQAPP described the quality assurance methodologies to be applied in the field and in the lab.
- *Materials Management Plan*. The Materials Management Plan (MMP) was developed as part of the NYSDEC-approved Upper Harbor Brook IRM Construction Work Plan. The MMP outlined the procedures for excavation and transport of materials generated during intrusive work.
- *Water Management Plan.* The Water Management Plan (WMP) was developed as Appendix C of the NYSDEC-approved Upper Harbor Brook IRM Construction Work Plan. The WMP described the equipment and approach for managing construction-generated groundwater and surface water during excavation, by-pass pumping of waters, and other construction activities.
- *Storm Water Pollution Prevention Plan*. The NYSDEC-approved Upper Harbor Brook IRM Storm Water Pollution Prevention Plan (SWPPP), dated May 2012, provided details of erosion and sedimentation controls (O'Brien & Gere, 2012d). NYSDEC approved this plan on August 21, 2012. The SWPPP included a signed Notice of Intent for the work being performed at the Site.

2.3.2 Other Governing Documents

- *Upper Harbor Brook IRM Final Design Report*. The NYSDEC-approved Upper Harbor Brook IRM Final Design Report, dated March 2012, provided an overview of planned remedial activities (O'Brien & Gere, 2012a). Remedial activities completed at the Site were conducted in accordance with this report and subsequent NYSDEC-approved field modifications to the design.
- *Community Air Monitoring Plan*. The Community Air Monitoring Plan (CAMP) was developed as Appendix B of the NYSDEC-approved Upper Harbor Brook IRM Construction Work Plan. The CAMP provided an outline of the air monitoring activities performed during the remedial action. Work was performed in accordance with the CAMP.
- *Citizen Participation Plan*. The Citizen Participation Plan (CPP) (O'Brien & Gere, 2002) was developed in accordance with NYSDEC's *Citizen Participation in New York's Hazardous Waste Site Remediation Program; A Guidebook,* dated June 1998. The CPP was developed to promote public understanding of departmental responsibilities, planning activities, and remedial activities. The CPP provided an opportunity for the public to submit information that may assist in development of a comprehensive remedial program that is protective of both public health and the environment and responsive to the public's concerns.
- *Materials Management, Grading, and Disposal Plan*. The NYSDEC-approved Materials Management, Grading, and Disposal Plan, dated January 2013, provides procedures for handling materials during execution of the work at the Site. This plan superseded the MMP listed in the previous section. Material was handled in accordance with this plan.

2.4 SUMMARY OF FIELD MODIFICATIONS

During construction of the Upper Harbor Brook IRM, field modifications to the design documents were developed and approved by NYSDEC. The following table includes a brief summary of field modifications listed by date. Correspondence and details of the field modifications are included in **Appendix B.**

Table 2-1. Field Modifications

Date	Description
May 31, 2012	Revisions to drawings (G-1,3,5,6,7,8,9,15,23,24,25,26,27,28,29,30,32,34,35,36,37,38,40, 41; I-1; E-1,2,3,4,5) due to NYSDEC and Operations Management International (OMI) comments. OMI operates and maintains the Willis Avenue GWTP.
July 10, 2012	Replacement of New York State Department of Transportation (NYSDOT) fencing and signs along the NYSDOT right-of-way. A Work Zone Traffic Control Plan and Sealing Plan were to be provided to NYSDOT for review and approval. Addition of copper tracer wire along force main from Pump Station-2 to tie in vault.
August 28, 2012	Relocation of Pump Station-2.
September 14, 2012	Modification of clay compaction requirements in wetlands.
October 23, 2012	Modification to perform in-situ stabilization prior to removal of accumulated sediments in Wastebed D/E ditch.
November 16, 2012	Modification to the depth of excavation and backfill in the Wastebed D/E Ditch at the request of NYSDOT and NYSDEC. Approval to not perform any sealing or grouting in Railroad Culverts-1 and 2. Modification of the outlet of the CSO culvert that enters WWR3 from the south to include a section (approximately 40-feet) of open ditch lined with rip-rap.
November 27, 2012	Design modifications to use a sheeted cell earthen support system around excavations for Pump Stations-1 and -2 and install jet grout columns beneath the wet wells as foundation support.
November 30, 2012	Modification to I-690 Drainage Ditch collection trench to install 16 inches of sand with slotted pipe and 16 inches of substrate material above geomembrane. Modification to begin collection trench in I-690 Drainage Ditch at Sta. 0+25 instead of Sta. 0+00.
January 11, 2013	Modification to keep the construction access road and 18-inch culvert permanent in Railroad Ditch-1 for future monitoring access to WRR 3 and WRR4 wetlands.
April 16, 2013	Installation of a passive NAPL collection trench in Harbor Brook OW-4 .
April 18, 2013	Installation of a passive NAPL collection trench in Harbor Brook OW-3.
May 31, 2013	Addition of: concrete base slab for Culvert-4, gabion baskets filled with Type K material on the eastern side of OW-3, and concrete wing walls and aprons in OW-3 and OW-4.
June 27, 2013	Installation of passive NAPL collection trench in Harbor Brook OW-1.
July 3, 2013	Application of a two part epoxy in Culvert-4 to leaking joints below the seasonal high groundwater level (from approximately the concrete base slab to 3 feet above concrete base slab).
August 16, 2013	Relocation of 2-inch solid wall fiberglass reinforced plastic (FRP) force main piping in

Table 2-1. Field Modifications

Date	Description
	OW-2.
August 29, 2013	Installation of concrete on the bottom and side slopes of OW-2. Installation of stone filled gabion mattresses over the concrete except in the Penn-Can ditch area of OW-2. Backfill the former WPC1, WPC2, and WPC3 areas with 18 inches of clay and 6 inches of topsoil instead of 12 inches of clay and 12 inches of topsoil. Backfill the Penn Can ditch with 18 inches of clay and 6 inches of Type J select fill material instead of 12 inches of clay and 12 inches of Type J select fill material.
September 11, 2013	Installation of concrete slab within Culvert-2 and concrete wingwalls at the downstream end of Culvert 2.
September 13, 2013	Expansion of wetland area WRR2 to compensate for the lost acreage of the former WPC1, WPC2, and WPC3 areas. Wetland plantings in the expanded area consisted of shrub swamp and wet meadow species accompanied by wetland companion seed mix. Former WPC1, WPC2, and WPC3 areas to be seeded with successional old field seed mix and wetland meadow seed mix.
September 18, 2013	Installation of gabion baskets in OW-1 on the slope opposite the I-690 Drainage Ditch. Installation of gabion mattresses in OW-1 between the 24-inch force main and the 10-inch water line on both side slopes.

3. REMEDIAL ACTION

Remedial activities completed at the Site were conducted in accordance with the NYSDEC-approved Upper Harbor Brook IRM Final Design Report (O'Brien & Gere, 2012a), and subsequent NYSDEC-approved field modifications to the design listed in Section 2.4.

The following sections represent the completed construction components of the IRM. Record Drawings, included in **Appendix A,** were developed based on as-built and surveyed information.

3.1 SUBCONTRACTORS AND CONSULTANTS

The following is a list of Subcontractors and Consultants that performed work during IRM construction and a brief summary of their tasks.

- Abscope Environmental, Inc. – Installation and removal of steel sheet piling at Pump Stations-1 and -2; Subcontractor to GeoSolutions, Inc.
- Accutest Laboratories – Analytical testing of soil and water samples
- Atlas Fence, Inc. – Installation of chain link fence
- Burns Brothers Contractors – Mechanical installations in pump stations
- Chenango Contracting, Inc. – Geotextile and geomembrane liner installation
- Clark Rigging and Rental Corp. – Rigging and setting of pump station structures
- Ciotti Enterprises, Inc. – Excavated material trucking
- CME Associates, Inc. –Concrete testing and geotechnical testing
- Corrosion Products and Equipment, Inc. – Sealing and lining of Culvert-3; Subcontractor to Peak Environmental
- C.P. Ward, Inc. – Work zone traffic control
- C.T. Male Associates – Surveying
- Donnelly Construction, Inc. – Work zone traffic control; Subcontractor to Precision Industrial Maintenance
- Galson Laboratories – Personnel safety monitoring analyses
- George Spak – Herbicide application
- GeoSolutions, Inc. – Pump station jet grouting
- Ground Effects – Seeding and mulching
- Kenney Engineering – Vibration monitoring; Subcontractor to Abscope Environmental, Inc.
- NYEG Drilling, LLC – Soil boring installation
- O'Brien & Gere – Engineer, Construction Manager, and Contractor
- O'Connell Electric Company – Electrical installation
- Parratt-Wolff, Inc. – Piezometer installation
- Peak Environmental, LLC – Cleaning, sealing, and testing of Culvert-3
- Precision Industrial Maintenance – I-690 sewer cleaning and video
- Riccelli Enterprises, Inc. – Clean fill trucking
- Sun Environmental Corp. – Culvert and frac tank cleaning
- TDK Engineering Associates, P.C. – Third party liner inspection
- Thew Associates – Surveying

3.2 PRE-CONSTRUCTION MEETING

A pre-construction meeting was conducted by O'Brien & Gere on May 10, 2011 to review key topics prior to initiating construction activities.

3.3 SITE PREPARATION AND MOBILIZATION

Clearing and Grubbing. Clearing and grubbing was performed in accordance with Technical Specification 02111 of the Final Design Report (O'Brien & Gere, 2012a). Clearing consisted of cutting brush and trees from the work area. A portion of the large trees were stockpiled for use as habitat features in the restored wetlands; the balance of the cleared materials was chipped at an on-Site location. Stumps were removed, chipped and placed in Wastebed B. Additionally, portions of the NYSDOT right-of-way fencing and fence posts in conflict with construction activities were removed and disposed of off-Site. Clearing and grubbing locations are shown on Sheet G-39 of the Record Drawings.

Utility Marker Layout. Layouts of utilities are shown on the Record Drawings in **Appendix A**. O'Brien & Gere coordinated the location of utilities in the field with Dig Safely New York, as appropriate.

3.4 GENERAL SITE CONTROLS

Construction was performed in accordance with the NYSDEC-approved Construction Work Plan developed by O'Brien & Gere and subsequent NYSDEC-approved field modifications to the design. Additional plans for general site controls are summarized below.

Erosion and Sedimentation Control. Methods used to manage water in the areas of work were performed in accordance with the Water Management Plan. The areas around perimeters of work areas were managed according to the NYSDEC-approved Construction Work Plan and SWPPP.

Dust Control. The NYSDEC-approved Material Handling and Disposal Plan was developed as Section 11 in the NYSDEC-approved Upper Harbor Brook IRM Construction Work Plan and describes the measures taken to minimize generation of dust. Dust was monitored at the perimeter of the Site in accordance with the NYSDEC-approved CAMP. Dust monitoring and control was implemented in areas of active construction. Dust was suppressed with application of water via a water truck.

Construction Water. Construction water, defined as water that enters the work area either as groundwater or surface water, was pumped to on-Site storage tanks for settlement prior to discharge into the existing Lakeshore groundwater collection/pumping system according to the Water Management Plan. Two frac tanks with weirs were used on the North side of I-690, and two poly tanks were used on the South side of I-690. Construction water from weir tanks was sent to the Willis Avenue GWTP via collection sump-6 on the West Wall. Construction water from the poly tanks was sent to the Willis Avenue GWTP via collection sump-7 on the East Wall.

Egress Housekeeping. Decontamination pads were installed to reduce tracking of contaminants onto paved roads. Excessive mud tracked onto roads was removed and/or cleaned as necessary,

Work Zone Traffic Control Plan. Work Zone Traffic Control Plans were submitted by Donnelly Construction and C.P. Ward, as necessary, to facilitate work requiring lane closures on I-690 and the Hiawatha Boulevard off-ramp. These plans were approved by the NYSDOT and work was performed in compliance with the approved plans.

Vibration Monitoring Plan. A Vibration Monitoring Plan was developed by Abscope Environmental as a subcontractor to Geo-Solutions, Inc., and reviewed by O'Brien & Gere. The plan documents the methods and equipment utilized during sheet pile installation for Pump Stations-1 and -2.

3.5 GROUNDWATER COLLECTION SYSTEM

The groundwater collection system minimizes the potential for discharge of groundwater to Upper Harbor Brook by lowering the groundwater level. The groundwater collection system consists of three separate collection trenches:

- Harbor Brook-1 collection trench (south side of I-690)
- Harbor Brook-2 collection trench (north side of I-690)
- I-690 Drainage Ditch collection trench

The groundwater collection trenches were excavated along the surveyed and staked alignment. The Harbor Brook-1 and -2 groundwater collection trenches align approximately parallel to Harbor Brook. The I-690 Drainage Ditch groundwater collection trench aligns with the centerline of the I-690 Drainage Ditch. The approximate total length of each groundwater collection trench is as follows:

- Harbor Brook-1 collection trench = 235 feet
- Harbor Brook-2 collection trench = 145 feet
- I-690 Drainage Ditch collection trench = 1,560 feet

The groundwater collection systems comprise a 4-inch slotted FRP collection pipe buried in sand trenches. Excavations were made approximately 4 to 5-feet wide to accommodate installation of the collection pipe and sand. A plan and profile view of the ground water collection trenches are shown on Sheet G-25 (Harbor Brook-1), Sheet G-26 (Harbor Brook-2), and Sheets G-5 through G-8 (I-690 Drainage Ditch) of the Record Drawings.

The Harbor Brook-1 groundwater collection trench consists of two segments from Observation Port (OP)-1 to Wet Well-1 and OP-2 to Wet Well-1. The segment from OP-1 to Wet Well-1 consists of approximately 165-feet of 4-inch FRP collection pipe installed approximately 12 to 17 feet below grade. The segment from OP-2 to Wet Well-1 consists of approximately 70 feet of 4-inch slotted FRP collection pipe installed approximately 17 to 19 feet below grade. Both segments were installed approximately 1.5 to 2.5 feet below the liner in OW-3 and OW-4. The slotted FRP pipes for both segments are connected to a Teflon flex joint and tied into Wet Well-1. A gate valve with extended riser stem was installed on both 4-inch pipes within the wet well. Backfill around the slotted FRP pipe consisted of Type H select fill (bedding sand).

The Harbor Brook-2 groundwater collection trench consists of two segments, from OP-3 to a buried wye fitting and OP-4 to the same buried wye fitting. The segment from OP-3 to the buried wye fitting consists of approximately 60 feet of 4-inch slotted FRP collection pipe installed approximately 19 feet below grade. The segment from OP-4 to the buried wye fitting consists of approximately 85 feet of 4-inch slotted FRP collection pipe installed approximately 13 to 20 feet below grade. Both segments were installed approximately 0.6 to 1.5 feet below the liner in OW-1 and OW-2. The segments connect to each other at the buried wye fitting and continue approximately 10 feet to Wet Well-2 as one 4-inch solid wall FRP pipe. The 4-inch solid wall FRP is connected to a Teflon flex joint, and tied into Wet Well-2. A gate valve with extended riser stem was installed on the 4-inch pipe within the wet well. Backfill around the slotted FRP pipe consisted of Type H select fill (bedding sand).

The I-690 Drainage Ditch groundwater collection trench consists of a 4-inch slotted FRP collection pipe installed approximately 16 to 32 inches below grade west of Sta. 12+00, and approximately 24 to 40 inches below grade east of Sta. 12+00, to accommodate retention of wetland functions around WL6. Additionally, the substrate material thickness above the geomembrane was modified from 24 inches to 16 inches. These modifications were approved by NYSDEC in an email dated November 30, 2012. The 4-inch slotted FRP collection pipe transitions to a 4-inch solid wall FRP pipe at approximately Sta. 15+00. The 4-inch solid wall FRP pipe runs approximately 60 feet, where it connects to a Teflon flex joint, and ties into Wet Well-2. A gate valve with extended riser stem was installed on the 4-inch pipe within the wet well. Backfill around the slotted FRP pipe consisted of Type H select fill (bedding sand).

Thirteen cleanouts were constructed along the groundwater collection systems using 4-inch solid wall FRP riser pipe. Cleanouts were finished with a flush mounted precast concrete collar and a frame and cover. The cleanout riser pipes were fitted with a locking J-plug. Cleanouts were installed as follows and as shown in the Record Drawings:

- Harbor Brook-1 collection system
  - Approximately 5 feet from OP-1 (CO-7) and OP-2 (CO-10)
  - Approximately 5 feet from Wet Well-1 (CO-8) in the OP-1 to Wet Well-1 segment
  - Approximately 10 feet from Wet Well-1 (CO-9) in the OP-2 to Wet Well-1 segment
- Harbor Brook-2 collection system
  - Approximately 5 feet from OP-3 (CO-11) and OP-4 (CO-13)
  - Approximately 10 feet from Wet Well-2 (CO-12)
- I-690 Drainage Ditch collection system
  - Approximately every 250 linear feet along the north side of the ditch (CO-1, -2, -3, -4, and -5)
  - Approximately 10 feet from Wet Well-2 (CO-6)

OPs were constructed from 24-inch solid wall FRP pipe with ½-inch thick FRP covers and extended approximately 2 feet above grade. OPs were constructed on both ends of the Harbor Brook-1 and Harbor Brook-2 collection trenches (OP-1, -2, -3, and -4). OPs were not installed on the I-690 Drainage Ditch collection pipe. The cleanouts and OPs were installed to provide access points to the groundwater collection system for cleaning, maintenance, and monitoring purposes.

NAPL was observed in construction water during excavation in open water areas OW-1, OW-3, and OW-4. The NAPL was collected with the construction water and pumped to the Willis Avenue GWTP for treatment. Upon NYSDEC request, a field modification was developed to install a passive NAPL collection system in OW-4. The field modification dated April 16, 2013 was submitted to and approved by NYSDEC. A similar passive NAPL collection system was installed in OW-1 and OW-3 based on field modifications dated June 27, 2013 and April 18, 2013, respectively. These field modifications were requested and approved by NYSDEC. A NAPL collection sump was installed in each NAPL collection system.

The passive NAPL collection systems consist of a 4-inch perforated FRP pipe surrounded by ¾-inch to 1½ -inch rounded washed stone and Mirafi 600X, as shown on Sheet G-44 of the Record Drawings. The 4-inch perforated pipe installed in OW-1, OW-3, and OW-4 transitions to a 4-inch solid wall FRP pipe on the western edge of the OWs and is surrounded by a 2-foot wide clay plug. The solid wall FRP pipe ties into an 8-inch solid wall FRP observation port with a locking cap.

3.6 GROUNDWATER PUMP STATIONS

The two groundwater pump stations consist of a wet well with one submersible pump, valve vault, and above grade electrical enclosures that are enclosed by chain link fencing. The same pump model was installed at Pump Stations-1 and -2. The pumps were designed to convey groundwater at an estimated flow rate of approximately 30 gallons per minute (combined total from both pump stations).

Pump Station-1 is located south of I-690 adjacent to OW-3. The pump station receives groundwater from the Harbor Brook-1 collection trench and discharges to the dual 2-inch solid wall FRP groundwater force main piping installed within the western barrel of Culvert-3, as shown on Sheet G-27 of the Record Drawings.

Pump Station-2 is located north of I-690 adjacent to OW-1. The location of Pump Station-2 was modified, as described in the NYSDEC-approved field modification dated August 28, 2012. The modified location south of the I-690 Drainage Ditch is shown on Sheet G-8 of the Record Drawings. The pump station receives groundwater from the Harbor Brook-2 and I-690 Drainage Ditch collection trenches and discharges to the 2-inch solid wall FRP groundwater force main piping that also carries Pump Station-1 effluent.

The pump stations and valve vaults consist of pre-cast concrete sections placed on approximately 2 feet of leveling stone overlying jet grout columns. A field modification was issued to install the jet grout columns to bedrock as the foundations beneath the wet wells. The same field modification called for stabilizing the excavations with steel sheeting installed approximately 50 feet below grade. This field modification dated

November 27, 2012 was submitted to and approved by NYSDEC. The dimensions and details of the pump stations and valve vaults are shown on Sheets G-29, G-30, G-42, and G-43 of the Record Drawings.

The interiors and exteriors of the pre-cast concrete sections forming the Pump Station-1 and Pump Station-2 wet wells and the exteriors of the valve vaults, were coated with an epoxy system. The joints between the riser sections were filled with non-shrink mortar, as required, to create a flat surface that could accept epoxy. The same epoxy system was then applied to the interior and exterior of the wet well joints and the exterior of the valve vault joints.

An electrical enclosure was installed above grade adjacent to each pump station. The electrical enclosures house the control panels, motor control panels, level controls, circuit breakers, variable frequency drives (VFDs), and other electrical and controls equipment. The pump stations are controlled remotely via the Willis Avenue GWTP and locally via an operator interface terminal. Details of the electrical systems are shown on Sheets E-1 through E-7 of the Record Drawings.

3.7 GROUNDWATER CONVEYANCE

Collected groundwater is conveyed from Pump Station-1 through a 2-inch solid wall FRP force main to the valve vault. Two force mains leave the valve vault and are installed along the bottom of the western barrel of the twin 78-inch corrugated pipes that comprise Culvert-3. Three 2-inch rigid galvanized steel (RGS) conduits were installed along with the two force mains in the bottom of the western barrel. One RGS conduit contains power cables, one contains fiber-optic cable, and one is a spare conduit. The two force mains and three 2-inch RGS conduits are encased in approximately 6 inches of concrete as shown on Sheet G-33 of the Record Drawings.

The two force mains continue into OW-2, where they are encased in concrete, prior to entering the force main valve vault. The Pump Station-1 valve vault and the force main valve vault contain valves that can be adjusted to allow for the use of either force main and also allows access for cleaning/draining the two force mains. The two 2-inch solid wall FRP groundwater force mains are insulated and heat traced from a point just outside of the western barrel of Culvert-3 (near Pump Station-1) to the top of the bank at OW-2. The force main valve vault is located adjacent to Culvert-2 and Pump Station-2 as shown on Sheet G-26 of the Record Drawings.

The two force mains transition to a single 2-inch solid wall FRP force main in the force main valve vault. Collected groundwater from Pump Station-2 ties into the same 2-inch solid wall FRP force main from Pump Station-1. The combined groundwater is conveyed via the 2-inch solid wall FRP force main to VV-6A (installed as part of the East Wall) that ties into the existing East Wall groundwater force main. A field modification dated July 11, 2012 added approximately 120 feet of #12 AWG stranded and coated copper tracer wire along the force main from Pump Station-2 to VV-6A to facilitate future line location via conductive tracing. The East/West Wall groundwater force main conveys collected groundwater to the Lakeshore Pump Station where it is pumped to the Willis Avenue GWTP via a separate force main.

A field modification was developed to relocate the 2-inch FRP force main piping from Culvert-3 to the top of the bank at Culvert-2 to address modifications to OW-2. The field modification dated August 16, 2013 was submitted to and approved by NYSDEC.

Eleven cleanouts (FMCO-1A, -1B. -2A, -2B, -3A, -3B, -4A, -4B, -5, -6, and -7) were installed on the dual and single force mains to provide access points to perform cleaning and maintenance, as shown on Sheet G-27 of the Record Drawings. Cleanouts were finished with a precast concrete collar with a frame and cover.

3.8 SEDIMENT REMOVAL, EXCAVATION, BACKFILL, AND ISOLATION LAYERS

3.8.1 Sediment Removal, Excavation, and Backfill

Site ditches, wetlands, and open water areas were excavated and backfilled as part of the IRM. Sediment removal locations are shown on Sheet G-39 of the Record Drawings. Groundwater collection system excavation was performed at the locations shown on Sheets G-5 to G-9 and Sheets G-25 to G-27 of the Record Drawings. Approximate excavation depths are as follows:

Table 3-1. Excavated Material	
I-690 Drainage Ditch	32 to 40 inches
Railroad Drainage Ditch-1 and -2 and Penn-Can Drainage Ditch	2 feet
Wastebed D/E Ditch	3 to 7 feet
Site Wetlands	2 feet
OW-1	6 feet
OW-2	2 feet
OW-3	8 feet
OW-4	6 feet
OW-5	Surficial sediment removal only
Culvert-2	4 feet (refer to Section 3.10)

Clean backfill was staged at clean backfill staging areas shown on **Figure 4.** Restored ditches and OWs were backfilled with substrate materials as follows:

Table 3-2. Substrate Materials	
I-690 Drainage Ditch	Approximately 16 inches of sand under the liner and approximately 16 to 24 inches of Type J Select Fill over the liner
Railroad Drainage Ditch-1	Approximately 1 foot of clay covered with 1 foot of Sennet Bank Run east of WRR1 and when located within wetland areas and 2 feet of Sennet Bank Run west of WRR2 (Sennet Bank Run mixed with topsoil was installed from the mean water level to the top of the slope)
Railroad Drainage Ditch-2	Approximately 2 feet of topsoil choked Sennet Bank Run east of WRR5 and 2 feet of Sennet Bank Run west of WRR5 (Sennet Bank Run mixed with topsoil was installed from the mean water level to the top of the slope)
Wastebed D/E Drainage Ditch	Approximately 1 foot of Sennet Bank Run (Sennet Bank Run mixed with topsoil was installed from the mean water level to the top of the slope)
Penn-Can Drainage Ditch	Approximately 18 inches of clay covered with 6 inches of Type J Select Fill
Site Wetlands	Approximately 12 inches of clay covered with 12 inches of topsoil
Former WPC1, WPC2, and WPC3 areas	Approximately 18 inches of clay covered with 6 inches of topsoil

Table 3-2. Substrate Materials	
OW-1	Approximately 24 inches of ¾-inch to 1½-inch rounded washed stone under the liner, 4 feet of Type K Select Fill over the liner and 2 feet on side slopes, except in select side slope areas where Gabion baskets and Reno mattresses filled with Type K Select Fill were installed
OW-2	Approximately 12 inches of Type K Select Fill over the 12-inch concrete base slab and on the side slopes and in the gabion mattresses
OW-3	Approximately 5 feet of ¾-inch to 1½-inch rounded washed under the liner 3 feet of Type J Select Fill over the liner, medium rip-rap at the outlet of Culvert-4, approximately 2 feet of Type K Select Fill on western and eastern slope, and in the gabion baskets
OW-4	Approximately 3 feet of ¾-inch to 1½-inch rounded washed stone under the liner, 3 feet of Type J Select Fill over the liner and 2 feet on side slopes, and medium rip-rap at the entrance of Culvert-4
OW-5	No substrate material was required
Culvert-2	Approximately 30 inches of Type J Select Fill under the 8-inch concrete base slab and 12 inches of Type K Select Fill over the concrete base slab (refer to Section 3.10)
Culvert-4	Approximately 4 inches of Type J Select Fill over the 8-inch concrete base slab and medium rip-rap at the entrance and exit (refer to Section 3.10)

Excavated areas outside of defined ditch, OW, and/or wetland areas were backfilled with embankment material and a minimum of 6 inches of topsoil.

Site ditches consisted of Railroad Drainage Ditches-1 and -2, Wastebed D/E Drainage Ditch (from Harbor Brook to Hiawatha Boulevard), Penn-Can Drainage Ditch, and I-690 Drainage Ditch. Excavated material was transported and staged at the Wastebed B Staging Area as shown in **Figure 4.**

The I-690 Drainage Ditch flows alongside I-690 Westbound, through WL6, and into OW-1. The ditch was originally designed to be excavated to a depth of 4 feet; however, during excavation groundwater, soft/plastic material, a concrete pad, and areas of hardpan (dense compacted cinders 6-inches to 3-feet thick) were encountered. A field modification was issued to modify the depth of excavation from 4 feet to 32 to 40 inches. The field modification, dated November 30, 2012, was submitted to and approved by NYSDEC, and is further discussed in Section 7. The excavation was backfilled with 16 inches of sand around the collection pipe and 16 inches of Type J select fill above the liner. The Type J select fill was increased to 24 inches east of Sta. 12+00, where possible, to increase the thickness of the habitat substrate along WL6.

Railroad Drainage Ditch-1 flows through wetlands WRR2 and WRR1, and into OW-4. The ditch was excavated to a depth of approximately 2 feet and backfilled and graded as shown on Sheet G-19 of the Record Drawings. Rip-rap aprons were installed on both sides of the culvert that is located under the New York, Susquehanna, and Western Railroad tracks according to the detail shown on Sheet G-35 of the Record Drawings.

Railroad Drainage Ditch-2 flows through wetlands WRR3 and WRR5, and into OW-5. The ditch was excavated to a depth of approximately 2 feet and backfilled and graded as shown on Sheet G-21 of the Record Drawings. Rip-

rap aprons were installed on both sides of the culvert that is located under the New York, Susquehanna, and Western Railroad tracks according to the detail shown on Sheet G-35 of the Record Drawings.

The Wastebed D/E Drainage Ditch originates from the east of the Site. It enters the site via a culvert pipe beneath Hiawatha Boulevard and flows into OW-3. The ditch was originally designed to be excavated to a depth of 2 feet; however, at the request of NYSDOT and NYSDEC, the design was modified and the ditch was excavated to a depth of approximately 3 to 7 feet. The excavation depth started at 3 feet near Hiawatha Boulevard and ended at 7 feet near OW-3. The excavated area was backfilled with 1 foot of Sennet Bank Run. This field modification, dated November 16, 2012, was submitted to and approved by NYSDEC.

The Penn-Can Ditch is located alongside the CSX Railroad and goes through the former WPC1, WPC2, and WPC3 areas and into OW-2. Four temporary piezometers were installed (three in the Penn-Can ditch and one in the open area north of the ditch) on May 9&10, 2013 to evaluate the groundwater level in the area. Three rounds of groundwater levels were collected on June 3, July 29, and August 28, 2013. Based on the data, a field modification dated August 29, 2013 was submitted to and approved by NYSDEC to modify the backfill material in the ditch from 12 inches of clay and 12 inches of Type J select fill material to 18 inches of clay in the center of the ditch and 24 inches of clay on both edges of the excavation with 6 inches of Type J select fill material installed over the clay in the center of the ditch. The ditch was excavated to a depth of approximately 2 feet from Sta. 0+00 to Sta. 12+00 and backfilled as presented above and as shown on Sheets G-10 to G-12 of the Record Drawings.

Wetlands WRR1, WRR2, WRR3, WRR4, WRR5, and WL6 generally border or surround Site ditches. The wetlands were excavated to a depth of approximately 2 feet and restored to approximate pre-construction grade with approximately 12 inches of clay and 12 inches of topsoil. The former WPC1, WPC2, and WPC3 areas were also excavated to a depth of approximately 2 feet but were not restored as wetlands, as discussed in Sections 3.9 and 7. The former WPC1, WPC2, and WPC3 areas were modified to be backfilled with approximately 18 inches of clay and 6 inches of topsoil. The field modification discussing these former wetlands, dated August 29, 2013, was approved by NYSDEC.

OW-1 is approximately 100-feet long and 23-feet wide, receives flow from the I-690 Drainage Ditch, and connects Culvert-1 to Culvert-2. This area was excavated to a depth of approximately 6 feet. The original design was modified as described in field modifications dated June 27, 2013 and September 18, 2013, which were approved by NYSDEC. A passive NAPL collection system was installed below the liner in OW-1 as described in Section 3.5. Upon completion of excavation activities, the excavation was backfilled with approximately 24 inches of ¾-inch to 1½-inch rounded washed stone under the liner. Approximately 4 inches of sand and then 4 feet of Type K select fill was installed over the liner. Side slopes were backfilled with approximately 2 feet of Type K select fill above the liner, except in select side slope areas where gabion baskets and Reno mattresses with Type K select fill were installed to prevent the potential for erosion. Approximately 1 foot of sand was installed over the 4-inch solid FRP pipe that connected the NAPL collection pipe to the FRP sump.

OW-2 is approximately 28 feet long and 24 feet wide, receives flow from the Penn-Can Drainage Ditch, and connects Culvert-2 to Culvert-3. This area was excavated to a depth of approximately 2 feet. A field modification, dated August 29, 2013, was approved by NYSDEC to install a 12-inch concrete base slab, 8-inch concrete side walls and side slopes prior to installing approximately 12 inches of Type K select fill (rounded) to match the invert elevation of Culvert-3. The concrete replaced the liner in OW-2 and stone filled gabion mattresses were installed along the side slopes of OW-2 above the concrete.

OW-3 is approximately 60-feet long and 21-feet wide, receives flow from the Wastebed D/E Drainage Ditch, and connects Culvert-3 and Culvert-4. This area was excavated to a depth of approximately 8 feet. The original design was modified as represented by field modifications dated April 18, 2013 and May 31, 2013, which were approved by NYSDEC. A passive NAPL collection system was installed below the liner in OW-3 as described in Section 3.5. Upon completion of excavation activities, the excavation was backfilled with approximately 5 feet of ¾-inch to 1½-inch rounded washed stone under the liner. Approximately 4 inches of sand and then 3 feet of Type J select fill was installed over the liner. Approximately 1 foot of sand was installed over the 4-inch solid FRP pipe that connected the passive NAPL collection pipe to the FRP sump. Approximately 2 feet of Type K select fill was installed on the western slope. Gabion baskets filled with Type K select fill were installed along the

eastern side of OW-3 near the outlet of Culvert-4. Medium rip rap was placed around the outlet of Culvert-4, and three boulders were placed in OW-3 as shown on Sheets G-24 and G-25 of the Record Drawings. Embankment material and topsoil was installed outside of the defined OW to original grade and restored as detailed on Sheets G-37 of the Record Drawings.

OW-4 is approximately 100-feet long and 17-feet wide, receives flow from Railroad Drainage Ditch-1, and connects Culvert-4 and Culvert-5. This area was excavated to a depth of approximately 6 feet. The original design was modified as represented by a field modification dated April 16, 2013, which was approved by NYSDEC. A passive NAPL collection system was installed below the liner in OW-4 as described in Section 3.5. Upon completion of excavation activities, the excavation was backfilled with approximately 3 feet of ¾-inch to 1½-inch rounded washed stone under the liner. Approximately 4 inches of sand and then 3 feet of Type J select fill was installed over the liner. Side slopes were backfilled with approximately 2 feet of Type J select fill. Approximately 1 foot of sand was installed over the 4-inch solid FRP pipe that connected the NAPL collection pipe to the FRP sump. Medium rip rap was placed around the entrance to Culvert-4. Four boulders were placed in OW-4 as shown on Sheets G-23 and G-35 of the Record Drawings. Boulders were approximately 10 feet apart, and not within 20 feet of the culverts and 5 feet of the brook banks. Embankment material and topsoil were installed outside of the defined OW to original grade and restored as detailed on Sheet G-38 of the Record Drawings.

OW-5 is approximately 300-feet long and 8 to 15-feet wide, receives flow from Railroad Drainage Ditch-2, and connects the upstream section of Harbor Brook (not part of this project) and Culvert-5. The floatable control station was the upstream boundary of the Upper Harbor Brook IRM site. OW-5 is lined with limestone block, which was left in place; however, the sediment deposits on the limestone block were removed and placed in Wastebed B as shown on **Figure 4**.

3.8.2 Isolation Layers

Isolation layers were installed with the primary objective of minimizing the potential for impacted groundwater to enter Harbor Brook, and subsequently Onondaga Lake. The isolation layers also minimize the potential for migration of contaminated sediments to Onondaga Lake, and will minimize the potential for surface water to enter collection trenches. Isolation layers for this project consist of geomembrane liner systems, concrete liner systems, and clay backfill.

A geomembrane liner system was installed in the I-690 Drainage Ditch, OW-1, OW-3 (liner continued 150 feet into Wastebed D/E Drainage Ditch), and OW-4. The geomembrane liner system typically consists of a 16-ounce geocushion, a 40-mil linear low density polyethylene (LLDPE) textured geomembrane, overlain with a 16-ounce geocushion, followed by a uniaxial geogrid. A geocomposite drainage layer was substituted for the lower layer of 16-ounce geocushion in the I-690 Drainage Ditch. The isolation layer cross-sections are shown on Sheets G-35 through G-38 of the Record Drawings. The LLDPE textured geomembrane component of the geomembrane liner system was attached to existing structures, such as culvert headwalls, as detailed on Sheet G-33 of the Record Drawings. The geomembrane liner system terminates in anchor trenches located on the upper banks of the ditch and the OW areas. Following the installation of the isolation layer, the area was restored to the approximate grades and elevations shown on the Record Drawings. Substrate material was placed over the isolation layers to achieve the designed final elevations.

The geomembrane liners were modified in the upstream portion of OW-3 and downstream portion of OW-4, near the outlet and inlet of Culvert-4, respectively. The inlet and outlet of Culvert-4 was lined with limestone rock and could not be safely excavated due to the concern of undermining the culvert; therefore, the geomembrane liner was modified in this area. A concrete slab and wing wall was added around the outlet and inlet of Culvert-4 as shown on Sheets G-45 and G-46 of the Record Drawings. The liner was attached to the concrete slab and wing wall. Addition of the concrete slab and wing wall was documented in a field modification dated May 31, 2013, which was submitted to and approved by NSYDEC.

Concrete base slabs were installed in Culvert-2, Culvert-4 (including the inlet and outlet aprons), and OW-2. During cleaning activities, it was observed that Culvert-2 and Culvert-4 did not have structural bottoms. Addition of a concrete base slab in Culvert-2 and Culvert-4 was documented in field modifications dated September 11, 2013 and May 31, 2013, which was submitted to and approved by NYSDEC. A concrete base slab

and sloped side walls were installed in OW-2 upon completion of excavation activities. This installation was documented in a field modification dated August 29, 2013, which was submitted to and approved by NYSDEC.

The concrete in Culvert-2 and OW-2 had a 28-day compressive strength of 4,000 psi whereas the concrete in Culvert-4 had a 28-day compressive strength of 5,000 psi for higher early strength. Admixtures included in the concrete mix design included air-entrainment for resistance to freeze-thaw damage and a cementitious crystalline waterproofing admixture to reduce the permeability of the concrete. The slabs were reinforced with Novomesh 950 macro-synthetic fiber blend to limit the size of cracks that would form in the concrete and to provide concrete durability. The fibers were added at the manufacturer's recommended dosage rate of five pounds per cubic yard. Joints were installed in the slabs at a maximum spacing of 20 feet to minimize the amount of random cracking in the concrete slabs. Chemically resistant water stops were installed at the joints within the slab.

Clay backfill was installed under a portion of Railroad Drainage Ditch-1, ditches that were located within a wetland area, former WPC1, WPC2, and WPC3 areas, the western edges of OW-1, OW-3, and OW-4 around the passive NAPL collection system, and Site wetlands. Approximately 1 foot of clay was installed under Railroad Drainage Ditch-1 starting at the edge of Harbor Brook to approximately 25 feet west. An approximately 18-inch clay liner was installed in the Penn-Can ditch and in the former WPC1, WPC2, and WPC3 areas. A 2-foot wide clay plug was installed on the western edges of OW-1, OW-3, and OW-4 around the 4-inch solid wall FRP pipe from the passive NAPL collection system as discussed in Section 3.5. Approximately 1 foot of clay liner was installed under the wetlands and under the ditches that were located within a wetland area.

Where feasible, standard compaction equipment was used to compact clay installed in the wetlands to reach 95% compaction. This correlated to a maximum permeability of 10^{-7} cm/sec based on the permeability testing included in **Exhibit 2**. Compaction reports are included in **Exhibit 3.** A field modification was required in the clay compaction requirements in some areas of the wetlands where soft/weak subgrade material was present. Clay was placed and compacted using a long reach excavator in lieu of typical compaction equipment due to safety concerns. The field modification dated September 14, 2012 was submitted to and approved by NYSDEC.

3.9 WETLAND CONSTRUCTION

As part of the IRM, select wetlands were excavated and restored at various locations within the Site so there was no net loss of wetland area. The wetland areas are shown on Sheet G-3 of the Record Drawings and **Figure 2**.

Wetlands WRR1, WRR2, WRR3, WRR4, WRR5, and WL6 were excavated to a depth of approximately 2 feet. Following excavation and backfill of approximately 12 inches of Type L select fill (clay), a habitat layer was installed to bring the elevation to final grade. The habitat layer consisted of approximately 12 inches of topsoil. The topsoil was seeded, as discussed in Section 3.11.1.

The former WPC1, WPC2, and WPC3 areas were considered to be lower quality wetland areas, as documented in a field modification, dated September 13, 2013, that was submitted to and approved by NYSDEC. The former WPC1, WPC2, and WPC3 areas were excavated to a depth of approximately 2 feet. Following excavation and backfill of approximately 18 inches of clay (24 inches of clay around the edge of the excavation), a habitat layer comprising approximately 6 inches of topsoil was installed to bring the elevation to final grade. The topsoil was seeded with successional old field seed mix, as described in Table 1 of Specification 02981 of the Final Design Report, in lieu of shrub swamp plantings (O'Brien & Gere, 2012a). Areas that may receive periodic flooding were seeded with the wetland meadow seed mix described in Table 5 of Specification 02981of the Final Design Report (O'Brien & Gere, 2012a). This was part of a field modification dated August 29, 2013 that was submitted to and approved by NYSDEC.

The original design intent was to restore a combined total of 0.447 acres of wetland in the former WPC1, WPC2, and WPC3 areas. These areas were excluded as wetlands per the field modification dated September 13, 2013, which was submitted to and approved by NYSDEC, and further discussed in Section 7. The acreage loss at the former WPC1, WPC2, and WPC3 areas was compensated for by the addition of acreage in WRR1 through WRR4. WRR1 was originally designed to encompass 0.046 acres; however, it was restored to encompass 0.07 acres. At the request of NYSDEC, WRR3 and WRR4 were combined into one large wetland. WRR2 was expanded to provide the additional necessary acreage, as documented in a field modification, dated September 13, 2013, that

was submitted to and approved by NYSDEC. The expansion wetland (WRR2) was planted with wet meadow and shrub swamp species, as shown in Table 4 and Table 7 of Specification 02981, respectively. Shrubs were installed on the upper edges of the wetland while wet meadow species were installed in lower areas that may receive periodic flooding. Following planting, the wet meadow seed mix (Table 5 of Specification 02981 of the Final Design Report) was applied (O'Brien & Gere, 2012a).

WRR1 and WRR2 were restored encompassing sections of Railroad Drainage Ditch-1. WRR2 was restored west of the Railroad Drainage Ditch-1 culvert, and WRR1 to the east. The wetlands were restored with a wet meadow – freshwater plant and seed mixes as shown in Tables 4 and 5 of Specification 02981 in the Final Design Report (O'Brien & Gere, 2012a).

WRR3 and WRR5 were restored encompassing sections of Railroad Drainage Ditch-2. WRR3 was restored west of the Railroad Drainage Ditch-2 culvert, and WRR5 to the east. WRR4 was restored within an unnamed ditch leading to Railroad Drainage Ditch-2 as shown on Sheet G-22 of the Record Drawings. WRR4 was restored with wet meadow seed mix and the shrub swamp plant species mix as shown in Tables 5 and 7, respectively, of Specification 02981 of the Final Design Report (O'Brien & Gere, 2012a). WRR3 was restored with wet meadow – freshwater plant and seed mixes (Tables 4 and 5 of Specification 02981 of the Final Design Report) in areas in and surrounding the ditch, and wet meadow seed mix and red maple – hardwood swamp plant mix (Tables 5 and 8, respectively, of Specification 02981 of the Final Design Report) in areas south of the ditch, as shown on Sheet G-22 of the Record Drawings. WRR5 was restored with wet meadow – freshwater plant and seed mixes on areas in and surrounding the ditch, and red maple – hardwood swamp plant mix in areas outside of the ditch.

WL6 was restored along the south side of the I-690 Drainage Ditch, as shown on Sheet G-9 of the Record Drawings. WL6 was originally designed to encompass 0.352 acres; however, approximately 0.27 acres were restored. Pump Station-2 was relocated within a portion of WL6, as documented in the field modification, dated August 28, 2012, that was submitted to and approved by NYSDEC. The Pump Station-2 relocation reduced the area of the WL6 footprint. WL6 was restored with the wet meadow seed mix and wet meadow – salt tolerant plants as shown on Tables 5 and 6, respectively, of Specification 02981 of the Final Design Report (O'Brien & Gere, 2012a).

The approximate area of each wetland before and after restoration is as follows:

Table 3-3. Wetland Restoration

Wetland	Original Design	Actual Restored Area
WRR1	0.046 acres	± 0.07 acres
WRR2	0.211 acres	± 0.47 acres
WRR3	1.214 acres	± 1.48 acres
WRR4	0.19 acres	± 0.22 acres
WRR5	0.038 acres	± 0.03 acres
WL6	0.352 acres	± 0.27 acres
Former Penn-Can Areas	0.447 acres	0 acres
Total Area	**2.498 acres**	**± 2.54 acres**

The total area of wetland restoration at the Site totaled approximately 2.54 acres, approximately 0.042 acres larger than originally proposed. In sum, this wetland work resulted in significant ecological enhancement as these wetlands were dominated by invasive species, such as common reed (*Phragmites australis*), which was removed during wetland excavation. Approximately 60 native plant species, including some that are locally

uncommon (*e.g.*, saltmeadow rush (*Juncus gerardii*), seaside goldenrod (*Solidago sempervirens*) and prairie cordgrass (*Spartina pectinata*), were introduced to the restored wetlands. Initial observations suggest successful establishment of wetland vegetation across the restored wetlands, with most herbaceous plugs and potted woody plants surviving and putting on substantial growth. Initial growth from the seed mix also appeared to be vigorous with Virginia wild rye (*Elymus virginicus*) and beggar ticks (*Bidens frondosa*) providing significant cover throughout the wetlands.

3.10 CULVERT AND STORM SEWER INSPECTION, CLEANING, AND REPLACEMENT

Cleaning/sediment removal, inspection, and repair was performed, as required, in culverts on Site as shown on Sheet G-3 of the Record Drawings**.** Culverts were cleaned of debris and sediment and collected material was staged at the Wastebed B Staging Area (**Figure 4**). The approximate length of each culvert is as follows:

Table 3-4. Culvert Lengths

Culvert-2	111 feet
Culvert-3	310 feet
Culvert-4	78 feet
Culvert-5	126 feet
Railroad Drainage Ditch-1 Culvert	41 feet
Railroad Drainage Ditch-2 Culvert	63 feet

Culvert-2 consists of a concrete culvert with an upstream end that is 16-feet x 7.5-feet for 12 feet, then transitions to 16-feet x 5-feet for the remaining distance, and connects OW-1 to OW-2. During cleaning activities, it was observed that Culvert-2 did not have a structural bottom. Addition of an approximately 8-inch concrete base slab was documented in a field modification dated September 11, 2013 that was submitted to and approved by NYSDEC. Chemical resistant water stops were installed at each concrete base slab joint spaced at a maximum of 20 feet apart. A cementitious crystalline waterproofing admixture and micro-synthetic fiber blend were added to the concrete for additional waterproofing and strength. In addition, a two part epoxy was installed at the interface between the new concrete base slab and the existing concrete walls. Approximately 12 inches of Type K select fill (rounded) was placed on top of the concrete slab.

Culvert-3 consists of two corrugated metal pipe (CMP) culverts (east and west) varying in diameters from 78 inch to 96 inches that connect OW-2 to OW-3. The western barrel was cleaned via high pressure water blasting. Leaks were patched with grout and/or concrete and the entire pipe was lined with epoxy. The eastern barrel was pressure washed and leaks were patched with grout and/or concrete. The repaired leaks were then coated with epoxy. Locations of the patches are shown in **Exhibit 4.** Two leaks are still present in the eastern barrel of Culvert-3 and will be repaired in 2014 during a period of low flow in Harbor Brook. NYSDEC will be apprised of the proposed schedule for this work.

Culvert-4 consists of a 16-foot x 14.5-feet limestone arch culvert that connects OW-3 to OW-4. During cleaning activities, it was observed that Culvert-4 had a stone bottom that allowed groundwater infiltration to enter the culvert.. In addition, groundwater was observed leaking from the joints of the side walls at several locations. Three leak locations were sampled on April 24, 2013 during a period of seasonally high groundwater. Volatile organic compounds (VOCs) detected included benzene, ethyl benzene, toluene, and xylene. Concentrations range from 0.27 micrograms per liter (µg/L) to 58.8 µg/L for these constituents. Predominant semivolatile organic compounds (SVOCs) detected were phenol and polycyclic aromatic hydrocarbons (PAHs) including acenaphthene, acenaphthylene, and naphthalene. SVOC concentrations ranged from 0.73 µg/L to 65 µg/L. Field modifications dated May 31, 2013 and July 3, 2013 were submitted and approved by NYSDEC to install a concrete base slab and seal the leaking joints in the side walls in Culvert-4, respectively.

To minimize groundwater infiltration into the culvert, an approximately 8-inch concrete base slab and wing walls were installed at both ends of Culvert-4. Chemical resistant waterstops were installed at each concrete base slab joint spaced at a maximum of 20 feet apart. A cementitious crystalline waterproofing admixture and micro-synthetic fiber blend were added to the concrete for additional waterproofing and strength. In addition, a two part epoxy was installed at the leaking joints below the seasonal high groundwater level (approximately 3 feet above original culvert invert) and to the interface between the new concrete base slab and the existing blocks walls. Approximately 4-inches of Type J Select Fill (rounded) was placed on top of the concrete slab.

Culvert-5 consists of two 7.5-feet x 8-feet concrete box culverts that connect OW-4 to OW-5. Culvert-5 was cleaned and one sample was taken from a leak found within the culvert on April 24, 2013. After evaluating the analytical results, NYSDEC agreed, in an email dated July 3, 2013, that repair of the leak would not be required.

Railroad Drainage Ditch-1 Culvert consists of a 24-inch culvert that connects WRR2 to WRR1. The culvert was cleaned of debris and inspected. Results of the inspection indicated minimal infiltration. Based on the culvert inspection, NYSDEC granted approval in a field modification, dated November 16, 2012, to leave Railroad Drainage Ditch-1 Culvert as is without performing any sealing or grouting. Rip rap aprons were installed on both ends of the culvert.

Railroad Drainage Ditch-2 Culvert consists of a 36-inch culvert that connects WRR3 to WRR5. The culvert was cleaned of debris and inspected. Results of the inspection indicated minor infiltration in three joints of the culvert. Since the culvert inspection indicated minimal infiltration that appeared to be coming in through the railroad bedding material, NYSDEC granted approval in a field modification, dated November 16, 2012, to leave Railroad Drainage Ditch-2 Culvert as is without performing any sealing or grouting. Rip rap aprons were installed on both ends of the culvert.

The I-690 Storm Sewer collects and conveys storm water runoff from I-690 Eastbound and Westbound to the I-690 Drainage Ditch. The collected storm water runoff discharges to a rip rap apron installed in the I-690 Drainage Ditch near Sta. 5+50, as shown on Sheet G-6 of the Record Drawings. Additional storm water runoff captured in the median of I-690 Eastbound and Westbound discharges to a rip rap apron installed in the I-690 Drainage Ditch near Sta. 0+25, as shown on Sheet G-5 of the Record Drawings. Catch basins, culverts, piping, and other appurtenances of the I-690 Storm Sewer system that discharge to the I-690 Drainage Ditch were flushed, and sediment was collected and staged in Wastebed B as shown on **Figure 4**. Following flushing, the storm sewer was inspected via closed circuit television (CCTV). CCTV reports and the videos are included as **Exhibit 5.** Emails summarizing the findings of the CCTV reports, NYSDEC comments, and response to NYSDEC comments are included in **Appendix C.** After reviewing the information summarizing the work, NYSDEC agreed that except for collection of a wet weather sample from the outfall pipe, no further action would be required in the storm sewer system.

3.11 SITE RESTORATION

Following construction activities, areas disturbed during construction were restored as described in the Technical Specifications and Record Drawings or as described in this section.

3.11.1 Topsoil and Seeding

A minimum of 12 inches of topsoil was placed over a minimum of 12 inches of Type L select fill (clay) in the restored wetlands to achieve the final grade at the Site. A minimum of 6 inches of topsoil was placed over embankment material along the banks of the I-690 Drainage Ditch, OW-1, OW-2, OW-3, OW-4, Wastebed D/E Drainage Ditch (section with liner), and Railroad Drainage Ditch -1 and -2. The topsoil was seeded to facilitate vegetation grown with seed mixes as shown on Sheet G-40 of the Record Drawings. The Manufacturing Quality Control and Construction Quality Control information for seed and erosion control blanket is provided in **Exhibit 6**.

3.11.2 Site Security

As shown on the Record Drawings, fence removed during construction was replaced in kind. Additional chain link fence was installed around Pump Station-1 and -2 and padlocks were installed on the gates and the electrical enclosures.

3.11.3 Restoration of Surfaces

Surfaces and other features disturbed or damaged during the performance of the work were restored to pre-construction condition. Where required, topsoil and seeding were placed to minimize the potential for erosion and maintenance of the restored area.

A field modification was issued to keep the construction access road and 18-inch culvert crossing Railroad Drainage Ditch-1. The field modification dated January 11, 2013 was submitted to and approved by NYSDEC. This access road reduces the potential for damage to the wetlands and ditch resulting from future personnel access to the site areas requiring long term monitoring. The seed mix applied to adjacent restored areas was placed on the banks of the access road to encourage vegetation and minimize erosion.

3.12 MATERIAL MANAGEMENT

Material was handled in accordance with the Materials Management Plan, which was included in the NYSDEC-approved Construction Work Plan, and the NYSDEC-approved Materials Management, Grading, and Disposal Plan, which superseded the Materials Management Plan. Excavated material was transported and staged at Wastebed B Staging Area as shown in **Figure 4**. Staged materials were sampled and analyzed for hazardous waste characteristics, as discussed in Section 3.13. The final disposition of the excavated material placed in Wastebed B will be evaluated during the final remedy for the Wastebed B/Harbor Brook site as discussed in the Wastebed B/Harbor Brook Materials Management, Grading, and Disposal Plan (O'Brien & Gere 2013).

3.12.1 Groundwater Collection System Waste

Excavation was required for installation of the following groundwater collection system utilities and facilities, as shown on Sheets G-5 to G-9 and Sheets G-25 to G-27 of the Record Drawings:

- Wet wells and valve vaults
- FRP collection pipes and force mains
- Electrical conduits associated with Pump Stations-1 and -2

Approximately 10,000 cubic yards of material was generated. Materials excavated from the portion of the Site to the south of the railroad tracks was direct loaded and transported via Part 364 permitted dump trucks on public roads. Materials excavated from the portion of the site to the north of the CSX railroad tracks were direct loaded and transported via off-road dump trucks on Honeywell roads. The material from both portions of the site was transported to Wastebed B Staging Area, as shown on **Figure 4.** Visibly stained material was temporarily staged and sampled prior to consolidation in the Wastebed B Staging Area. The transported waste was consolidated, graded, and the area will be seeded in accordance with the Wastebed B/Harbor Brook Materials Management, Grading, and Disposal Plan (O'Brien & Gere, 2013).

3.12.2 Wetland, Ditch, Open Water, and Culvert Waste

Approximately 30,000 cubic yards of material was generated from culvert rehabilitation and wetland, ditch, and open water excavation work. Materials excavated from the portion of the site to the south of the CSX railroad tracks was direct loaded and transported via Part 364 permitted dump trucks on public roads. Materials excavated from the portion of the site to the north of the CSX railroad tracks was direct loaded and transported via dump trucks on Honeywell roads. The material from both portions of the site was transported to Wastebed B Staging Area, as shown on **Figure 4.** Visibly stained material was temporarily staged and sampled prior to consolidation in the Wastebed B Staging Area. The transported waste was consolidated, graded, and the area will be seeded in accordance with the Wastebed B/Harbor Brook Materials Management, Grading, and Disposal Plan (O'Brien & Gere, 2013).

3.13 MATERIAL SAMPLING

Material sampling was performed for the purpose of waste characterization, documentation sampling, culvert sampling, and sampling offsite sources to the Wastebed D/E Ditch. Waste characterization sampling was performed on excavated materials staged on Site, as shown on **Figure 4,** that were visibly stained. Documentation sampling was performed on native material remaining in place at terminal excavation depth, as shown on **Figure 5.** Culvert samples were collected from storm water entering site ditches or observed leaks

within the culverts. Wastebed D/E Ditch offsite sampling was performed on surface water and sediment upgradient from the Wastebed D/E Ditch, and from the collection sump at the upgradient inflow of the Wastebed D/E Ditch.

3.13.1 Waste Pile Characterization Sampling

Materials that appeared to be visibly stained were stockpiled separately on poly sheeting at characterization sampling piles, as shown on **Figure 4,** and waste characterization sampling was conducted to characterize material and evaluate its final disposition. A total of 11 waste characterization samples were collected. One sample was collected from the first 500 cubic yards and then one every 1,000 cubic yards thereafter for each area. Samples were analyzed for the following:

- Total and Toxicity Characteristic Leaching Procedure (TCLP) VOC's by Method 8260B and 1311/8260B, respectively
- Total and TCLP SVOC's by Method 8270C and 1311/8270C, respectively
- Total and TCLP Mercury by Method 7471A and 1311/7470A, respectively
- Total and TCLP Metals by Method 6010A and 1311/6010A, respectively
- Ignitability, by EPA Method 1010
- Reactivity, (Cyanide and Sulfide) by Methods 7.3.3.2 and 7.3.4.1
- Corrosivity, by Method 9045C, and
- Percent Moisture, by Method D2216

At the request of the NYSDEC, in addition to the 11 standard waste characterization samples, 8 additional samples were collected for every 500 cubic yards of material staged on site from OW-1, -2, -3, and -4. Samples were collected for the following:

- Total VOCs by Method 8260B
- Total SVOCs by Method 8270C

A summary of the analytical data is included in **Table 2**. A description of the sampling locations is included in **Table 2H.**

3.13.2 Documentation Sampling

Documentation sampling was performed to evaluate the chemical composition of the material that will remain in place beneath areas restored as part of the IRM. Samples were collected from the first 6 inches of material remaining at terminal excavation depth. Samples were collected prior to placement of backfill and/or isolation layers. Twenty-six documentation samples were collected at the following locations:

- 4 samples from I-690 Drainage Ditch
- 5 samples from Wastebed D/E Drainage Ditch
- 1 sample from Railroad Drainage Ditch-1
- 4 samples from OW-1, OW-2, OW-3, and OW-4 (one at each location)
- 4 samples from WRR1, WRR3, WRR4, and WRR5 (one at each location)
- 3 samples from WRR3
- 5 samples from Penn-Can Drainage Ditch and former WPC1, WPC2, and WPC3 areas

A summary of the analytical data and sampling locations are included in **Table 3** and **Figure 5.**

3.13.3 CULVERT SAMPLING

Sampling was performed on storm water and observed leaks originating from the following culverts:

- 1 storm water sample from the I-690 outfall pipe at Sta. 0+25 in the I-690 Drainage Ditch
- 1 storm water sample from the I-690 outfall pipe at Sta. 5+50 in the I-690 Drainage Ditch
- 3 samples from leaks into Culvert-3
- 3 samples from leaks into Culvert-4
- 1 sample from a leak into Culvert-5

A summary of the analytical data are included in **Table 4.**

3.13.4 WASTEBED D/E DITCH OFFSITE SAMPLING

The following sampling was performed to characterize flow to the Wastebed D/E Ditch from offsite and upgradient of Hiawatha Boulevard:

- 1 upstream sediment sample
- 1 upstream surface water sample
- 1 sample in the sump collecting water from the Hiawatha discharge pipe as it enters the Wastebed D/E Ditch

A summary of the analytical data are included in **Table 5**.

3.14 IMPORTED BACKFILL

Prior to placement of select fill and topsoil on-Site, O'Brien & Gere reviewed the names and locations of the sources of the material, affidavits, and test reports of the material. As required, samples were collected, tested, and evaluated for compliance with the CQAPP and technical specifications included in the Final Design Report (O'Brien & Gere, 2012a). To evaluate compliance, certain samples were submitted for particle size distribution, laboratory compaction characteristic using modified Proctor effort, and/or analyzed for characteristics of hazardous waste found under 6 NYCRR Part 375 -6.8; Table 375-6.8(a) and Subpart C of 40 CFR 261.20. The moisture-density relationship of applicable select fill material was estimated by ASTM D698, Method D.

Tables summarizing analytical results for select fill and topsoil materials are provided in **Exhibit 2**. A summary table of imported backfill sources with estimated quantities is shown in **Table 6**.

3.15 COMMUNITY AIR MONITORING PROGRAM

As specified in the NYSDEC-approved CAMP, perimeter air quality monitoring (AQM) consisted of real-time monitoring for dust (as PM_{10}) measured in micrograms per cubic meter ($\mu g/m^3$), total volatile organic compounds (TVOCs) measured in parts per million (ppm), and odors measured in odor units (OU). Real-time dust and TVOC levels were monitored continuously and presented as 15-minute time-weighted averages during days when Site activities included ground intrusive work comprising excavation, sediment removal, backfilling, liner installation, and installation of the groundwater collection system. Odors were quantified downwind on-Site whenever they were observed to increase noticeably due to Site activities.

Perimeter AQM was conducted over a 58-week period of ground intrusive Site activities. A total of 197 days of AQM were conducted. AQM work perimeter limits and/or action levels specified in the CAMP were compared to the difference between the downwind perimeter concentration and the upwind (background) perimeter concentration measured over the same time period (background-corrected concentration). Copies of AQM field data sheets and AQM station locations for each day are provided in electronic format in **Appendix D.**

AQM results are summarized below.

- TVOCs - no exceedance of the CAMP work perimeter limit (5 ppm) or action levels (3 ppm and 2 ppm); the maximum 15-minute downwind concentration was 0.6 ppm
- Odors - no exceedance of CAMP action levels (7 OU); the maximum observed downwind odor level was less than 2 OU

- Dust - no exceedance of CAMP work perimeter limit (150 µg/m^3); 15-minute dust concentrations exceeded the investigate/control action level (100 µg/m^3) for three 15-minute periods (136 µg/m^3, 121 µg/m^3, and 101 µg/m^3) within a 1-hour period on April 24, 2013. As prescribed in the CAMP, dust suppression consisting of watering Site roads was performed and all subsequent downwind perimeter dust concentrations were below the action level.

3.16 REPORTING AND DOCUMENTATION

Monthly reports were developed for the Upper Harbor Brook IRM and submitted to NYSDEC as part of the Wastebed B/Harbor Brook IRM Monthly Progress Reports. The photo log, showing construction progress throughout the IRM, is provided in **Appendix E**.

4. STARTUP AND COMMISSIONING

To confirm proper installation and operation of system components in a systematic manner, startup and commissioning procedures were performed following project completion. This activity included startup and commissioning procedures for systems and corresponding components as follows:

Table 4-1. Systems and Components

System	Component
Harbor Brook-1 Collection Trench	Pump Station-1
Harbor Brook-2 Collection Trench	Pump Station-2
I-690 Collection Trench	Pump Station-2

4.1 INSTALLATION COMMISSIONING

Installation commissioning procedures included field verification of individual components of the collection system. These procedures were designed to confirm components were properly installed in the correct location, as indicated in the project documents, and were ready for operation. Installation commissioning involved the following elements:

- Vessel Leak Test Verification
- Force Main Pressure Test Verification
- Equipment Installation Verification
- Instrumentation Installation Verification
- Electrical Installation Verification
- Motor Overload Setting Verification
- Process and Instrumentation Diagram (P&ID) Walk-down Verification

Each wet well and valve vault was visually inspected to verify that the pump stations were installed in general compliance with the design documents. Each wet well and valve vault was hydrostatically tested to verify leakage was within the limits defined in the design documents and applicable code. Testing reports are included in **Appendix F**.

Hydrostatic test reports were reviewed to verify that piping requiring pressure testing had been tested, in accordance with the project documents, prior to being placed in service. Pressure test documentation is provided in **Appendix F.**

Newly installed process equipment was inspected to verify that the installation was in conformance with design documents and manufacturer's recommendations. Equipment tag numbers were field inspected to confirm equipment was installed at the correct locations.

Instrument installations were field inspected to confirm proper installation per design documents and manufacturers' recommendations. Calibration and field testing of instrumentation for proper functionality was conducted. Tagging of instrumentation was field verified. Elevations of level control float switches and sensors were verified to be in accordance with the design documents and functional requirements. Loop checks were performed on each instrument and control device to confirm proper function and communication to the appropriate Operator Interface Terminal (OIT).

Electrical terminations and wire labeling were field inspected to verify that conductors were properly connected to equipment and/or terminal blocks in the appropriate panel and to verify that the installation was in

conformance with design documents and manufacturer's recommendations. Heat trace and select power feed conductors were Megger tested prior to circuit energization to confirm the integrity of wire insulation.

Motor overload settings were field verified to confirm they were properly set based on actual motor nameplate data and as required by NEC 430.32.

The system was inspected to verify proper installation of process equipment and piping in accordance with the electrical drawings and the P&ID, as shown on Sheet I-1 of the Record Drawings.

4.2 OPERATIONAL COMMISSIONING

Operational commissioning activities began following completion of installation commissioning. During this process, elements of the collection and conveyance systems were tested to confirm that overall system function and performance of individual elements met design and operational requirements. Functionality of individual elements, sub-systems, and the complete system were demonstrated by initially starting up wet wells individually followed by allowing both wet wells to function as a system. During these activities, pump operation, control sequences, level and flow controls, interlocks, and alarm functions were field verified for proper operation as defined in the design documents. Testing conducted included, but was not limited to:

- Pump start sequence
- Pump stop sequence
- Pump Fail alarm indication
- High temperature alarm indication
- High level alarm indication
- High-High level alarm indication
- Wet well Low level alarm indication
- Low flow alarm indication

5. OPERATION, MAINTENANCE, AND MONITORING

Details of the operation and maintenance of the IRM systems are provided in the Operation and Maintenance (O&M) Plan and the performance monitoring and verification activities for the wetlands, Harbor Brook and the groundwater collection systems are provided in the Performance Verification and Monitoring (PV&M) Plan. These documents will be submitted under separate covers.

6. QUALITY ASSURANCE/QUALITY CONTROL

Materials used during the remedial action met the Construction Quality Assurance/Construction Quality Control requirements of the NYSDEC-approved CQAPP, submitted as Appendix J of the Upper Harbor Brook Final Design Report (O'Brien & Gere, 2012a). The following is a summary of materials testing that are attached in the referenced Exhibits:

- Imported Backfill (**Exhibit 2**)
- Seed and Erosion Control Blanket (**Exhibit 6**)
- Geotextiles (Stabilization Fabric and Cushion) and Geomembrane (**Exhibit 7**)
- Third Party Liner Inspection (**Exhibit 8**)
- Geomembrane Liner Systems (**Exhibit 9**)
- Mechanical - Piping and Appurtenances (**Exhibit 10**)
- Concrete and Testing Reports (**Exhibit 11**)
- Underground Electrical Equipment (**Exhibit 12)**
- Rip-rap (**Exhibit 13**)
- Special Coatings (**Exhibit 14**)
- Structures (**Exhibit 15**)
- Underground Grout Product Data – Pump Stations-1 and -2 (**Exhibit 16**)
- Geotechnical Borings (**Exhibit 17**)
- Vibration Monitoring (**Exhibit 18**)

7. CHALLENGES ENCOUNTERED

The following provides a brief description of challenges encountered during construction of the IRM, and steps taken to resolve them.

Wastebed D/E Ditch excavation

Dewatering efforts were performed in the Wastebed D/E ditch for approximately three weeks with minimal success. The sediment material exhibited soft/plastic characteristics and progress was hampered as the excavation tended to immediately fill in with surrounding material and water. A field modification was issued to utilize in-situ stabilization prior to removal of accumulated sediments in the Wastebed D/E ditch. In-situ stabilization consisted of mixing sand into the sediment material prior to transporting it to the Wastebed B Staging Area. The field modification dated October 23, 2012 was submitted to and approved by NYSDEC.

I-690 Drainage Ditch

The original design for the I-690 Drainage Ditch was based on a 2005 topographic survey. Upon commencement of construction in 2012, the I-690 Drainage Ditch was resurveyed and there was a difference in the ditch elevations ranging from 1 to 3 feet below the 2005 survey. The difference in elevations may have been due to the removal of sediment in the ditch sometime between 2005 and 2012.

During excavation of the I-690 Ditch; groundwater, soft/plastic material, pipe crossings, wood pilings, powerline interference, a concrete pad, and areas of hardpan (dense compacted cinders 6-inches to 3-feet thick) were encountered. The hardpan was difficult to excavate and once it was removed soft material flowed into the excavation. Due to the elevation of the I-690 Drainage Ditch the proposed depth of the excavation and the depth of substrate over the liner had to be revised to approximately 1.9 to 3.6 feet of sand (with the slotted pipe) and approximately 16 inches of substrate material above the liner, in lieu of 2 feet of sand (with the slotted pipe) and 2 feet of substrate material above the liner.

Additionally, due to the proximity to I-690 and potential impact to the highway sub-base, the collection trench alignment was modified to begin at Sta. 0+25 in lieu of Sta. 0+00. The depth and alignment of the I-690 Drainage Ditch was modified in a field modification to begin at Sta. 0+25 in lieu of Sta. 0+00. The field modification dated November 30, 2012 was submitted to and approved by NYSDEC.

Former WPC1, WPC2, and WPC3 areas

The original IRM design included restoration of the former WPC1, WPC2, and WPC3 wetland areas. Prior to construction these wetland areas were observed to be of low quality due to their proximity to a fill material lobe immediately to the north and railroad tracks to the south, and the prevalence of invasive vegetative species. In addition, it appeared that the general area of the three former wetlands was significantly drier and contained less area of hydrophytic species than observed when the original wetland delineation was performed, approximately 10 years previous.

The likelihood is that the restored areas may not contain wetland hydrology, may not support hydrophytic vegetation, and would continually be encroached upon by invasive plant species, the former WPC1, WPC2, and WPC3 areas were not suitable to be restored as wetland areas. This was captured in a field modification dated September 13, 2013, which was issued to and approved by NYSDEC. To compensate for the loss of these areas, the area adjacent to and south of wetland WRR2 was developed as an expanded wetland area. Additional wetland acreage developed in WRR1 and the area between WRR3 and WRR4 was also used to compensate for the lost wetland areas.

Clay compaction in WRR4 and WRR3

Where feasible, standard compaction equipment was used to compact clay in the wetlands. Compaction reports are included in **Exhibit 3.** The Upper Harbor Brook Final Design documents required compaction of clay to reach 95% compaction. This correlated to a maximum permeability of 10^{-7} cm/sec based on the permeability testing included in **Exhibit 2**. Excavation in wetland WRR4 and a portion of wetland WRR3 to the required depth of 2 feet revealed a soft, weak, and plastic sub-grade material. Safety considerations dictated that neither equipment nor personnel were to be allowed into these wetland areas to compact the 1 foot of clay to achieve the specified permeability.

A field modification was issued to place and compact the clay using a long reach excavator in lieu of standard compaction equipment. The field modification dated September 14, 2012 was submitted to and approved by NYSDEC. The clay was shaped and spread with the excavator bucket prior to placing 1 foot of topsoil over the clay. Topsoil was placed in the same manner.

8. SUMMARY OF COSTS

The Upper Harbor Brook IRM was completed at a total construction cost of approximately $12,375,000.

REFERENCES

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