INTERIM REMEDIAL MEASURE CONSTRUCTION COMPLETION REPORT

WILLIS AVENUE/SEMET TAR BED IRM TIEBACK WALL/ENGINEERED FLOODPLAIN IRM

County of Onondaga, New York

Prepared for:

Honeywell

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MAY 2014

CERTIFICATION

I, Mark T. Otten, certify that I am currently a New York State registered professional engineer (PE). I had primary direct responsibility for implementation of the subject construction program, and I certify that the Remedial Design was implemented and that all construction activities were completed in substantial conformance with the Department-approved Remedial Design.[(1)]

NYS Professional Engineer #81375	5/28/2014	Mark T Otten
	Date	Signature

(1) This certification statement is required under Section 1.5 of the NYSDEC Program Policy DER-10: Technical Guidance for Site Investigation and Remediation, issued May 3, 2010 and shall be interpreted using the definitions of scope and responsibility provided in Section 1.5 of DER-10, particularly subsections 1.5(b)3. This certification was reviewed and signed in accordance with the provisions of New York Board of Regents Rule 29.3.

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LIST OF ACRONYMS

ATL	Atlantic Testing Laboratories
CAMP	Community Air Monitoring Plan
CCR	Construction Completion Report
CM	construction manager
CQA	construction quality assurance
CQAP	Construction Quality Assurance Plan
DMP	deflection monitoring point
DNAPL	dense non-aqueous phase liquid
DUSR	Data Usability Summary Reports
ECs/ICs	engineering and institutional controls
FCF	field change form
ft.	feet
HDPE	High density polyethylene
ICE	International Construction Equipment, Inc.
IRM	interim remedial measure
JPW	JPW Riggers & Erectors, Inc.
LWF	light weight fill
MRCE	Mueser Rutledge Consulting Engineers
$\mu g/m^3$	micrograms per cubic meter
NAPL	non-aqueous phase liquid
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
OMM Plan	Operation, Maintenance and Monitoring Plan
OSHA	Occupational Safety and Health Administration
P.E.	professional engineer
PID	photoionization detector
PM	project manager
ppm	parts per million
psi	pounds per square inch
PSP	Project Safety Plan
QA/QC	quality assurance/quality control
RFI	request for information
RWF	regular weight fill
SES	Sevenson Environmental Services, Inc.
SHSO	Site Health and Safety Officer
VOCs	volatile organic compounds

SECTION 1

INTRODUCTION

1.1 BACKGROUND AND SITE DESCRIPTION

Honeywell International Inc. (Honeywell) entered into an Order on Consent (Index #D7-0004-01-09) with the New York State Department of Environmental Conservation (NYSDEC), to perform an Interim Remedial Measure (IRM) on a 65.9-acre property located in the Town of Geddes, New York, known as the Willis Avenue and Semet Tar Beds (Willis/Semet) Site. The Willis/Semet site includes the Willis Avenue Site, the Semet Tar Beds Site and the Willis/Semet IRM location as shown on Figure 1.1. The Order on Consent, effective April 16, 2002, required an IRM to address migration of site contaminants into Onondaga Lake.

The Willis/Semet site is located in the County of Onondaga, New York and is identified as the following parcel on the Onondaga County Tax Maps:

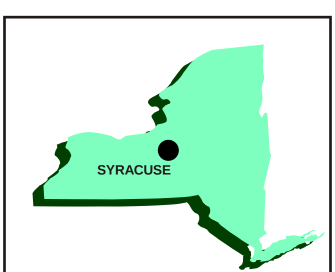
- Tax Map No. 028-01-09.1 (Town of Geddes)

The work area is located north of the Willis/Semet site proper and is identified as the following parcel on the Onondaga County Tax Maps:

- Tax Map No. 29-1-3.1, Liber 324, Page 441 (Solvay Process Company)

The Willis/Semet site including this IRM work area is bounded by Onondaga Lake to the north; the Crucible Specialty Metals Corporation, Conrail railroad tracks and an industrial complex to the south; Willis Avenue to the east, and the Crucible Specialty Metals Corporation to the west (see Figure 1.1). The site boundaries are detailed in the property survey and tax map provided in Appendix A. This Construction Completion Report (CCR) addresses the Tieback Wall/Engineered Floodplain IRM which is a component of the work performed under the Willis/Semet IRM.

An electronic copy of this CCR with all supporting documentation is included as Appendix B.



Syracuse West, N.Y. Quadrangle

LATITUDE: N43° 4' 6"
LONGITUDE: W76° 12.1' 15.5"

FIGURE 1.1

HONEYWELL
WILLIS AVENUE/SEMET TAR BEDS SITE
SYRACUSE, NEW YORK

SITE LOCATION MAP

PARSONS
301 PLAINFIELD ROAD, SUITE 350, SYRACUSE, NY 13212 PHONE: (315) 451-9560

SECTION 2

INTERIM REMEDIAL MEASURE

2.1 INTERIM REMEDIAL MEASURE (IRM) SUMMARY

This IRM CCR describes the Tieback Wall/Engineered Floodplain IRM portion of the Willis/Semet IRM construction and presents Engineering Certification of the construction performed to satisfy the Order on Consent as identified in Section 1.0.

The Tieback Wall/Engineered Floodplain project included construction of a tieback anchoring system and 60-mil high density polyethylene (HDPE) membrane and reinforcing grid system along the previously installed Willis Wall.

2.2 IRM OBJECTIVES

The primary objectives of the Tieback Wall/Engineered Floodplain were to:

- Tieback Wall: Provide geotechnical support for areas of the existing Willis barrier wall that will be used to support Onondaga Lake dredging and capping
- Engineered Floodplain: Maintain separation of surface and ground water during periods of inundation from high lake levels, allowing surface water to discharge directly to Onondaga Lake while minimizing infiltration into the site, thus reducing the volume of groundwater requiring collection and treatment

Both the membrane and anchoring systems were designed to function without interfering with the existing groundwater and dense non-aqueous phase liquids (DNAPL) collection systems.

The Tieback Wall/Engineered Floodplain IRM supplements the previously constructed Willis Wall. Construction of the Willis Wall is documented in the *IRM Construction Completion Report, Willis Portion of the Willis Avenue/Semet Tar Beds Sites IRM* (Parsons, 2012).

The Willis Wall is part of a larger hydraulic control system consisting of the Willis/Semet IRM and the Wastebed B/Harbor Brook IRM (West Wall, East Wall and Upper Harbor Brook) to address area groundwater. This system, which includes a sheet pile barrier wall along the Onondaga Lake shoreline and a groundwater collection system, was constructed in three phases beginning in 2006 and finishing in 2012. The system was designed and constructed to eliminate, to the extent practicable, the discharge of contaminated groundwater and non-aqueous phase liquid (NAPL) to Onondaga Lake from the southeast shoreline area of Onondaga Lake. These IRMs were constructed consistent with the NYSDEC-approved designs. The system prevents the discharge of contaminated groundwater and NAPL to the lake from this area and has addressed the potential for groundwater upwelling to impact the Onondaga Lake sediment cap consistent with the cap design assumptions for this area.

In addition to the above IRMs, a DNAPL collection system was installed along the lakeshore in 1993. The system was expanded to include additional collection wells in 1995 and 2002. In 2012, the system was again expanded and the entire system upgraded and optimized.

2.3 DESCRIPTION OF SELECTED REMEDY

The Tieback Wall/Engineered Floodplain IRM construction was completed in accordance with the *Tieback Wall/Engineered Floodplain IRM Work Plan* (Parsons, 2011) and included the following components:

- Tieback Wall:
  1. Concrete waler system
  2. Segmented steel sheet pile deadman and waler system
  3. Tierods and connectors to the walers
  4. Timber piles
  5. Pile-supported concrete work platform and access apron
  6. Wooden fenders
  7. Site grading
- Engineered Floodplain:
  1. Concrete waler system
  2. Reinforcing grid
  3. HDPE membrane system
  4. Site grading/landscaping

2.4 REMEDIAL CONTRACTS

Honeywell was ultimately responsible for completing the IRM in accordance with the Order on Consent. The following subsections describe the roles and responsibilities of the other entities.

2.4.1 Regulatory Agency

The NYSDEC was the lead agency for the Tieback Wall/Engineered Floodplain IRM. Mr. Richard Mustico, P.E. was the Project Manager for NYSDEC. The construction team coordinated design and field modifications with the NYSDEC. Agency approval correspondences are provided in Appendix C.

2.4.2 Remedial Action Contractor

The Parsons Corporation (Parsons) of Syracuse, NY was the contractor selected by Honeywell to carry out the remedial activities for the IRM. Parsons provided full-time construction management and oversight of the project activities. Some of these responsibilities included: management of remedial action sub-contractors, documentation of daily work activities, review of subcontractor submittals, providing engineering support for design and field changes, administration of quality assurance oversight and testing through laboratories, coordinating reviews of submittals and work plans, coordination with the NYSDEC and other regulatory agencies, and conducting project meetings.

SECTION 3

REMEDIAL ACTIVITIES

3.1 REMEDIAL ACTIONS PERFORMED

Remedial activities completed at the site were conducted in accordance with the NYSDEC-approved *Willis Avenue/Semet Tar Beds IRM, Tieback Wall/Engineered Floodplain IRM Work Plan* (Parsons, 2011). All approved field design modifications to the Work Plan are presented in Section 3.14 of this report. The following subsections describe the construction work performed to complete the IRM.

3.2 GOVERNING DOCUMENTS

Construction was completed under the approved design, which includes the following governing documents:

- *Construction Quality Assurance Project Plan,* Appendix G of the *Final (95%) Design Report for the Willis Avenue/Semet Tar Beds Sites IRM,* (Parsons, 2006).
- *Willis Avenue/Semet Tar Beds IRM, Interim Shoreline Restoration, Contracts A and B,* Narratives and Contract Drawings (Mueser Rutledge, 2011)
- *Willis Avenue/Semet Tar Beds IRM, Tieback Wall/Engineered Floodplain IRM Work Plan* (Parsons, 2011)

Agency-approved correspondence of the *Tieback Wall/Engineered Floodplain IRM Work Plan* is provided in Appendix C.

3.2.1 IRM Work Plan

The *Willis Avenue/Semet Tar Beds IRM, Tieback Wall/Engineered Floodplain IRM Work Plan* was submitted to the NYSDEC on December 16, 2011 and subsequently approved. The IRM Work Plan presented the following information:

- Project organization
- Remedial activities
- Project schedule
- Design drawings

3.2.2 Site Specific Project Safety Plan

A Project Safety Plan (PSP) was prepared by Parsons to establish mandatory safety practices and procedures for the project. In addition, all subcontractors prepared and submitted their own PSPs to further define their specific tasks.

All remedial work performed under this Remedial Action was in full compliance with governmental requirements, including site and worker safety requirements mandated by the Federal Occupational Safety and Health Administration (OSHA). The PSP was complied with for all remedial and invasive work performed at the site.

3.2.3 Construction Quality Assurance Plan

A Construction Quality Assurance Plan (CQAP) was prepared and submitted as Appendix G of the *Final (95%) Design Report for the Willis Avenue/Semet Tar Beds Sites IRM* (Parsons, 2006). The CQAP managed performance of the remedial action tasks through designed and documented quality assurance/quality control (QA/QC) methodologies applied in the field and in the lab. The CQAP provided a detailed description of the observation and testing activities that were used to monitor construction quality and confirm that remedy construction was in conformance with the remediation objectives and specifications.

3.2.4 Community Air Monitoring Plan

Community Air Monitoring Plan (CAMP) monitoring is defined as perimeter or fence line monitoring. Fence line monitoring is defined as along the perimeter of Honeywell property or 200 ft. downwind of a work area; whichever distance is less.

Due to the nature of known or potential contaminants at this site, continuous monitoring for volatile organic compounds (VOCs) and particulates was required for all ground intrusive activities. Ground intrusive activities included, but were not limited to, soil excavation and handling, trenching, and the installation of steel sheet piles.

No exceedences of the VOC or particulate action levels occurred during construction. Results of the CAMP monitoring are presented in Section 3.3.8 and Appendix D.

The following sections summarize the CAMP monitoring approach, instruments, action levels, and response measures, etc.

3.2.4.1 VOC Monitoring

VOCs were monitored at the downwind perimeter of the immediate work area (i.e., the exclusion zone) on a continuous basis. Upwind concentrations were measured at the start of each work day and periodically thereafter to establish background conditions. VOC monitoring was performed using two Gas MiniRAE 2000 photoionization detectors (PIDs), one upwind and one downwind. The calibration of the PIDs was checked at least daily for the contaminant(s) of concern or for an appropriate surrogate and when required, a full calibration was performed in accordance with the manufacturer’s specifications.

The PIDs calculated 15-minute running average concentrations which were recorded and compared to the VOC action levels specified below:

- If the ambient air concentration of total organic vapors at the downwind perimeter of the work area or exclusion zone exceed 5 parts per million (ppm) above background for the 15-minute average, temporarily halt work activities and continue monitoring. If the total organic vapor level readily decreases (per instantaneous readings) below 5 ppm over background, resume work activities with continued monitoring.

- If total organic vapor levels at the downwind perimeter of the work area or exclusion zone persist at levels in excess of 5 ppm over background but less than 25 ppm, halt work activities, identify the source of the vapors, take corrective actions to abate emissions, and continue monitoring. After these steps, resume work activities provided that the total organic vapor level 200 ft. downwind of the exclusion zone or half the distance to the nearest potential receptor or residential/commercial structure (whichever is less; but in no case less than 20 ft.) is below 5 ppm over background for the 15-minute average.
- If the organic vapor level is above 25 ppm at the perimeter of the work area, shutdown work activities.

3.2.4.2 Particulate Monitoring

Particulate concentrations were monitored continuously at the upwind and downwind perimeters of the exclusion zone at two temporary particulate monitoring stations, one upwind and one downwind. The particulate monitoring was performed using DataRAM 4 model DR-4000 real-time monitoring equipment capable of measuring particulate matter less than 10 micrometers in size (PM-10) and capable of integrating over a period of 15 minutes (or less) for comparison to the airborne particulate action level. In addition, fugitive dust migration was visually assessed during all work activities. The particulate levels were compared to the levels specified below:

- If the downwind PM-10 particulate level was 100 micrograms per cubic meter ($\mu g/m^3$) greater than background (upwind perimeter) for the 15-minute period or if airborne dust was observed leaving the work area, employ dust suppression techniques. Continue work with dust suppression techniques provided that downwind PM-10 particulate levels do not exceed 150 $\mu g/m^3$ above the upwind level and provided that no visible dust was migrating from the work area.
- If after implementation of dust suppression techniques the downwind PM-10 particulate levels remain greater than 150 $\mu g/m^3$ above the upwind level, stop work and re-evaluate the dust suppression techniques initiated. Resume work provided that dust suppression measures and other controls have reduced the downwind PM-10 particulate concentration to within 150 $\mu g/m^3$ of the upwind level and prevented visible dust migration.

Since many particulate monitoring instruments operate on nepholometric principles, they can record false positive results during certain atmospheric conditions. For this reason, particulate monitoring was suspended during periods of:

- Steady rain

- Heavy fog, where dust suppression methods preclude visible dust emissions and prior results indicate that dust suppression measures for controlling particulate migration are adequate
- Site activities that did not generate particulate containing hazardous constituents

3.2.4.3 Odors

The site-specific PSP directed that all projects must consider the potential for off-site odors that could result in complaints by the public when disturbing contaminated materials. The project team did not receive odor complaints associated with the Tieback Wall/Engineered Floodplain construction.

3.2.5 Submittals

The Design Engineer reviewed all plans and submittals for this remedial project (i.e., those listed above plus contractor and subcontractor submittals) and confirmed that they were in compliance with the Remedial Design and approved changes. All remedial documents were submitted to NYSDEC and New York State Department of Health (NYSDOH) in a timely manner and prior to the start of work.

3.3 REMEDIAL PROGRAM ELEMENTS

3.3.1 Roles and Responsibilities

The roles and responsibilities of the team members include the following:

NYSDEC: The NYSDEC was the lead agency for the construction. The NYSDEC's designated Project Manager (PM) participated in progress meetings, conducted site inspections, and provided regulatory approval for components of the remedy.

Parsons: The Parsons PM served as Honeywell's representative. The PM was responsible for ensuring that construction was completed in accordance with the Contract Documents and approved Final Design. The PM interfaced directly with Honeywell, NYSDEC and the Parsons project staff as necessary.

The Parsons Construction Manager (CM) was responsible for completion of the construction work. The CM communicated directly with the PM for project needs and monitor on-site construction activities.

The Parsons full-time on-site Site Health and Safety Officer (SHSO) was responsible for implementation of the PSP and to ensure work was performed in compliance with the PSP and applicable regulations. The SHSO also implemented the air monitoring program and report data, performed routine safety inspections, and reported and investigated near misses or incidents.

Parsons and Mueser Rutledge design engineers provided engineering support as needed and reviewed construction submittals that required engineering interpretation.

The Parsons Construction Quality Assurance (CQA) staff was on-site during the construction and made daily field observations to monitor that the construction, installation, materials, workmanship and QC performed by the subcontractors were conducted in accordance with the approved design drawings and specifications. The CQA Manager was also responsible for conducting CQA testing (or working with independent testing subcontractor).

The Parsons CM and CQA Manager were on-site during the construction and made daily field observations and reports.

3.3.2 Remedial Contractor

Parsons was the Remedial Contractor selected by Honeywell to carry out the remedial construction. Project personnel for Parsons included:

- Alan Steinhoff (Senior PM)
- Mike Broschart (Engineering Support/Design Team Interface)
- Thomas Abrams (PM)
- William Long (Construction Manager)
- William Salomone, P.E. (Design Engineer)
- Ron Prohaska (Construction Superintendent)
- Dan Douglass (Quality Assurance)
- Dale Dolph (SHSO)
- Mark Otten, P.E. (Certifying Engineer)

Parsons self-performed the Engineered Floodplain portion of the project and the excavation and fill for the Tieback Wall portion. The following subsections identify Parsons' subcontractors who performed the remedial design construction.

3.3.3 Consultants

Mueser Rutledge Consulting Engineers (MRCE) of New York, NY completed the following activities under subcontract to Parsons:

- Design of the Tieback Wall and Engineered Floodplain
- Full-time QA technical oversight and consulting for installation of the steel sheet pile deadman and timber piles, dynamic pile testing of the timber piles, and tierod tensioning
- Documentation of steel sheet pile and timber pile installation and tierod tensioning
- Monitoring of the existing sheet pile barrier wall for movement during construction

Project personnel for MRCE included:

- Peter W. Deming, P.E. (Design Engineer of Record)
- David R Good P.E. (Project Manager)
- Srinivas Yenamandra, P.E. (Design Engineer)
- Jerry Chan (Quality Assurance Engineer)

- Raj Chinthamani (Quality Assurance Engineer)

3.3.4 Subcontractors

Sevenson Environmental Services, Inc, (SES) of Niagara Falls, NY installed the Tieback Wall portion of the project as a subcontractor to Parsons.

Project personnel for SES included:

- Joseph Burke (PM)
- Brian Shanahan (Construction Superintendent)
- Michael Marrone (QC Manager)
- Scott Allaire (Project Safety Representative)

Atlantic Testing Laboratory (ATL) performed dynamic testing of the timber piles, testing of concrete cylinders and compaction testing as a subcontractor to Parsons. Project personnel for ATL included:

- Shawn Crowe, P. E.

O'Connell Electric of East Syracuse, NY installed electrical power and controls for the groundwater collection and monitoring systems as a subcontractor to SES. Project personnel for O'Connell Electric included:

- Ken Palmisano (PM)
- Kevin Hearn (Construction Superintendent)

Seaway Diving and Salvage Company of Waterford, NY installed the relocated groundwater collection pipe to collection sump CS-2 as a subcontractor to Parsons. Project personnel for Seaway included:

- Tim Joslyn (Dive Supervisor)
- Dom Carlino (Dive Supervisor)

Thew Associates (Thew) of Marcy, NY performed survey services as a subcontractor to Parsons. Project personnel for Thew included:

- Ryan Sadlon (PM/Surveyor)

3.3.5 Site Preparation

A January 5, 2012 kick-off meeting was attended by Parsons and SES prior to beginning on-site work. Documentation of agency approvals required by the Order on Consent is included in Appendix C.

Site preparation including mobilization of heavy equipment, utility mark out and construction of staging areas was completed from January 12-18, 2012.

3.3.6 General Site Controls

The following activities related to site controls were performed:

- Site security – Parsons and its subcontractors coordinated locking of site trailers and perimeter gates daily during non-working hours.
- Job site record keeping – Parsons maintained records of visitors and personnel working at the site on the trailer sign-in sheet.
- Equipment decontamination and residual waste management – Subcontractors coordinated with Parsons to complete decontamination of equipment prior to leaving the site.
- Soil screening results – Parsons performed analytical conformance testing of imported soil materials prior to delivery to the site.

3.3.7 Nuisance Controls

Dust control for the construction haul roads was performed as needed during dry periods. Dust control consisted of the application of water using a water truck. Subcontractors limited construction traffic to temporary access roads stabilized with gravel over the existing surface to reduce the potential erosion of soil outside of road areas.

Equipment decontamination consisted of the removal of soils from excavation equipment prior to demobilization from the site. Decontamination water was allowed to percolate into the ground where it would subsequently be collected by the groundwater collection system.

No nuisance dust or odor complaints associated with the construction were received.

3.3.8 CAMP Results

A description of the VOC and particulate action levels and response actions for the CAMP are provided in Section 3.2.4. No exceedences of the VOC or particulate action levels occurred during construction.

Copies of all air monitoring (CAMP) field data are provided in electronic format in Appendix D.

3.3.9 Reporting

Parsons, SES and MRCE prepared daily reports during construction. The daily reports include a description of the operations conducted for the day, equipment, and personnel on-site, problems encountered, weather conditions, and monitoring results. The daily reports were placed on the project SharePoint website for review on a daily basis.

Project coordination meetings were conducted on a weekly basis every Tuesday during construction. Meeting attendees included representatives from Honeywell, NYSDEC, Parsons and SES. Weekly meeting minutes were prepared and placed on the project SharePoint website on a weekly basis.

The daily reports and weekly meeting minutes are provided in electronic format in Appendix E.

Quality control phase meetings were conducted for each definable feature of construction. QC phase meetings included three phases (preparatory, initial and follow-up) and final inspections. Field logs were prepared for sheet piling driving, timber pile driving, tierod tensioning and tierod coupler inspections. Identification and resolution of construction issues or deficiencies were handled via field correspondence, requests for information (RFIs), field change forms (FCFs) and meetings. The QC phase meeting minutes and field logs were placed on the project SharePoint website during construction and are provided in electronic format in Appendix F.

Parsons maintained a separate photo log of the daily construction activities. The photo log is included in electronic format in Appendix G.

3.4 ENGINEERED FLOODPLAIN CONSTRUCTION

Construction of the Engineered Floodplain began on January 23, 2012 and was substantially complete by May 25, 2012. Work began on construction of the reinforced concrete waler system by drilling bolt and cutting drain holes in the existing sheet pile barrier wall. The floodplain area was then graded and lightweight fill (LWF) placed adjacent to the barrier wall to reach subgrade elevation. The waler was then constructed by installing anchor bolts and drain pipes through the barrier wall; installing forms, reinforcing steel and a reinforcing geogrid (Tensar UX1500); and placing 4,000 pound per square inch (psi) concrete in the forms. A continuous 3/8-inch bead of DeNeef Swellseal WA was placed on the barrier wall to provide a seal between the barrier wall and waler concrete. Sets of six concrete cylinders were made by ATL each day of concrete placement and tested for compressive strength at three, seven and 28 days. All concrete reached the required 4,000 psi strength by 28 days (Appendix F).

Following removal of the waler forms, the geogrid with one end cast into the waler was rolled out a distance of approximately 45 ft perpendicular to the waler and the leading (south) end embedded in an anchor trench. The anchor trench was then filled with concrete. LWF was then placed on top of the geogrid and regular weight fill (RWF) was placed south of the geogrid/anchor trench to reach the subgrade elevation for the membrane system. LWF was also used to form a berm between the floodplain and tieback area.

A cover system consisting of, from bottom to top, a 7-ounce non-woven separation geotextile fabric (SKAPS GT-180), a textured 60-mil HDPE membrane (Solmax 460T) and a geocomposite drainage net (SKAPS Transnet 160-1-8) was then installed. The cover system extended south from the waler a minimum of 55 ft and extended east over the berm described above. The edges of adjacent membrane sheets were wedge welded and the downstream (north) edge fastened to the concrete waler with stainless steel batten strips, a neoprene gasket and silicon sealant. HDPE boots were installed at all penetrations in the membrane and sealed with a hot shoe welder. Adjacent edges of the geotextile and drainage net were sewn together.

AadvanEDGE® pipe was also installed along the waler and connected to the drain pipes through the wall.

RWF was placed on top of the cover system and graded to achieve final slopes. Compaction testing of the RWF was performed by ATL on two separate dates to ensure proper compaction was achieved (minimum 85 or 92% of maximum dry density by standard Proctor outside and under the access road, respectively). Compaction test results are included in Appendix F.

A 20-foot wide access road extending the entire length of the floodplain area from east to west was constructed by installing a woven geotextile fabric (US Fabrics US 4800) and covering it with 12 inches of dense graded aggregate. The berm was covered with 6-12 inches of riprap. Areas outside the access road and berm were covered with 6 inches of topsoil, seeded and covered with a straw erosion control fabric. Landscape rocks approximately 12-18 inches in size were installed along both side of the access road to keep traffic on the road. The access road was later paved with asphalt under a separate project.

A concrete pad was constructed at the east end of the access road adjacent to the south side of the DNAPL building to protect utilities in the area. The pad was constructed of reinforcing steel, two access hatches and 4,000 psi concrete. Two sets of eight concrete cylinders were made by ATL and tested for compressive strength at three, seven and 28 days. The concrete pad reached the required 4,000 psi strength by 28 days (Appendix F).

Record drawings of the Engineered Floodplain are provided in Appendix H. Submittals for all materials and certifications for the reinforcing steel and the membrane are provided in Appendix I.

3.5 TIEBACK WALL CONSTRUCTION

Construction of the Tieback Wall began on January 18, 2012 and was completed on May 29, 2012. Work began by excavating LWF and RWF from the work area to reach subgrade elevation and expose existing utility lines. The LWF and RWF were stockpiled separately east of the tieback work area for later reuse as backfill. (Note that additional quantities of LWF and RWF were imported to achieve the required grades.)

3.5.1 Steel Sheet Pile Deadman and Waler System

The steel sheet pile deadman was constructed of AZ 19-700 steel sheet piles manufactured by Skyline Steel LLC. The sheet piles consisted of excess sheet piles from construction of the East Wall IRM and new sheet piles. The sheet piles from the East Wall had been welded into pairs by JPW Riggers & Erectors, Inc (JPW). The upper 9 ft. or more of the welded sheet pile pairs were coated by JPW with PPG Amercoat® 78HB coal tar epoxy. The new sheet piles were welded into pairs by Dura-Bond Pipe, LLC. The upper 9 ft. of the welded sheet pile pairs were coated by Dura-Bond with Carboline Bitumastic® 300 M coal tar epoxy. The sheet piles ranged from 35 to 36 ft. long. No sealant was required between the sheet pile pairs as the sheets serve no environmental function. Steel components for the walers were fabricated and coated with Carboline Bitumastic® 300 M coal tar epoxy by Dura-Bond.

The deadman is made up of 13 individual segments containing three to eight sheet pile pairs each installed approximately 100 ft. south of the barrier wall. The sheet piles were driven with a Link-Belt LS-718 crawler crane with a vibratory hammer. Sheet pile installation began at the east end at deadman segment 1 and proceeded generally west. The sheet piles were driven to the design depths and the top of the sheets were cut when needed to achieve the proper top elevation. Sheet piles in the two deadman segments passing under the access apron to the crane pad (segments 7 and 8) were driven 4 ft. deeper than sheet piles in the other segments. One sheet pile pair was deleted from segment 10 due to a conflict with existing utility lines from recovery well RW-18.

The sheeting alignment was controlled by using offset stakes and a steel H-beam as a template and was documented by Parsons using GPS-based survey equipment. Sheet pile pairs were connected by threading the interlocking channel of the pile being installed with the previously installed pile. Plumbness was controlled by the use of a standard 4-foot level monitored by the sheeting foreman as the piles were driven and by adjusting the vibratory hammer angle of impact on the sheet piles as they were driven.

MRCE provided full-time onsite QA oversight during sheet pile driving. MRCE personnel documented the following information for each sheet pile pair:

- Sheet pile pair number
- Sheet pile length
- Coating length
- Date of installation
- Start and end times for driving
- Driving time
- Final top and tip elevations
- Deviation from plumbness
- Notes such as driving conditions, adjustments, etc.

The final sheet pile driving log is provided in Appendix F. Record drawings of the deadman are included in Appendix H. Submittals of the sheet piles mill certificates are provided in Appendix I.

The deadman waler system was constructed by bolting two parallel steel C-channels horizontally to the south side of each deadman segment. The channels are spaced approximately 5-1/2 inches apart to provide a space for the tierods to pass through and be anchored to the deadman. The elevation of several waler segments and the anchoring location of several tierods were adjusted to avoid interferences with existing utilities or recovery wells in the tierod area. Portions of the coal tar epoxy coating damaged during waler installation were field coated with Carboline Bitumastic® 300 M coal tar epoxy.

One zinc anode was installed on each deadman segment for cathodic protection of the steel wall in accordance with the design. Anodes were attached using steel angle brackets welded to the steel sheeting. Brackets were field coated with Carboline Bitumastic® 300 M coal tar epoxy.

3.5.2 Concrete Waler System

Work began on construction of the reinforced concrete waler system by drilling bolt holes in the existing sheet pile barrier wall for waler anchors and fenders. The waler was then constructed by installing anchor bolts through the wall, forms, reinforcing steel and tierod anchors; and placing 4,000 psi concrete in the forms. A continuous 3/8-inch bead of DeNeef Swellseal WA was placed on the barrier wall to provide a seal between the barrier wall and waler concrete. Sets of six concrete cylinders were made by ATL each day of concrete placement and tested for compressive strength at three, seven and 28 days. All concrete reached the required 4,000 psi strength by 28 days (Appendix F).

3.5.3 Tierods

A total of 50 tierods connecting the deadman segments to the concrete wale and existing sheet pile barrier wall were installed approximately 9 ft. apart. The tierods consist of multiple lengths of 2.25 or 2.5 inch diameter threaded steel rods, articulating couplers, bearing plates and tensioning nuts. All components were fabricated and coated with 3M Scotchkote 413 Fusion Bonded Epoxy or Valspar Greenbar® Epoxy Coating by Dura-Bond Pipe, LLC.

Prior to installing the tierods, the influent pipe to collection sump CS-2 was relocated and the phase 1 timber piles installed as discussed in Sections 3.5.4 and 3.5.5, respectively. LWF was then placed in the tierod area and graded to prevent sag in the tierods when installed. Holes were cut in the deadman sheets for the tierod ends to pass thru for anchoring to the steel waler.

Threaded rods and couplers located under the crane pad, access apron and areas with a final elevation greater than 365.0 were installed inside HDPE pipes to minimize stress on the tierods due to potential ground settlement. The HDPE pipes at the couplers were a larger diameter than at the threaded rod (24 inches for couplers, 12 inches for threaded rods) due to the larger coupler size. The lengths of threaded rod were connected with the couplers and fastened to the steel waler with a bearing plate and nut. Each coupler was inspected by Parsons to ensure that the threaded rods had been installed fully into the couplers. Portions of the epoxy coating damaged during tierod installation were field coated with Berry Plastics Corporation Powercrete R-95 liquid epoxy. Following coupler inspection and coating repair, the larger diameter sections of HDPE pipe was slid over the couplers and covered with woven geotextile fabric (US Fabrics US 4800) to keep fill out. Couplers not installed in an HDPE pipe sleeve were wrapped with the same woven geotextile fabric

Double-acting center-hole hydraulic jacks were used to tension the tierods. Tensioning began at the center deadman segments and proceeded both east and west in an alternating fashion. Jacks were connected to each of the tierod ends at a given deadman segment and the tension increased incrementally until the required tension, or lock-off load, was reached. The required lock-off loads for each tierod are provided in the Record Drawing (Appendix F). Upon reaching the lock-off load, the bearing nut on each tierod was tightened to maintain tension. MRCE provided full-time onsite QA oversight during tensioning and prepared tierod tensioning logs. Deflection of the deadman segments, sheet pile barrier wall and concrete waler were surveyed by Thew during tensioning and recorded on the tierod tensioning logs by MRCE (Appendix F).

3.5.4 Collection Trench Pipe Relocation

The existing influent pipe to collection sump CS-2 was relocated to avoid it being damaged during installation of the timber piles for the crane pad. Due to the high permeability of the LWF in the tieback area and expected large volume of water to dewater the excavation, the work was performed using divers to install the new pipe. The excavations were shored using trench boxes and proceeded from CS-2 north to the Willis-Semet collection trench pipe running parallel to the barrier wall. The existing fiberglass reinforced pipe was cut off outside sump CS-2 and abandoned in place. A new hole was cut in the side of CS-2 to accommodate the new pipe direction and a new ductile iron pipe installed from CS-2 to the collection trench pipe. The former pipe opening and annular space around the new pipe into CS-2 were sealed with hydraulic cement. The trench excavation was backfilled with LWF.

The as-built location for the new collection pipe is shown on the record drawings provided in Appendix H.

3.5.5 Crane Pad

A pile-supported crane pad and access apron to support Onondaga Lake dredging and capping operations was constructed adjacent to the barrier wall. The crane pad measures approximately 45 ft. by 113 ft. and is designed to accommodate two crawler cranes, each with a total dead weight of 357 kips (178.5 tons) and a pick load of 20 kips (10 tons) at a maximum reach of 100 feet. A total of 164 pressure-treated southern yellow pine timber piles were installed to support the pad. The timber piles were 60 ft. in length with a minimum tip diameter of 7 inches and a minimum butt diameter of 12 inches. The design ultimate load carrying capacity of each pile is 36 kips (18 tons).

The crane pad was installed in two phases to allow for tensioning of the tierods prior to driving the four rows of timber piles immediately adjacent to the barrier wall. Phase 1 included driving 112 piles, placement of reinforcing steel and 6,000 psi concrete for the crane pad and access apron on top of the Phase 1 piles, and curing of the concrete to a minimum of 6,000 psi before driving the Phase 2 piles. Phase 2 included driving the remaining 52 piles adjacent to the barrier wall and the placement of reinforcing steel and 6,000 psi concrete for the crane pad on top of the Phase 2 piles. All concrete reached the required 6,000 psi strength by 28 days (Appendix F).

The piles were driven with a Link-Belt LS-718 crawler crane equipped with an International Construction Equipment, Inc. (ICE) model I-8^{V2} single-acting diesel hammer. Pile locations were pre-drilled with a mini-excavator equipped with an auger to minimize pile breakage during initial driving. The pile tops were cut with a chain saw to achieve a 6-inch embedment in the bottom of the crane pad concrete. Six bollards were installed adjacent to the barrier wall to provide anchorage for floating equipment.

MRCE provided full-time onsite QA oversight during pile driving for both Phases 1 and 2 and prepared driving logs for each pile. MRCE inspected each timber pile for straightness, diameter and cracks prior to installation. Timber piles deemed unsatisfactory were rejected and replaced. ATL performed dynamic pile testing for the first three piles driven during Phase 1. Copies of the driving logs, dynamic pile testing report and concrete test results are included in Appendix F.

3.5.6 Site Restoration

The northern half of the tieback was backfilled with LWF only to the same elevation as the top of the concrete wale at the barrier wall. The southern half of the tieback area was backfilled with 18 inches of LWF, 12 inches of RWF and 6 inches of topsoil. A non-woven geotextile (SKAPS GT-180) was placed between the LWF and RWF. The area south of the deadman was backfilled with RWF only and 6 inches of topsoil. The final grade at the southern half of the tieback area was approximately the same elevation as the top of the deadman sheet piles. The topsoil was seeded and covered with straw for erosion protection.

A berm was constructed at the east end of the tieback area by placing clay over a non-woven geotextile fabric (SKAPS GT-180). The berm was covered with 6-12 inches of riprap.

Several utilities lines associated with the Willis-Semet groundwater collection system that were disconnected during construction were reinstalled.

3.5.7 Fenders

Timber fenders were installed on the north (lakeside) of the barrier wall along the entire length of the tieback area to facilitate barge berthing during Onondaga Lake dredging and capping operations. The timbers were made of 8 inch by 8 inch and 8 inch by 10 inch southern yellow pine. The timbers were bolted together then to the barrier wall. Wood shims were provided where needed to adjust for imperfections in the barrier wall alignment.

3.6 MONITORING OF BARRIER WALL

No excessive deflection of the wall occurred during construction. During construction of the Tieback Wall and Engineered Floodplain, the existing barrier wall was monitored to ensure that there was not excessive deflection of the wall due to construction activities. Monitoring was done by surveying the location of deflection monitoring points (DMPs) located on the wall approximately weekly.

3.7 DISPOSAL OF WASTES

3.7.1 Construction Water

Construction water is defined as water collected from excavations. Dewatering of the tieback wall/floodplain area was performed occasionally in order to lower the groundwater elevation below the ground/work elevation. The construction water was discharged into the existing groundwater collection system for treatment at the Willis Avenue treatment plant. The quantity of construction water collected and treated was not measured.

3.7.2 Excavated Soil

LWF and RWF excavated during the project were stockpiled and reused onsite. No excavated soil was disposed offsite.

3.8 REMEDIAL PERFORMANCE/DOCUMENTATION SAMPLING

Remedial performance, end-point sampling, or Data Usability Summary Reports (DUSRs) for site contamination were not part of the IRM.

3.9 IMPORTED BACKFILL

Imported soil and gravel materials consisted of LWF, RWF, clay, dense graded aggregate, riprap and topsoil.

Analytical testing was conducted for imported RWF, clay and topsoil for compliance with the 6NYCRR Part 375 Unrestricted Use Soil Cleanup Objective. Test results are summarized in Table 3.1 and included in Appendix J. Analytical testing was not conducted for imported LWF, dense graded aggregate for the access road and riprap as those materials met the exemption from 6 NYCRR Part 375 chemical analysis as per DER-10 Section 5.4e.5 (less than 80% passing the #80 sieve and virgin material from a permitted mine or quarry). The quantities of each imported material and a summary of the analytical tests collected for imported backfill material is provided in Table 3.1 and the analytical results are provided in Appendix J.

3.10 CONTAMINATION REMAINING AT THE SITE

As presented in Section 2.2, the Tieback Wall/Engineered Floodplain IRM objectives supplement the previously constructed Willis Wall IRM and do not include excavation or removal of a contamination source. The Willis Wall is part of a larger hydraulic control system designed and constructed to eliminate, to the extent practicable, the discharge of potentially contaminated groundwater and NAPL to Onondaga Lake from the Southeast Shoreline area of Onondaga Lake. Procedures for monitoring, operating and maintaining the groundwater collection system and site final closure systems are provided in the Operation, Maintenance and Monitoring Plan (OMM Plan) for the Onondaga Lake Lakeshore Barrier Wall Hydraulic Containment System for the site.

3.11 FINAL COVER SYSTEM

In order to prevent exposure to remaining contamination at the site, additional measures will be evaluated and constructed in the future under other IRMs or the final remedy for the site.

3.12 ENGINEERING CONTROLS

This IRM did not require Engineering and Institutional Controls (ECs/ICs).

Procedures for monitoring, operating and maintaining the groundwater collection system and site final closure systems are provided in the Operation, Maintenance and Monitoring Plan (OMM Plan) for the Onondaga Lake Lakeshore Barrier Wall Hydraulic Containment System for the site.

3.13 INSTITUTIONAL CONTROLS

The final site remedy will include an environmental easement or deed restriction placed on the property as required.

3.14 DEVIATIONS FROM THE IRM WORK PLAN

During construction, a total of 19 deviations from the final design were required. Deviations presented in this section are modifications that required evaluation and approval by the design engineer and/or the NYSDEC prior to implementation. However, none of the field changes impacted the design intent or long-term effectiveness of the system. Typical minor construction modifications or "field fit" of the components that did not require design evaluation and approval by the design engineer or the NYSDEC are not covered under this section but are recorded on the record drawings (Appendix H). Field changes are documented on a Parsons FCF and numerically identified with the prefix "FCF". In addition, design clarifications or changes were also documented on a Parsons RFI form and numerically identified with the prefix "RFI".

The following approved changes were implemented:

FCF

1	Tierods - Articulating Couplers
2	Geogrid
3	Berm at Deadman

RFI

1	Rebar at Waler
2	Geogrid Replacement for WWF
3	Floodplain LWF
4	Coating Repairs
5	Floodplain Aggregates
6	Dike Construction between Contracts A&B
7	Dike Construction Contract B East Side
8	Dike Construction Contract B Flood Prevention
9	Top of Existing Sheeting @ Contract A
10	Rod Connections to Deadman
11	Wood Pile Locations
12	Anodes
13	Crane Pad Details
14	Nonfunctional Inclinometers

15 SK-4 Bracket Detail at Deadman Waler
16 Crane Pad Approach Apron Grade

FCFs, RFIs and supporting documentation are provided in Appendix K.

Table 3.1 - Summary of Imported Material and Analytical Testing

Material	Application	Vendor	Imported Quantity (tons)	Imported Quantity (cy) [(1)]	# Analytical Samples [(2)]	Analytical Sample Dates [(2)]
Light Weight Fill (LWF)	Backfill	Solite	1,813	2,266	0	Not Required [(3, 4)]
Regular Weight Fill (RWF)	Backfill	Riccelli - Granby	12,825	8,550	22	4/21/11 and 10/3/11
Dense Graded Aggregate	Access road	Hanson - Marcellus	4,509	2,505	0	Not Required [(3)]
Riprap	Berm cover	Hanson - Marcellus	142	79	0	Not Required [(3)]
Clay / Low Permeability Material	Berm	Riccelli - Brickyard Pit	1,623	955	14	4/21/11, 6/7/11 and 7/9/11
Topsoil	Landscape areas	Riccelli - Black Creek	1,355	1,042	12	8/11/11 and 4/4/12
		Riccelli - Island Road	2,545	1,958	10	8/11/11 and 5/11/12

Notes.

1. Volumes of imported material are calculated based on average unit weight and load quantities.
2. Analytical testing results provided in the appendices.
3. Chemical testing not required for aggregates meeting DER-10, Section 5.4(e)(5) requirement of less than 10% passing #80 sieve.
4. LWF approved as part of the Willis portion of the WillisAvenue/Semet Tar Beds Sites IRM.