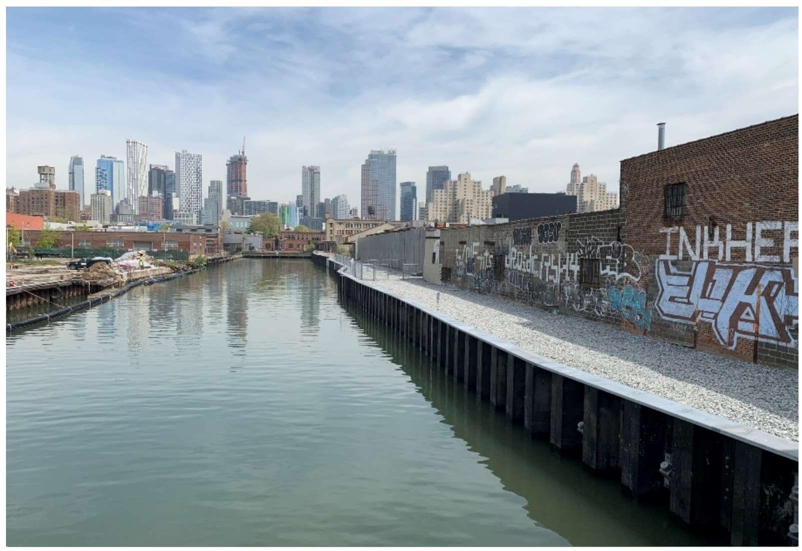
Proactive by Design

CONSTRUCTION COMPLETION FINAL REPORT
BULKHEAD BARRIER WALL

FULTON FORMER MANUFACTURED GAS PLANT (MGP) SITE
Brooklyn, New York



Prepared By:
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August 2021

Proactive by Design

GEOTECHNICAL
ENVIRONMENTAL
ECOLOGICAL
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August 20, 2021
GZA File No. 03.0034060.10

Mr. Christos Tsiamis
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United States Environmental Protection Agency (USEPA), Region 2
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Re: Construction Completion Final Report
Bulkhead Barrier Wall
Fulton Former Manufactured Gas Plant (MGP) Site
Brooklyn, New York
Administrative Settlement Agreement and
Order on Consent Docket No. CERCLA-02-2018-2003

Dear Mr. Tsiamis:

On behalf of The Brooklyn Union Gas Co. d/b/a National Grid NY (National Grid), GZA GeoEnvironmental of New York (GZA) hereby submits the attached Construction Completion Final Report documenting construction of the bulkhead barrier wall pursuant to Paragraph 59b. of the United States Environmental Protection Agency (EPA) Administrative Settlement Agreement and Order on Consent (AOC) with National Grid for the Former Fulton MGP Site. In accordance with the above referenced AOC, this bulkhead barrier wall was constructed along the eastern side of the Gowanus Canal extending from the head end south to the Union Street Bridge.

This report serves to document bulkhead barrier wall construction activities and associated changes relative to the EPA-approved 100% Design Report and Bid Documents dated March 1, 2019.

If you have any questions, please feel free to contact James Clark at (860) 858-3134.

Very truly yours,

GZA GEOENVIRONMENTAL OF NEW YORK

Matthew J. Page, P.E.
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Attachment: Construction Completion Final Report, Bulkhead Barrier Wall – Fulton Former MGP

CC: Brian Carr, Esq., USEPA (via email & 1 hardcopy first class)
Janet Brown, Dan Eaton, John Miller, NYDEC (via email)
Patrick Van Rossem, Andrew Prophete, Carolyn Rooney, National Grid
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Certification

I, James J. Clark, certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I have no personal knowledge that the information submitted is other than true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

August 20, 2021
Date

James J. Clark
GZA GeoEnvironmental of New York

Project:

Construction Completion Final Report
Bulkhead Barrier Wall
Former Fulton Manufactured Gas Plant (MGP) Site
Brooklyn, New York

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1.0 INTRODUCTION

On behalf of The Brooklyn Union Gas Co. d/b/a National Grid NY (National Grid), GZA GeoEnvironmental of New York (GZA) has prepared this Construction Completion Final Report (Final Report) pursuant to Paragraph 59b. of the United States Environmental Protection Agency (EPA) Administrative Settlement Agreement and Order on Consent Docket No. CERCLA-02-2018-2003 (herein referred to as the AOC) with National Grid documenting construction of the bulkhead barrier wall for the Fulton Former Manufactured Gas Plant (MGP) Site. In accordance with the above referenced AOC and as described further herein, this bulkhead barrier wall was constructed along the eastern side of the Gowanus Canal extending from the head end south to the Union Street Bridge.

This report serves to document bulkhead barrier wall construction activities, including any deviations from the EPA approved 100% Design Report and Bid Documents prepared by GZA dated March 1, 2019.

This Final Report is organized as follows:

- Section 1.0 contains this introduction;
- Section 2.0 describes the barrier wall design;
- Section 3.0 describes barrier wall construction;
- Section 4.0 describes deviations from the 100% design; and
- Section 5.0 summarizing results of groundwater elevation monitoring performed prior to, during and subsequent to construction of the bulkhead barrier wall.

2.0 BARRIER WALL DESIGN

The approximately 872 linear foot bulkhead barrier wall was installed along the east side of the Gowanus Canal, extending from the head end of the canal to the north side of the Union Street Bridge. The bulkhead barrier wall is composed of 5 sections, as shown on the as-built provided as **Appendix A**. This section provides a summary of the basis of design and design methodology which were presented in the EPA approved 100% Design Report and Bid Documents prepared by GZA, dated March 1, 2019.

The design of this bulkhead barrier wall was completed while taking into consideration the planned EPA remedy for the Gowanus Canal which includes dredging, in-situ stabilization in certain areas, and capping as well as Combined Sewer Outfall (CSO) control measures to be implemented by New York City Department of Environmental Protection (NYCDEP). NYCDEP control measures will involve construction of an in-line sewage/stormwater retention tank and its appurtenances immediately upland of the barrier wall. NYCDEP is responsible for taking all necessary measures in their CSO design and construction to protect the stability and integrity of the barrier wall system presented herein. This includes, but is not limited to, adhering to the wall movement tolerances developed by National Grid. NYCDEP's responsibilities also include design, installation and performance of all barrier deflection monitoring during CSO tank (or other upland construction) to ensure consistency with the wall movement tolerances described herein, as well as any additional steps that may be required should NYCDEP exceed relevant tolerances during their construction efforts.

All units for design are presented in the United States Customary System. All elevations described herein are in reference to the North American Vertical Datum of 1988 (NAVD 1988) and the North American Datum of 1983 (NAD 1983).

2.1 BASIS OF DESIGN

The design of the bulkhead barrier wall was based on historical documentation provided to GZA, conditions observed through field investigations, and anticipated future update uses and development. The following was considered for the barrier wall design basis:

- *Design Soil Profiles and Parameters*: Design soil profiles and parameters for both the canal (passive) and upland (active) side of the barrier wall were developed based on correlations to field and laboratory data.
- *Existing Bulkheads and Outfalls*: The existing bulkhead alignment, condition, and extension of combined sewer outfalls (CSOs) discharging into the Gowanus Canal.
- *Wall Geometry*: The bulkhead barrier wall geometry was designed in consideration of the phased construction conditions presented in the EPA ROD for the Gowanus Canal NPL Site. These conditions included the following planned work to be performed by others as part of the canal remedy: pre-dredge (existing conditions), post dredge, and post cap construction surfaces.
- *Loading Conditions*: Short-term (temporary) and long-term (permanent) uniform surcharge loading conditions were incorporated into the design to accommodate anticipated future construction activities along the upland side of the barrier wall. In addition, loading from existing buildings and hydraulic pressures due to tidal fluctuations, flood events, and sea level rise mounding were considered for the barrier wall design.
- *Deflections*: Barrier wall deflections and potential ground settlement were assessed. Acceptable tolerances for post-construction movement of the barrier wall were evaluated for the design.
- *Interlock Joints*: To reduce the permeability of the barrier wall, pairs of sheet piling were specified to be shop welded and a Non-Aqueous Phase Liquid (NAPL) compatible sealant was specified to be applied within the steel sheet pile interlocks. Additionally, each leading driving interlock was specified to be equipped with a declutching detector to verify that each pair of sheet piles were connected throughout the length of the interlock.
- *Material Properties*: Structural material properties based on industry standards were used for construction of the barrier wall and associated systems, including but not limited to, steel, concrete, and timber.
- *Groundwater Modeling and Hydraulic Relief*: Groundwater modeling performed by GZA as part of the barrier wall design process indicated that only limited localized groundwater mounding would result from the construction of this barrier wall[1]. However, predictions of rising sea levels and future flood events overtopping the bulkhead as well as the NYCDEP CSO tank project and other potential upland development provide uncertainties related to additional future hydraulic loads on the barrier wall system.[2] Therefore, a shallow hydraulic relief system was incorporated into the design.

2.2 DESIGN METHODOLOGY

The bulkhead barrier wall design sections were analyzed under long-term and short-term surcharge loading for static and seismic conditions. The following design assessments were performed:

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[1] As described in Section 5.0, groundwater elevation monitoring performed prior to, during and after construction of this bulkhead barrier wall indicate no significant changes in observed groundwater elevations in the vicinity of the barrier wall. This data, which is consistent with the predictive groundwater modelling performed as part of the design, confirms that installation of this bulkhead had no measurable impact on local groundwater elevations or flow directions.

[2] Pursuant to orders between EPA and the City of New York, the City is responsible for the design and construction of any groundwater management system necessary for the long-term operation of the RH-034 Tank.

- *Static Analysis*: A static analysis was performed for each of the wall sections and is controlled by forces and moments acting on the wall, deflection of the wall, and minimum toe embedment. The Simplified Method was used to assess the cantilevered Wall Section 4 (described herein) and the Free Earth and Fixed Earth Methods (USS Steel Sheetpile Manual) were used to assess the anchored Wall Sections 1, 2, 3, and 5 (described herein).
- *Seismic Analysis*: A seismic analysis of each wall section was performed in accordance with the procedure outlined in the NCEL Technical Report – *The Seismic Design of Waterfront Retaining Structures*. The seismic active and passive earth pressures were determined using the Mononobe Okabe method, which is equivalent to the static earth pressure component plus the dynamic earth pressure component. Iteration of the embedment depth was performed until moment equilibrium of the wall system was achieved.
- *Liquefaction Susceptibility*: A liquefaction susceptibility assessment was performed using an empirical method set forth by Idriss and Boulanger (2008), for representative explorations from the 2017 Parcel VI and VII Pre-Design Investigation (PDI) Exploration Program, and in accordance with the 2014 NYCBC. The results indicated that while liquefaction is not expected, generation of cyclic pore pressure is possible and therefore, structural wall elements were sized for potential seismic loading conditions using pseudo-static methods.
- *Load Combinations*: Load combinations, including dead loads, live loads, and earthquake loads, were evaluated for each of the wall sections in accordance with ASCE 7-10, Section 2.4.1, based on the results of the static and seismic analyses. The worst-case results of the load combination analysis were used for design of the wall sections and anchorage systems.
- *Global Stability*: A global stability assessment was performed for each wall section of the bulkhead barrier wall using the Morgenstern-Price method and Slope/W software by Geosystems International, Inc. Based on the results of the global stability analysis, the bulkhead barrier wall sections meet the standard of care.
- *Pile-Supported Deadman System*: At Wall Section 2, the pile-supported deadman consisting of a battered compression micropile and a vertical tension micropile embedded in a concrete cap was designed to resist compression and uplift tension loads in accordance with FHWA, PTI DC35.-14, ACI 318-14, and NYCBC. Combined stresses were evaluated in accordance with AISC 2011 to verify the pile system could resist axial, moment, and shear forces associated with the horizontal load applied to the barrier wall. Design loads were field verified through proof testing, as described in Section 3.5.4.4 of this report.
- *Tieback Anchors*: Tieback anchors were designed utilizing the soil bond stresses determined from the anchor load test performed prior to the start of construction in December 2017, and in accordance with PTI DC35.1-14 for Wall Sections 1, 3, and 5. Performance tests, proof tests, and lift-off tests were performed in accordance with the load test schedule for the tieback anchors along Wall Sections 1, 3, and 5 outlined in Section 3.5.4.3 of this report.
- *Corrosion Protection*: Due to the corrosive marine environment, corrosion protection or corrosion loss was considered for design. Based on the corrosion protection assessment, the sheet piles were sized for sacrificial steel loss, specified as Grade A690 Mariner grade steel, and coated with coal tar epoxy. Tieback and tie-rod anchors were encapsulated with double corrosion protection. Micropiles were sized to account for sacrificial steel loss. As described in Section 3.6.11, a cathodic protection system consisting of sacrificial anodes was also installed to provide additional protection to the steel sheet piling.

2.3 DESCRIPTION OF FINAL BARRIER WALL TYPES AND LAYOUT

The approximately 872 linear feet of bulkhead barrier wall was designed to replace the existing bulkheads along the east side of the Gowanus Canal, extending from the head of the canal to the Union Street Bridge. As described herein, and as shown on the attached **Appendix A**, the barrier wall is made up of the following five (5) sections.

WALL SECTION	WALL TYPE
Section 1 (127 ft)	Sheet Pile Wall with Deadman and Tiebacks
Section 2 (92 ft)	Sheet Pile Wall with Deadman
Section 3 (147.5 ft)	Sheet Pile Wall with Tiebacks
Section 4 (42.5 ft)	Combination Sheet Pile/Steel Beam Wall
Section 5 (461 ft)	Sheet Pile Wall with Tiebacks

This barrier wall was specifically designed to facilitate installation using a hydraulic press-in system (Giken Silent Piler F401-1400) in place of conventional impact or vibratory methods. This installation method was selected over conventional piling installation techniques due to its ability to significantly reduce noise and vibrations during installation. As described further in Section 4.2, EPA approved the use of a vibratory hammer system to install approximately 207 feet of sheeting along the southern end of the wall adjacent to the 525 Union Street building. This system was used in this area after portions of the 525 Union Street building were supported via underpinning. No additional movement or significant vibrations were observed during sheet piling installation using the variable moment vibratory hammer system.

2.3.1 Sheet Pile Wall with Pile Supported Deadman (Sections 1 and 2)

The barrier wall design at Wall Section 2, approximately 101 linear feet, and approximately 91.5 linear feet of Wall Section 1 consists of an anchored sheet pile wall with a pile supported deadman system. A deadman system was used in this area to avoid potential conflicts with the NYCDEP planned CSO tank construction. Per EPA requirements and in consultation with NYCDEP, in order to avoid conflicts with the City's CSO project, this deadman system extends no greater than 50 feet upland from landside face of the new bulkhead (see **Appendix A**). The deadman system consists of battered compression and vertical tension micropiles embedded in a concrete cap. Steel tierods connect the new sheet pile wall to the concrete cap/micropile system.

2.3.2 Sheet Pile Wall with Tieback Anchors (Sections 1 and 3)

The barrier wall design at Wall Section 3, approximately 139.5 linear feet, and the remaining portion of Wall Section 1, approximately 37 linear feet, consists of an anchored sheet pile wall with a tieback anchor system. Tieback anchors connect to a wale system located behind the new sheet pile wall. The tiebacks extend beneath the existing building on Parcel VI and are installed at alternating angles of 35 and 45 degrees from horizontal. As shown on **Appendix A**, per EPA requirements and in consultation with NYCDEP, the tiebacks extend in the horizontal direction less than 50 feet from the back face of the new bulkhead to avoid potential conflict with the NYCDEP planned CSO tank construction.

2.3.3 Combination Sheet Pile and Steel Beam Wall (Section 4)

The barrier wall design at Wall Section 4, approximately 36.7 linear feet, consists of a cantilever combination sheet pile and steel beam wall system. The combination wall consists of interlocked box sheet piles with a steel beam installed in the center of the box and the void space filled with grout. The combination wall acts as a cantilever system, therefore eliminating the need for anchorage along this section (see **Appendix A).** This approach limits interference with the existing CSO outfall RH-038. A portion of the box sheets was filled with soil in lieu of concrete to facilitate future installation of the CSO tank outfall by NYCDEP.

2.3.4 Sheet Pile Wall with Tieback Anchors (Section 5)

The barrier wall design at Wall Section 5, approximately 466.5 linear feet, consists of an anchored sheet pile wall with a tieback anchor system. Tieback anchors connect to a wale system located behind the new sheet pile wall. The tiebacks extend beneath the existing buildings on Parcel I and the 525 Union Street property and were installed at an angle of

45 degrees from horizontal. As shown on **Appendix A,** the tiebacks extend in the horizontal direction up to 49 feet from the back face of the new bulkhead[3].

2.3.5 CSO Outfall Penetrations

Three NYCDEP combined sewer outfalls (CSOs) within the limits of this bulkhead alignment were identified during the design:

- CSO RH-033 - 42" diameter pipe that is located along the property boundary between Parcels VI and VII;
- CSO RH-038 - concrete outfall structure with six (6) 39.25" diameter steel outlet pipes that is located within the Degraw Street ROW; and
- CSO RH-037 - 18" diameter pipe with a concrete enclosure that is located at the face of the existing timber lagging wall within the Sackett Street Right-of-Way.

The bulkhead barrier wall was designed to accommodate these existing outfalls with the technical input and approval from the NYCDEP Bureau of Water and Sewer (BWSO). To accommodate the existing CSO outfalls, penetrations were constructed through the new steel sheet piles and the existing outfall pipes were outfitted with pipe extensions and mechanical connections to extend the outfalls into the canal. The design approach of the outfall penetrations was coordinated with NYCDEP including accommodation for a future outfall penetration at RH-038 to be constructed by NYCDEP. The cantilever wall system along Section 4 at RH-038 was designed to accommodate the hydraulic press-in system and minimize future NYCDEP modifications to the wall system. Plan set approval for the outfall penetrations was received from NYCDEP as described further in Section 4.4. Refer to **Appendix A** for as-built locations of these CSO outfall extensions and penetrations.

3.0 BARRIER WALL CONSTRUCTION

Construction of the bulkhead barrier wall was performed from July 2019 through May 2021. The following sections describe routine reporting to EPA throughout the project, the roles and responsibilities of agencies, contractors, and consultants involved in the project, permits and approvals obtained for construction, property access, community outreach, and construction activities performed.

3.1 ROUTINE REPORTING

In accordance with Paragraph 59 of the AOC, GZA, on behalf of National Grid, prepared and submitted to EPA comprehensive weekly reports documenting progress of the bulkhead barrier wall construction project[4]. In total, 90 weekly reports were submitted to EPA. The reports, which are included as **Appendix F**, describe work completed during the subject week, community air monitoring results, cultural resource monitoring results, movement and vibration monitoring results, upland and marine sedimentation control monitoring results, noise monitoring results, work planned for the following week, and photographs documenting work progress. The subsections presented below are intended to provide a brief summary of the barrier wall construction activities. For more detailed information, please refer to the weekly reports provided in **Appendix F**.

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[3] The access agreement between National Grid and the Owner of the 525 Union Street property (Sackett River LLC) allowed for the anchors to extend into the land up to 55 feet horizontally from the existing bulkhead.

[4] Bulkhead barrier wall design progress was documented in monthly reports submitted to EPA which were initiated in June 2017.

3.2 ROLES AND RESPONSIBILITIES (AGENCIES, CONTRACTORS, CONSULTANTS)

As described previously, the bulkhead barrier wall was constructed in accordance with the EPA Administrative Settlement Agreement and Order on Consent (AOC) with National Grid. Per the AOC, all work was coordinated with EPA's Remedial Project Manager (RPM) - Christos Tsiamis by National Grid's assigned Project Coordinator - James Clark (GZA). EPA also engaged Jacobs Engineering Group to assist in EPA's review and approval of the design reports as well as other bulkhead barrier wall design submittals and modifications during construction.

In addition and in accordance with the AOC, throughout the design and construction phases of this project, National Grid coordinated and cooperated with NYCDEP (the City) such as to ensure that the City's design and construction of their RH-034 CSO tank does not compromise the structural integrity of this bulkhead barrier wall. As described above, per EPA requirements and in consultation with the City, the anchoring systems for this bulkhead barrier wall were designed and installed such that they extend no greater than 50 feet from the back face of the new bulkhead in the area of the City's planned RH-034 CSO tank in order to avoid potential future conflicts. National Grid also coordinated and reviewed designs of the three CSO outfall penetrations described previously with the City.

National Grid also coordinated certain in-canal activities associated with this bulkhead barrier wall construction project with the Gowanus Canal Environmental Remediation Trust and the Gowanus Canal Environmental Remediation Trust #2 (collectively, GERT). The GERT initiated in-canal work associated with the Gowanus Canal clean-up project in November 2020 which required daily activity coordination to limit potential conflicts and maintain schedules.

National Grid engaged the following companies as part of the barrier wall construction:

- Ramboll USA Inc. served as the project Construction Manager.
- Emilcott Associates, Inc. served as the Health and Safety Auditor/EHS Compliance.
- GZA GeoEnvironmental of New York (GZA) was the project Engineer of Record, prepared the design documents and performed on-Site construction oversight for adherence to the design, and provided engineering support services throughout the duration of the project. In addition, GZA performed movement and vibration monitoring services and performed the Community Air Monitoring Plan (CAMP) monitoring.
    - GZA subcontracted Archaeology & Historic Resource Services, LLC. (AHRS) to provide the required cultural resource review and monitoring.
- Odeh Engineers (Odeh) provided structural engineering support services to National Grid as necessary throughout construction.
- Posillico Inc. (Posillico) was the General Contractor (GC) responsible for barrier wall construction.
  Posillico's primary subcontractors and suppliers, and associated roles/responsibilities, are summarized in the following table.

SUBCONTRACTOR/SUPPLIER	ROLES/RESPONSIBILITIES
Amaracon Testing & Inspections LLC	• Geotechnical and analytical testing of imported soils and aggregate. • On-site compaction testing of backfill material. • On-Site concrete testing.
Aquifer Drilling and Testing, A Cascade Company	• Installation of drilled inclinometers. • Installation of drilled micropiles.
Clean Globe Environmental	• Location and mark out of subsurface utilities.
Concrete Corrosion Incorporation (CONCORR Inc.)	• Cathodic protection system testing an QA/QC.
Conway Marine Construction, Inc.	• Sectional Barge Rental.

	• Pre-clearing of canal sediment/debris to 10 feet below existing mudline within barrier wall alignment. • Marine support yard.
Eurofins TestAmerica	• Analytical testing of excess materials.
Gateway Demo/Civil Corp.	• Demolition of the Parcel I building addition.
Groundwater Treatment & Technology	• Mobilization, installation, operation and maintenance, and demobilization of the temporary water treatment system.
Island Paving	• Installation of the carbon fiber wrap on the 525 Union Street Building.
New Style Contracting	• Asbestos abatement for the Parcel I building addition demolition.
Phoenix Marine	• Jack-Up-Barge (JUB) rental, setup, and moves during initial phases of construction to accommodate progression of work within the Gowanus Canal.
Ponderosa Fence Enterprises	• Construction of Noise Barrier Wall and fencing for Site restoration.
Skyline Steel, a Nucor Company	• Steel sheet pile fabrication.
Special Testing & Consulting	• Geotechnical and analytical testing of imported soils and aggregate. • On-Site concrete testing. • On-site compaction testing of backfill material.
Vibra-Tech Engineers	• Noise monitoring during construction activities. • Pre- and Post-Construction Surveys

3.3 <u>PERMITS AND APPROVALS</u>

Consistent with the AOC and based on discussions with EPA, the majority of the federal, state and local permitting related to the barrier wall construction was performed consistent with EPA Permit Equivalency for CERCLA Response Actions. Documents related to the permits and approvals described in the following sections are included in **Appendix B**.

3.3.1 EPA Permit Equivalency

Prior to initiating bulkhead barrier wall construction activities, a permit equivalency package was submitted to EPA which covered the following:

- U.S. Army Corps of Engineers/New York Department of Environmental Conservation (USACE/DEC) Joint Permit Application for Section 404, Section 10, Excavation & Fill in Navigable Waters, 401 Water Quality Certification, and Tidal Wetlands Permits;
- DEC State Pollution Discharge Elimination System (SPDES) Permit for Construction Activities;
- DEC SPDES for Treated Construction Wastewater Permit;
- New York Department of State (DOS) Coastal Consistency Review;
- New York City Department of City Planning (DCP) Local Waterfront Revitalization Plan (LWRP) Review;
- Office of Parks, Recreation and Historic Preservation (OPRHP) Review; and
- New York City Department of Buildings (NYCDOB) Forms; and New York City Small Business Services (NYCSBS) Forms.

EPA provided approval of this equivalency package submittal via letter dated August 19, 2019. Supplemental permit equivalency packages related to underpinning of the 525 Union Street, Parcel I, and Parcel IV buildings as well as the Parcel I building addition demolition were submitted during the construction phase. As described in Section 3.6.10, each of these permit equivalency submittals were also approved by EPA.

3.3.2 Other Permits

In addition to the EPA Permit Equivalency submittals described above, Posillico submitted, obtained, and maintained the following required permits throughout construction phase:

- Dig Safely New York Permits;
- NYCDEP Hydrant Permits;
- USCG Notice to Mariners;
- NYCDOT Right-of-Way Permits (sidewalk closures, sidewalk construction, road occupancy, equipment in roadway);
- NYCDOT Building Operations/Construction Activity Bridges Permit; and
- Fire Department of New York Permits.

Additionally, in June 2020 plan set approval for the CSO Outfalls RH-033, RH-037, and RH-038 were received from NYCDEP Bureau of Water and Sewer Operations (BWSO). Final Acceptance for sewer and drainage work at CSO-RH-033 was received on June 7, 2021 and presented in **Appendix B**.

3.4 PROPERTY ACCESS

Access agreements were obtained with the property owners adjacent to the canal as well as certain properties within the project vicinity. The bulkhead barrier wall borders four (4) privately owned properties (listed below from north to south). Access agreements for these properties generally covered construction-related activities including, but not limited to pre- and post-construction condition surveys, site surveys, movement and vibration monitoring, air monitoring, installation of temporary controls and material/equipment laydown, site access, installation of the bulkhead barrier wall systems, and site restoration.

- Parcel VII is located at 226 Nevins Street (Block 411, Lot 24) at the head end of the canal and is owned by the City of New York. Parcel VII was formerly used for truck repairs is a vacant open lot;
- Parcel VI is located at 242 Nevins Street (Block 418, Lot 1) and is owned by the City of New York. Parcel VI is currently used for truck repair, parking, office space and other commercial uses;
- Parcel I is located at 270 Nevins Street (Block 425, Lot 1) and is currently owned by the City of New York. Parcel I is predominantly occupied by a building that is currently used as a film studio; and
- 525 Union Street (Block 432, Lot 15) is located adjacent to Parcel I and north of the Union Street Bridge and consists of two, one- to two-story industrial/manufacturing buildings. It is owned by a private entity.

3.5 COMMUNITY OUTREACH

A Citizen Participation Plan (CCP) dated September 2018 was prepared by National Grid. This CCP outlined a variety of communication methods that, based on applicable New York State law and NYSDEC regulations and guidance, provide for constructive communication of program activities between the stakeholders and other interested parties.

In October 2019, a Community Update on the Fulton Bulkhead Barrier Wall was issued by the EPA. This Community Update provided key contact information, planned barrier wall construction activities, construction timing, and background information related to the Site as well as planned activities related to the Gowanus Canal Superfund cleanup.

As part of the CCP, National Grid maintained a project website: http://www.fultonmgpsite.com/index.html throughout construction. The website provided an overview of the Fulton Municipal former MGP, on-going activities at the Site, listing of key documents, and contacts. The website was routinely updated during the barrier wall construction to keep the public and surrounding community informed of on-going Site activities. During construction, these website updates were provided on a weekly basis.

3.6 CONSTRUCTION ACTIVITIES

The sections below describe the Site preparation, mobilization, demolition, monitoring, and construction activities that were performed as part of the bulkhead barrier wall construction.

All personnel on Site were required to abide by project-specific Health and Safety Plans (HASPs). In addition, Emilcott Associates performed routine safety checks and audits, the results of which were incorporated into day-to-day safety practices.

3.6.1 Demolition of Parcel I Building Addition

Prior to the start of barrier wall construction activities and with the consent of the property owner and tenant, the building addition located at 270 Nevins Street along the west face of Parcel I was demolished to allow for installation of a temporary noise barrier between the Parcel I building (Movie Studio) and the barrier wall construction area. A Work Plan describing Parcel I Building Addition Abatement and Demolition activities was submitted to EPA on May 24, 2019 and subsequently approved by EPA on June 7, 2019. Between July 12 and 17, 2019, New Style Contractors (subcontractor to Posillico) performed asbestos abatement of the building addition. Demolition of the building addition was performed by Gateway Demolition/Civil Inc. (subcontractor to Posillico) between July 18 and 23, 2019. Demolition was performed utilizing roll-off containers, ladders, skid steer, and demolition saws. All demolition material was segregated and disposed off-Site in accordance with applicable federal, state, and local regulations. Asbestos laboratory testing results and debris disposal documentation is included in **Appendix E**.

3.6.2 Site Preparation and Mobilization

On August 28, 2019, Posillico mobilized to the Site for construction of the bulkhead barrier wall. Site preparation was performed within and adjacent to the Site and consisted of set up of material staging and laydown areas, utility clearances, performance of pre-construction surveys, obtaining survey control, and implementation of temporary sediment, water, and noise control measures.

3.6.2.1 Utility Clearance

Prior to executing any intrusive Site work, the following activities were performed to identify utilities within and adjacent to the project limits:

- Obtained and reviewed current Site and utility plans from the property owners and National Grid;
- Performed a visual Site inspection to verify that there were no additional exposed utilities not shown or indicated on the plans;
- Contacted Dig Safe to identify and mark locations of underground utilities within the project limits;
- Maintained Dig Safe utility clearances throughout duration of construction;
- Coordinated locating of gas services lines with National Grid; and
- Utilized a private utility locating service (Clean Global Environmental, LLC) to identify and mark the locations of underground utilities at the project Site, material staging and laydown yards, and within the Gowanus Canal.

3.6.2.2 Pre and Post Construction Surveys

Buildings and properties adjacent to the Site were photographed to document existing conditions and any apparent existing damage to the interior and/or exterior of the properties prior to the start of project-related intrusive work. In addition, exterior pre-construction surveys, consisting of photographs were taken by Posillico prior to the start of intrusive work on August 30, 2019 and September 5, 2019. Following completion of construction activities, post-construction surveys were also performed.

Note, access to exterior and interior portions of certain buildings was not obtained from several properties due to owner/residents unresponsiveness or denying of access. The pre- and post-construction building surveys were performed by Vibra-Tech on behalf of Posillico and are documented in reports provided in **Appendix C**.

3.6.2.3 Survey Control

Posillico, A New York State Licensed Surveyor, performed the surveying for the duration of the project. Site controls were established prior to the start of construction using the New York State Plane East Zone horizontal datum and the North American Vertical Datum of 1988 (NAVD 88) vertical datum in U.S. survey feet.

Survey data was recorded utilizing a Trimble SPS930 1-inch robotic total station with Direct Reflection and multitrack technology and a Trimble R10 integrated GNSS System. The equipment included a Real Time Kinematic System (RTK) supported by the NY precision GPS Network.

Field notes were recorded in electronic format and were time stamped. All locations were required to have a 5-point resection to determine the Northing/Easting/Elevation and required overlap to confirm continuity.

3.6.2.4 Temporary Controls (Upland and In-Canal)

Erosion and sedimentation control measures were implemented in upland areas of the Site to control and limit potential transport of sediment, construction material, and construction-related water entering the canal and active work areas. Soil stockpile controls, stabilized construction entrances, and silt fence (Filtrexx Soxx) were in place within the limits of work consistent with the Site-specific Storm Water Pollution Prevention Plan (SWPPP). Inspections of upland erosion and sedimentation controls were performed by NYS Department of Environmental Conservation (DEC) erosion and sediment control-trained personnel from Posillico and GZA on a weekly basis and after storm events throughout construction. Deficiencies in controls were addressed as needed.

All soil stockpiles were placed on a base layer of 20-mil polyethylene sheeting and covered with a weighted layer of 10-mil polyethylene sheeting. Filtrexx Soxx barriers surrounded the limits of all stockpiles for sediment control. The base layer of polyethylene sheeting was positioned over the barriers to prevent the seeping of water to surrounding areas.

A decontamination pad was constructed on the central portion of Parcel VI. This pad consisted of a 40-mil layer of polyethylene sheeting overlain by a minimum of 12 inches of NYSDOT type 733.2001 material. Large concrete blocks were placed at the perimeter of the pad and the polyethylene sheeting was draped over the blocks to create an impervious basin. Liquids within the pad were collected and placed in water totes for subsequent processing and treatment through the temporary on-Site wastewater treatment system.

Monitoring of the erosion and sediment controls was performed throughout the duration of the construction phase in conformance with the requirements presented in the New York State Guidelines for Urban Erosion and Sediment Control and the site-specific SWPPP. SWPPP inspections were conducted by Posillico's NYSDEC erosion and sediment control trained personnel in the presence of GZA's Engineer. A minimum of one inspection was performed every seven days and/or post-precipitation events with a total accumulation over 1 ¼ -inch. SWPPP inspection reports are included in **Appendix D**.

Oil booms, sediment curtains, and turbidity curtains were placed within the canal to control potential sheens and sedimentation. Turbidity curtains and booms were placed adjacent to the Union Street Bridge both on the north and south of the bridge. Additional curtains and booms surrounding in-canal activities were put in place and modified as the work progressed. Oil booms and curtains were inspected on a regular basis to confirm that no repairs or corrective actions were necessary and were replaced as needed. For the duration of construction, suspended sediments, NAPL, or sheens generated by project-related work were not observed outside of the turbidity curtains. Summaries of marine resuspension observations are provided in the weekly EPA reports included in **Appendix F**.

As indicated previously, a noise barrier was erected by Ponderosa Fence Enterprises (subcontractor to Posillico) at the eastern portion of the construction limits, between the northern face of 525 Union Street and the southern face of 517 Degraw Street (Parcel VI). The noise barrier consisted of 20-foot-tall barrier with galvanized steel mesh. A sound absorbent blanket was attached to the barrier post and mesh to prevent construction noise affecting nearby businesses (Parcel I – Movie Studio). The location of the noise barrier is shown on the attached **Appendix A**.

3.6.2.5 Noise Monitoring

A noise monitoring program was prepared and performed during construction by Vibra-Tech Engineers, Inc. (Subcontractor to Posillico). The program was prepared in compliance with the requirements of Title 15 Rules of the City of New York (RCNY) Chapter 28: Citywide Construction Noise Mitigation and all other applicable laws and regulations.

Vibra-Tech Engineers, Inc. installed sound monitors adjacent to the project construction limits on Parcel I, Parcel VI, and 525 Union Street. A Larson Davis System Class 1 Sound Level Meter was installed at three locations. The meters were installed two weeks prior to construction activities to establish ambient sound levels. Automatic notifications were sent out via email or text when sound levels exceeded established thresholds. All construction activities were halted if an exceedance was recorded and the source of the exceedance was remedied to lower the acoustical impact. Noise monitoring data was recorded in the Equivalent Continuous 1-minute Sound Pressure Level ($L_{Aeq(1MIN)}$) as a function of time. Noise measurements were recorded above the project established $L_{Aeq(1MIN)}$ = 85 dB(A) at various times during construction as a result of outside sources (e.g. construction along canal, vehicles), environmental conditions (e.g. high winds, and onsite equipment (excavators and vibratory hammers). The most frequent occurrences of the elevated noise levels attributable to construction site activities were measured at Parcel VI. The noise monitoring records and summary of exceedances are included in **Appendix D**.

3.6.2.6 Temporary Water Treatment System

Ground/Water Treatment & Technology (GWTT), subcontractor to Posillico designed and provided the temporary water treatment system. The system was designed to reduce the levels of total suspended solids (TSS), oil & grease, semi- & volatile organic compounds (VOCs & SVOCs), and metals from water generated from construction activities prior to discharge to the canal in accordance with the SPDES permit.

The temporary groundwater treatment system was placed at the northern portion of Parcel VII and designed for a flow rate of 100 gallons per min (max).

The temporary water treatment system consisted of the following components:

- One open top, influent tank with under/over weirs
- One oil water separator
- One duplex transfer pump skid
- Two duplex bag filter skids, operating in series
- Four liquid phase granular activated carbon adsorption units, operating in series and parallel
- Two ion exchange vessels, operating in series
- One process flow meter
- One effluent holding tank
- One effluent flow meter with totalizer

Discharged waters were tested based on the parameters and frequencies outlined in the SPDES Permit Equivalent Application for Discharge of Treated Construction Wastewater presented in **Appendix B.** All sampling and analysis of treated water was in compliance with the permit limits. In total, approximately 137,460 gallons of water were treated and discharged during construction activities between March 5, 2020 and November 23, 2020. As described in **Section 3.6.12** (herein), all construction wastewater that was generated when the temporary water treatment system was not in operation was collected, transported, and disposed off-Site. Analytical test results and treatment/discharge volume summary are included in **Appendix D.**

3.6.3 <u>CAMP Monitoring</u>

During the construction phase of the barrier wall, real-time air monitoring for Total Volatile Organics (TVOC) and airborne particulate matter less than 10 micrometer in diameter (PM_{10}) was performed by GZA, on behalf of National Grid. The monitoring was conducted continuously (24 hours per day, 7 days per week) between September 12, 2019 and March 24, 2021.

Monitoring was performed using air monitoring stations provided by AirLogics equipped with a MiniRAE 3000+ photoionization detector (PID) and TSI Dust Trak DRX Dust Meter. Three stations were positioned on-Site, one generally upwind and the other one two generally downwind of construction activities. Each air monitoring station contained: 1) a portable data-logging PID for monitoring the airborne concentration of total VOC; and 2) a portable, data-logging aerosol photometer for monitoring airborne concentration of PM_{10}. In addition, the CAMP system included a weather station (Davis Vantage Pro2 Plus) which continuously measured meteorological conditions including wind speed (mph), wind direction, temperature (degree F) and relative humidity (%). This AirLogics system included integrated telemetry that allowed GZA to remotely monitor and download data generated and received automated alerts throughout the duration of the project in the event action or alert levels for total VOCs or dust were reached. The following presents a summary of the pre-established action and alert levels used during this project:

CAMP MONITORING	ALERT VALUE	ACTION VALUE
VOC Monitoring	TVOC (ppm) = 1 ppm for a 15-minute average	TVOC (ppm) = > 5 ppm for a 15-minute average
Dust Monitoring	PM10 (µg/m3) = 100 for a 15-minute average	PM10 (µg/m3) = > 150 ug/m^3 for a 15-minute average

Community air monitoring also included routine perimeter walks during work hours to monitor odor and visible dust. The time and outcome of each perimeter walk/check along were documented in a daily log. With the exception of periodic detections of particulate dust attributable to either off-Site, non-project related sources or discrete on-Site activities, CAMP monitoring levels were below the established alert and action levels. No significant observation of visible dust or odors associated with barrier wall construction activities were observed and reported. Air monitoring reports were prepared and submitted to EPA as part of the weekly reporting throughout barrier wall construction. Refer to **Appendix F** for air monitoring data included in the weekly EPA reports.

3.6.4 Movement and Vibration Monitoring

Real-time movement and vibration monitoring was performed by GZA, on behalf of National Grid, throughout the duration of the barrier wall construction activities. Movement of adjacent structures was monitored utilizing Structure Monitoring Points (SMPs) and crack gauges installed on adjacent structures. Construction-related vibration was monitored utilizing seismographs set up on the Site.

Movement of adjacent structures and bulkheads was monitored using Automated Motorized Total Stations (AMTS), an Automated Data Acquisition System (ADAS) system, and SMPs installed on structures located along the east side of the canal and head of the canal, parallel to Butler Street. Two AMTS units were located on the west side of the canal: AMTS#1 was placed on top of 479 Degraw Street (Block 417, Lot 21) and AMTS#2 on the right of way of Sackett Street. SMPs consisting of reflective mini prisms were attached to structures to monitor horizontal and vertical displacement of the adjacent structures and existing bulkheads. Single point SMPs were used to monitor movement in the longitudinal (north/south), transverse (east/west), and vertical (height) directions. SMPs designated as virtual tilt meters consisted of two reflective mini-prisms installed at top and bottom buildings which were utilize to assess angular distortion. Single point SMPs were installed on the following structures: 525 Union Street building, Parcel I building, Parcel VI building, Parcel VII building, Gowanus Pumping Station & Flushing Tunnel, Union Street Bridge Control building, Union Street Bridge, and the existing bulkhead at the project Site. Virtual tilt meters were installed on the 525 Union Street building, Parcel VI building, Parcel VII building, and Gowanus Pumping Station & Flushing Tunnel. Refer to **Appendix F** for movement and vibration monitoring equipment locations and data included in the weekly EPA reports.

Crack gauges were installed on the Parcel I, Parcel VI, and 525 Union Street buildings to monitor existing cracks throughout construction. Six (6) manual crack gauges were installed along the west side of the NYC plumbing building (Parcel VI), fourteen (14) manual crack gauges (consisting of nine (9) crack gauges on the west wall and five (5) on the southeast corner) were installed on the Parcel I building, and twenty (20) manual crack gauges were installed on the 525 Union Street building (twelve (12) on the north face and eight (8) on the west face)). In addition, ten (10) electronic extensometers were installed on the west face of the 525 Union Street building to monitor existing cracks in real time.

Vibration levels resulting from on-Site construction equipment and activities were monitored using automated seismograph systems to record peak particle velocities (in./sec.) in the longitudinal direction, transverse direction, vertical direction, and peak vector sum velocity. Seismographs were set up on the north and south ends of Parcel I, on Parcel VI, Parcel VII, and 525 Union Street.

Response Values (Threshold and Limiting Values) for movement and vibration were established prior to the start of construction based on the condition of the structures to be monitored and anticipated construction activities. The table below summarizes the Response Values for the movement and vibration monitoring:

INSTRUMENT	THRESHOLD VALUE	LIMITING VALUE
SMPs on buildings or other structures (e.g. bulkheads)	0.375-Inch vertical or horizontal displacement; or 1/1000 angular distortion	0.5-Inch vertical or horizontal displacement; or 1/750 angular distortion
Crack Gauges	Change in crack width of 0.06 inches (1.5mm)	Change in crack width of 0.1 inches (2.5mm)

Seismographs – Continuous or steady state vibration	Peak Particle Velocity: 0.25 in/sec	Peak Particle Velocity: 0.4 in/sec
Seismographs – Transient or impact vibration	Peak Particle Velocity: 0.3 in/sec	Peak Particle Velocity: 0.5 in/sec

If data collected indicated that a Response Value was reached or exceeded, GZA notified the project team and Posillico implemented mitigation measures to further limit movement or vibration levels. Refer to **Appendix F** for movement and vibration monitoring data included in the weekly EPA reports. As described further below, movement was observed along portions of buildings located at Parcel I, Parcel VI, and 525 Union Street necessitating fortification of existing structures.

Monitoring data for the Union Street bridge was provided to NYCDOT on a weekly basis when barrier wall related activities were performed within 100 feet of the bridge. Between November 23rd, 2020 and April 18th, 2020 no height, transverse, and longitudinal readings were recorded above the threshold value of 0.25 inches and no vibration levels were recorded above the threshold PPV limit of 0.5 inches/sec.

Movement of the existing bulkhead that fronts an approximately 100-foot portion of the Parcel VI building was observed during pre-drilling activities the week of January 20, 2020. This bulkhead movement resulted in measurable movement of the adjacent Parcel VI building and work was temporarily suspended in this area to allow National Grid's structural engineer (ODEH) to evaluate conditions. Based on recommendations from ODEH, a supplemental support system for the Parcel VI building and annex structure was designed. The design of the support system described in **Section 3.6.10** was approved by EPA in April 2020 and installation of it was completed in late April 2020.

As the Parcel VI building movement described above was being further evaluated, the pre-drilling operations just south of Parcel I at Sackett Street were initiated. Due to the observed movement of the bulkhead and building at Parcel VI, additional instrumentation specifically designed to monitor subsurface and bulkhead movements proximate to these pre-drilling operations were put in place. In early March 2020, localized height readings indicated movement of the Parcel I building occurred as a result of movement of a portion of the existing bulkhead fronting the building area during pre-drilling activities. The monitoring data indicated this movement was limited to the southern portion of the Parcel I building. In response to this observed movement, pre-drilling work was suspended on March 5, 2020 to allow for ODEH to evaluate conditions. While ODEH's evaluation indicated that the building was stable, GZA and ODEH, on behalf of National Grid, completed the design of supplemental support for the southern portion of the Parcel I building where some movement was observed. This design involved underpinning certain Parcel I foundation elements along the southern end of the building. As described in **Section 3.6.10**, installation of this underpinning was initiated in late March 2020 and completed in early April 2020.

Based on the observed movement of the Parcel I and VI buildings, National Grid modified barrier wall installation procedures along 525 Union Street and underpinned a portion of the 525 Union Street west wall prior to barrier wall activities. Installation of sheetpiling near the northern extent of the 525 Union Street property was initiated in early October 2020. Despite the installation of the underpinning system described above and due to the extremely poor condition of the 525 Union Street building (particularly along the northern portion of the building), additional building movement and cracking was observed when sheet pile installation was resumed in early October 2020. These observations necessitated the sheeting installation in this area be paused to allow National Grid and their project engineering team to further evaluate and design options for further fortifying the 525 Union Street building to allow for sheet pile installation to resume.

On October 21, 2020, GZA on behalf of National Grid, provided EPA design drawings detailing a proposed approach for additional fortification designed to minimize further movement of the northwest corner of the 525 Union Street building. This design included installation of concrete grade beams with tiebacks, additional underpinning pile caps, and installation of a carbon fiber wrap to structurally repair portions of building walls. As described in **Section 3.6.10**, this work was initiated on November 23, 2020 and completed on December 29, 2020.

3.6.5 Demolition

3.6.5.1 Selective Demolition of Existing Bulkheads and Site Features

Posillico removed the existing fence on Parcel VII (242 Nevins Street) on September 12, 2019. A safety barrier consisting of road barrels and high visibility rope was installed approximately 10-feet offset from the existing bulkhead. Between September 16, 2019 and September 20, 2019, Posillico cleared and grubbed the area located from the head of the canal (Parcel VII) to Parcel I.

After obtaining the access agreement for 525 Union Street property, Posillico completed removal of the existing fencing between Parcel I (270 Nevins Street) and 525 Union Street on October 1, 2019.

Existing pavement on Parcel VI and Parcel VII and portions of the existing bulkhead systems were removed as necessary to construct the barrier wall system. Demolition materials were segregated and placed into separate roll-off containers for subsequent off-Site disposal.

3.6.6 Cultural Resource Review

Archaeology & Historic Resource Services, LLC. (AHRS) of Rock Tavern, New York was subcontracted by GZA to conduct Cultural Resource Training for project personnel, perform photo documentation of the existing bulkheads, perform Level 1 & Level 2 monitoring of screened debris from the project Site, and prepare an end-of-fieldwork letter report in accordance with the Cultural Resource Monitoring Plan prepared by Archaeology & Historic Resource Services, LLC dated May 2021 for the Gowanus Canal Superfund Site.

3.6.6.1 Cultural Resource Training

An AHRS archaeologist provided a Cultural Resource Training session to non-archaeological Site personnel. All on-Site personnel involved with excavation and demolition activities and management were trained on definition, identification, and the proper procedure to follow if potentially significant cultural resources were encountered.

3.6.6.2 Bulkhead Photo Documentation

Photographs of the existing historical timber bulkhead were collected by AHRS prior to the installation of the new sheet pile wall.

3.6.6.3 Level 1 Monitoring

Level 1 monitoring was performed for excavation and demolition activities in areas that were not within 50 feet of or within areas of known or suspected cultural resources. The monitoring was conducted by on-Site personnel who received the cultural resource training described above. As part of Level 1 Monitoring, all manmade objects encountered during excavation or demolition activities were photo-documented and sent to AHRS for an archaeological review.

A weekly review was conducted by AHRS of encountered objects that were sorted and stockpiled by Posillico in the staging areas. After archaeological review, AHRS determined that all elements retained during Level I monitoring did not retain sufficient integrity for preservation and was not considered of historic value and therefore disposed of off-site.

3.6.6.4 Level 2 Monitoring

Level 2 monitoring required that an AHRS archaeologist was present for excavation and demolition activities in areas that were within a 50-foot radius of any known or suspected cultural resources and/or or any excavation that may exceed the former canal dredge elevation.

Encountered objects of possible historical significance were screened by the AHRS archaeologist and documented on Site. Subsequent to archaeological review, AHRS determined that all elements retained during Level II monitoring did not retain sufficient integrity for preservation and not considered of historic value and therefore disposed of off-Site.

3.6.6.5 Reporting

Site visits by AHRS and objects encountered of potential historical significance were documented in the weekly progress report provided to EPA. A Final Letter Report was also prepared by AHRS summarizing all monitoring activities and potential cultural resources observed. This report provides a summary of dates and duration of monitoring, description of areas monitored, description of encountered objects, monitoring methodology, and supporting documentation including but not limited to photographs and maps. Refer to **Appendices D and F** for the Final Letter Report and EPA Progress Reports, respectively.

3.6.7 Barrier Wall Construction

Following Site preparation, mobilization, and demolition activities, barrier wall construction began in October 2019 and was completed in May 2021. Construction of the barrier wall included, an in-canal debris pre-clearing and removal program, sheet pile installation, waler installation, tieback anchor installation and testing, deadman system installation, sheet pile wall cap installation, cathodic protection system installation, installation of CSO outfalls, installation of the hydraulic relief system, and Site restoration.

3.6.7.1 In-Canal Debris Pre-Clearing and Removal

Prior to installation of the sheet pile wall, Posillico implemented an in-canal pre-clearing of debris/obstruction removal program along the bulkhead barrier wall alignment. Between December 20, 2019 and March 10, 2020, canal debris/obstructions located within approximately 10 feet of the mudline were removed utilizing a 30x45 foot sectional barge with a tracked Caterpillar 320D-I 52’ extended boom excavator with an attached rake bucket.

Removed debris/obstructions were transported to dumpsters staged either on the barge or the upland area, depending on the location of the debris removal operations. Debris/obstructions that required further sediment removal were placed on the decontamination pad for rinsing. All canal debris was removed from the Site via land access after decontamination.

Pre-drilling of the bulkhead wall alignment was also performed by Posillico between December 20, 2019 and March 5, 2020. Pre-drilling was performed utilizing a Delmag RH-32 drill rig and a Comacchio CH450 drill rig equipped with Kelley bar drilling equipment. The drill rigs positioned from land or on a 50x80 foot sectional flexi float jack up barge were used to remove obstructions and facilitate the use of sheeting installation for the Giken Hydraulic Press-in system. The Delmag RH-32 and Comacchio CH450 were tooled with 1000mm and 620mm casing diameters, respectively. Along Parcels VI and VII, drill casings/Kelley bar tooling were installed in overlapping columns to approximate elevation -43.0

feet (barrier wall tip elevation). Cleaning buckets were used to remove spoils from the casing. Upon achieving casing tip elevation, casings were backfilled with sand and extracted. The pre-drilling approach was modified along Parcel I to consist of drilling to elevation -24 ft and using reverse flight auger techniques. As described in **Section 4.2**, in lieu of pre-drilling, probing was performed along 525 Union Street due to concerns related to potential building movement.

All removed soils were placed within debris dumpsters located either on the sectional flexi float barge or the upland area. All removed soils were transported via truck to Bayshore Recycling Corporation of Keasbey, New Jersey for thermal treatment. Water recovered from the soil removal was placed within 500-gallon water totes and processed through the temporary water treatment system. Refer to **Appendix E** for disposal documentation.

3.6.7.2 Sheet Pile Installation

Steel sheet piles (AZ 46-700N) in lengths of 52-, 54-, and 69-feet were procured by Posillico Inc. through Skyline Steel (Skyline). Consistent with the EPA approved design, Skyline paired and welded the sheet piles into doubles with a continuous weld and installed a protective pipe for declutching devices at the sheeting interlock. Sheet piles were coated on both sides their full length using Tnemec 46H-413 Polyamide Epoxy coal tar applied at a thickness of 16-20 mil. Dura-Bond Pipe of Steelton, Pennsylvania inspected the coated sheets to verify the applied thickness.

Dixeran Declutching detectors were installed on each steel sheet pile pair at the 267 Bond Street staging yard prior to installation. The detectors were installed through the protective pipe and the shear pin was protected from damage prior to sheet placement. The declutching detectors were used to verify the pin at the bottom of the interlock was sheared, indicating a continuous sheet interlock extending to the bottom of the sheet. The status of the declutching detectors during installation was checked via the manufacturer's monitoring unit and interlock connections were field verified. All connections were verified for continuous continuity.

Adeka Ultraseal was applied to the interlock of each sheet using a standard caulking gun after a thorough interlock cleaning. The Ultraseal was applied immediately prior to installation.

A Giken Silent Piler F401-1400, an ABI TM14/17 pile driver with a variable moment vibratory hammer, and an ICE 22RH hanging vibratory hammer were used to install steel sheeting along the barrier wall alignment. The Giken Silent Pier was used to install Sheet Piles Nos. 2 through No. 154 (approximately 702 linear feet) along Parcels I, VI, and VII between March 27 and October 14, 2020. The ABI pile driver, supported by the Jack-Up-Barge (JUB), was used to install Sheet Piles Nos. 155 through No. 184 (approximately 179 linear feet) along the 525 Union Street alignment between November 24 and December 30, 2020. A hanging vibratory hammer was used to install Sheet Piles Nos. 184 through No. 191 (approximately 28 linear feet) along the 525 Union Street alignment between December 3 and December 4, 2020.

Refer to **Appendix D** for sheet coating inspections, Adeka Ultraseal application times, declutching detector status, and sheet pile installation records.

3.6.7.3 Tieback Anchor and Waler Installation

Upon installation of the steel sheet pile wall, tieback anchors were installed at Wall Section 1 along Parcel VII, Wall Section 3 along Parcel I, and Wall Section 5 along 525 Union Street between July 11, 2020 and January 20, 2021. Tieback anchor work included installation of a waler system along the upland side of the sheet piles and all associated connections required to engage the tieback anchors with the sheet pile wall.

The tieback anchors were installed through holes cut in the sheet pile wall at El. +4.0 ft (NAVD 88). Tiebacks were installed perpendicular to the sheet pile wall at inclinations from the horizontal varying between 35 and 45 degrees. A total of 45 tieback anchors were installed along Wall Sections 1 & 3, alternating between 35- and 45-degrees and spaced approximately 4.6 ft on center. A total of 23 tieback anchors were installed along Wall Section 5 at an angle of 45 degrees and were spaced at approximately 9.19 ft on center. Modifications to specific tiebacks are outlined in **Section 4.2**.

A Fraste Roto-sonic drill positioned on the 50x80 foot sectional flexi float jack up barge was used for the tieback anchor installation. The tieback anchor consisted of either 3 or 6, 0.6-inch, 60 mil HDPE coated strands. The strands were wrapped in a 3.6-inch outer diameter HDPE corrugated sheath with a 0.75-inch central grout tube. A 0.75-inch, PVC, re-grout tube was externally attached to the corrugated sheath. Anchors varied in length from 48- to 67-feet. All anchors were grouted via the central grout tube and pressure grouted through the bond zone. Post-grouting was performed within a 24-hour period after installation at all tieback anchor locations.

After installation of the tieback anchors, tieback assemblies were installed at each anchor location. The tieback assemblies consisted of two bearing plates with a wedge plate assembly welded to the plates. A 36-inch long, 5-inch diameter schedule 40 steel casing was welded to the wedge plate assembly. The tieback assemblies were attached to the sheet pile wall with ten, 1.25-inch diameter, A325 bolts at Wall Section 1 & 3. At Wall Section 5, the tieback assemblies were attached with four, 1.25-inch diameter, A325 bolts and 5/16-inch fillet welds around the bearing plates onto the sheet piles. A wedge plate with grippers and a grease filled cover cap with a cover bolt were added during and after tieback anchor testing. Refer to **Appendix D** for all tieback anchor installation and testing logs.

All installed tieback anchors were proof tested by Posillico and observed by GZA between November 5, 2020 and February 8, 2021. Performance testing of tieback anchors was performed on one (1) sacrificial test anchor and one (1) production anchor located along Wall Section 5 (Parcels I and 525 Union Street). Lift-off testing was performed by Posillico and observed by GZA at 8 tieback anchors between November 10, 2020 and January 28, 2021. All performance tests, proof tests, and lift-off tests of tieback anchors achieved their specified acceptance criteria. After testing was complete the anchors were loaded to 80% of the design working load and locked off. Refer to **Appendix D** for all tieback anchor test logs.

Steel beam walers comprising of HP 12x63, HP 12x74, or HP 12x84 sections were installed on the upland side of the sheet pile wall. Walers at Wall Section 1 & 3 consist of HP12x63 sections and walers at Wall Section 5 consist of HP 12x74 sections. At the CSO RH-033 and CSO RH-038 locations, double rows of walers were installed to accommodate the additional tieback anchor level on either side of the CSO locations and consist of HP12x63 sections for the lower row and HP 12x84 section for the upper row. The centerline of the installed walers at Wall Section 1, 3, 5, and the lower row of CSO RH-033 & CSO RH-038 is located at El. +4.0 ft(NAVD 88). The upper row of walers at CSO RH-033 and CSO RH-037 were installed at the centerline located at El. +6.5 ft(NAVD 88). All walers were attached to the sheet pile wall using 1.25-inch diameter, A325 bolts, nuts, and washers.

At locations where waler beams connect, splice plate connectors were attached to the top and bottom sides of the waler webs. The plate connectors consisted of 1.25 in. x 9 in. x 25.5 in., Grade 50 steel plate with twelve 1.25-inch diameter bolt holes. Twelve, 1.25-inch diameter A325 bolts were used to make the connection. Upper walers at CSO RH-033 & CSO RH-037 extended a minimum of 9.2 feet from the center line of the tieback anchors located immediately to the north and south of the CSO.

3.6.7.4 Deadman System Installation

A micropile supported deadman system was installed along Wall Section 2 and a portion of Wall Section 1 on Parcel VI and Parcel VII, respectively. The system is comprised of 101- and 73.5-foot-long deadman concrete cap sections with an approximate 27.5-foot gap between the deadman concrete caps to allow for CSO RH-033 access. Steel tie rods (2.5-inch diameter) were installed through the deadman caps and were attached to the sheeting wall via a wale connection system.

Micropile Installation

A total of 39 micropiles were installed for the deadman system between June 5 and November 16, 2020. Two rows of micropiles, parallel to the sheet pile wall, were installed at each deadman concrete cap. The eastern row consists of battered compression micropiles and the western row are tension micropiles.

The compression micropiles are comprised of a 65-foot, 3-inch diameter, Grade 75, epoxy coated threaded bar with an inner and outer casing installed through the free length of each compression micropile. Centralizers were installed onto the threaded bar to center the bar within the casing. The outer casing consists of a 30-foot, 13.375-inch diameter, grade 80 steel casing which was installed from the top of the micropile. The inner casing consists of a 25-foot, 9.625-inch, grade 80 steel casing which was installed approximately two feet below the top of the micropile. All compression micropiles reached or exceeded the design minimum tip elevation of -54.0 ft NAVD88.

The tension micropiles are comprised of a 60-foot, 2.5-inch diameter, Grade 75, epoxy coated threaded bar with an outer casing installed through the free length of each micropile. Centralizers were installed onto the threaded bar to center the bar within the casing. The outer casing consists a 30-foot, 13.375-inch diameter, grade 80 steel casing and was installed from the top of the micropile. All tension micropiles reached or exceed the minimum tip elevation of -50.0 ft NAVD88.

All micropiles were installed utilizing a Comacchio MC-28 drill rig. A tri-cone roller bit and drill polymer flush were used to remove cuttings from within the drill hole. The outer casing was drilled to the design elevation and the threaded bar with centralizers were installed. A tremie tube was used to grout the micropiles.

Casing was removed from within the bond zone at all micropile locations. After removal of each casing section, a pressure cap was attached to the casing and the micropile was pressure grouted. All micropiles were pressure grouted through the bond zone. At compression micropile locations, the inner casing was then inserted. A 2.75” x 14” x 14” grade 50 bearing plate with a hex nut and washer was affixed to the micropile prior to the concrete pour for the deadman caps.

Refer to **Appendix D** for micropile installation records.

Micropile Axial Testing

A tension axial load test was performed on one compression (batter) and one tension (vertical) micropile. The tests were performed by Posillico and observed by GZA. Refer to **Appendix D** for micropile axial testing sequence and test logs. Load testing of the vertical (tension) pile was performed at production pile No. 32 and met the acceptable load test criteria. Initial load testing of the battered (compression) pile at production pile No. 35 failed to achieve the ultimate test load. This pile location was selected based on the minimum observed grout return at the ground surface. A 2nd micropile designated as 35A was drilled approximately two feet to the north of micropile No. 35. The additional compression micropile was then load tested and met the acceptable load test criteria.

Waler Installation

Walers were installed parallel with the deadman caps, onto the sheet pile wall. The waler consists of two MC 12x50 sections spaced 4 inches vertically and centered at El. +4.0 ft (NAVD88). 1-Inch diameter, A325 bolts and washers with Schedule 40 pipe spacers were used to connect the MC 12x50 sections. The walers were attached to the sheet pile wall utilizing steel connection plate and 1.25-inch diameter A325 bolts and washers. At locations where the waler beams meet, 1.25" x 9" x 18" grade 50 steel connection plates were installed on the top and bottom of the MC channels utilizing eight, 1.25-inch diameter A325 bolts and washers.

Deadman Cap Installation

After installation and testing of the micropiles, the top of the micropiles were cut to El. +4.0 (NAVD 88) in preparation for installation of the 3-foot by 5.5-foot reinforced concrete cap. The reinforced concrete cap was installed between November 8 and December 30, 2020. The reinforcement consists of #9, galvanized, reinforcing bars and #7 galvanized stirrups with a minimum concrete clearance of 3-inches. Schedule 40 PVC sleeves, centered at El +4.0ft (NAVD 88), were placed within the cap for installation of the tie rods. The tops of the installed deadman micropiles are horizontally in-line with the PVC sleeves.

Tie Rod Installation

A total of seventeen tie rods were installed for the deadman system. Ten tie rods were installed through the deadman cap located on Parcel VI and seven on the deadman cap located on Parcel VII. Each tie rod is comprised of 45-feet of 2.5-inch diameter, grade 75, galvanized threaded bar. Each tie rod was encapsulated in 5,000-psi grout and wrapped in smooth, PVC sheathing. At the midpoint of each tie rod a sleeve nut was placed and surrounded with corrosion inhibiting grease. The sleeve nut and grease were then shrink wrapped in PVC.

The tie rods were placed through the opening between the two MC 12x50 wales and through the PVC sleeves located within the deadman caps at El. +4.0 ft (NAVD 88). The ends of the tie rods, located at the sheet pile and at the deadman caps, were attached utilizing a 12" x 12" x 1.5" steel plate, hex nut, and a cap filled with corrosion inhibiting grease. The connection of the tie rod was first tightened on the sheet pile wall side and then at the deadman cap. The tie rods were tightened with a torque wrench to max torque of 300 ft-lbs.

Refer to **Appendix D** for tie rod installation records.

3.6.7.5 Sheet Pile Wall Cap

A steel wall cap was installed after the full installation of the sheet pile wall, tieback anchors, and deadman system between March 1 and April 7, 2021. The cap consists of a 24.5 inch wide, 3/8-inch-thick galvanized steel bent cap plate with a 3-inch overhang on both the east and west sides of the sheet pile wall.

Where necessary, the sheet piles were cut to provide a continuous elevation at select sheet pile locations. The tops of the sheet piles were epoxy coated prior to cap placement. Angle bracket seats with 3-inch legs in 12-inch lengths were centered and fillet welded onto the southern sheet of every sheet double and field coated. The wall caps were then placed onto the seats and welded together. All welded locations were field coated.

Per the design, at Wall Sections 1, 2, and 3 the top of the wall cap is located at El. +10.5 ft (NAVD 88). At Wall Section 5, the top of the wall cap is located at El. +8.5 ft (NAVD88).

3.6.8 CSO Extensions

Three NYCDEP CSOs within the limits of the Site discharge into the Gowanus Canal: CSO RH-033, CSO RH-038, and CSO RH-037. Each of these outfalls was extended through a penetration in new sheet pile wall consistent with designs approved by NYCDEP BWSO.

3.6.8.1 RH-033

CSO RH-033, located on Parcel VII, was extended through the sheet pile wall via installation of an approximately 80-foot-long, 48-inch inner diameter (52-inch outer diameter), ductile iron outfall pipe and an 8-foot diameter manhole. The outfall pipe maintained a 1% slope and penetrated the sheet pile wall at El. -4.0 ft. (NAVD88, invert elevation). The outfall extension pipe was supported by drilled micropiles and reinforced concrete saddle caps. The new CSO pipe and manhole are supported via reinforced concrete, micropile supported pile caps (saddles). Twelve micropiles were installed with the footprint of the new pipe. Two pile caps consisting of a 2-micropile configuration and two pile caps consisting of a micropiles were installed.

The micropiles consisted of 60-foot, grade 75, threaded rod with a 21-foot minimum bond zone. An outer casing was installed through the free length of each micropile. Centralizers were installed to center the bar within the casing. The outer casing was a 50-foot, 9.625-inch diameter, grade 80 steel casing and was set from the top of the micropile. The threaded bar was a 2.5-inch diameter, Grade 75, 60-foot-long bar that was cut off at the top of the casing upon installation. The micropiles were pressure grouted through the bond zone. All micropiles reached or exceed the minimum bottom of casing and tip elevations of -20.0 ft and -41.0 ft. NAVD88, respectively. The top cut-off elevations of the micropile casing was between El. +4.0 and El. +5.0 (NAVD 88). The installed tip elevations ranged from El. -45 and El. -46 (NAVD88).

All micropiles were installed utilizing a Comacchio MC-28 drill rig. A tri-cone roller bit and drill polymer flush were used to remove cutting from within the drill hole. The outer casing was drilled to required elevation and the threaded bar with centralizers were installed. A tremie tube was used to grout the micropiles with 5,000-psi grout. Grout cubes were collected for testing.

The micropiles were cut to the required elevation for the reinforced concrete saddles. A 2" x 11" x 11", grade 50, steel bearing plate and hex nut & washer was affixed to the top of each micropile. The micropiles extended 6 inches into the concrete saddles. Refer to **Appendix D** for micropile installation logs and grout cube test results.

A temporary cofferdam located within the canal was installed to facilitate the extension of the CSO pipe through the sheet pile wall. Two, 15-foot-long sections of HP 12 x 84 walers were welded to the sheet pile wall at El. +6.0 ft (NAVD 88). The walers were installed approximately 10 feet apart and connected, creating a continuous rectangular waler. A crane with a hanging vibratory was used to install the 25-foot-long, AZ14 steel sheets to an approximate tip elevation of -30.0 ft NAVD88.

A 7.5' x 6.3' section of the barrier wall sheet pile wall was cut and removed to accommodate the CSO pipe extension. The CSO pipe was positioned within the removed section and braced to maintain an invert of El. -4.0 ft (NAVD88). A reinforced concrete collar was poured and extended approximately 6 inches from the outward face of the sheet pile wall into the canal. Refer to the attached **Appendix A** for the location of RH-033.

3.6.8.2 RH-037

CSO RH-037, located at the intersection of Parcel I and 525 Union Street, was extended through the sheet pile wall at the terminus of Sackett Street. A temporary cofferdam located within the canal was used to facilitate the extension of the CSO pipe through the sheet pile wall.

A crane with a hanging vibratory hammer was used to install the 25-foot-long, AZ14 steel sheets to an approximate tip elevation of -33.0 ft.

A 7.5' x 6.3' section of the sheet pile wall was cut and removed to accommodate the CSO extension. In accordance with the design approved by NYCDEP BWSO, this larger opening will allow for a future 48-inch diameter CSO pipe to be installed by NYCDEP. The existing CSO pipe was observed to be a 12-inch inner diameter PVC pipe with an invert of El. -4.5 ft (NAVD 88). The existing CSO pipe was extended through the new sheet pile wall using a 12-inch inner diameter ductile iron pipe. The ductile iron pipe was attached to the PVC pipe with a Fernco coupler. A reinforced concrete collar was poured extending approximately 6 inches from the outward face of the sheet pile wall into the canal. Refer to the attached **Appendix A** for the location of RH-037.

3.6.8.3 RH-038

CSO RH-038, located at the terminus of Degraw Street between Parcel I and Parcel VI, consisted of six, 36-inch- inner diameter pipes extending through an existing concrete retaining wall with a concrete cap located at approximate El. +6.0 ft (NAVD 88) was constructed to join Wall Section 3 to Wall Section 5.

The previously installed double row of steel piles located between the terminus of the CSO pipes and the canal were cut to El. -4.0 ft (NAVD 88). to allow for installation of a new headwall to extend the CSO pipes to the outward face of the new sheet pile wall alignment.

The reinforced concrete headwall is comprised of galvanized #5 reinforcing bars and 5,000-psi grout. Reinforcing bars were drilled and epoxied into the existing concrete cap and shear studs were welded to the adjoining sheets. 40-inch inner diameter wooden pipe forms were placed to create the extension through the new headwall. Concrete for the new headwall was poured to a top elevation of +8.5 ft (NAVD 88). Refer to the attached **Appendix A** for the location of RH-038.

3.6.9 <u>Hydraulic Relief System</u>

A hydraulic relief system was installed along the upland side of the sheet pile wall to limit the elevation of hydraulic loading on the wall. The system consists relief piping installed parallel to the wall which are connected to two hydraulic relief vaults that discharge through the sheet pile wall. Each of the hydraulic relief vaults were designed to control potential sedimentation and sheening. The vault locations on Parcel VII and 525 Union Street were positioned between adjacent tieback anchors. Refer to **Appendix D** for the hydraulic relief system shop drawing. Refer to **Appendix A** for as-built locations and elevations.

Upon installation, a flow test of the hydraulic relief system was performed to confirm proper operation. As shown in **Appendix D,** the relief piping consist of 6-inch diameter perforated ADS N-12 connected to 6-inch diameter solid ADS N-12 at the vault locations. The solid pipe enters the vault on the eastern face of the vault at the low point invert of El. +1.5 ft (NAVD 88).

Three high points located at El. 2.0 ft (NAVD 88) are located along the system at the southern extent of 525 Union Street, the southern portion of Parcel VI, and the northern extent of Parcel VII. NYSDOT type 733-2001 material, underlain by geotextile fabric, was placed to provide the design slope for the piping. A minimum of 6 inches of NYSDOT type 733-2001 material was placed around the piping and wrapped in geotextile filter fabric. Tracer tape reading "Caution Buried Pipeline Below" was placed over the relief piping prior to backfill.

The relief vaults consist of 9.5' x 5.5' x 7.0' 5,000-psi reinforced concrete. A diffuser baffle, oil retaining baffle, and a sediment weir are located within each vault. At each of the vaults, the inlet pipe has an invert of El. +1.5 ft (NAVD 88) and an outlet pipe invert of El. +1.0ft (NAVD88). A 12-inch diameter penetration was made through the sheet pile wall at each vault location. A flanged steel ring connector was placed and welded onto the penetration. The installed inline check valves (to control potential backflow into the vault from the canal) were fitted with an 8-inch diameter solid, ADS pipe threaded through the sheet pile wall at the penetration opening maintaining an invert of El. +1.0 ft (NAVD 88). The annulus of the steel ring connector was filled with non-shrink grout.

An 8-inch-thick top slab with two, 2-foot-diameter, man openings was placed over each of the vaults. Brick risers were built extending the openings to the top of finish grade elevation at each vault location. Steel, heavy duty manhole rings and covers were installed.

3.6.10 Adjacent Structure Fortification (Parcel I, VI, and 525 Union Street)

The following provides a description of structure fortification that was designed and implemented during the construction phase of the barrier wall system.

In late March/early April 2020, foundation underpinning was installed along the southwest corner of the Parcel I building. Foundation underpinning consisted of installation of 5 pile supported concrete pile caps installed along the exterior portion of the Parcel I building. A total of seven 9.625-inch diameter micropiles consisting of two 2-pile caps and three 1-pile caps. Each pile cap was reinforced and was either doweled into the side of the existing footing or extended under adjacent footings. Refer to **Appendix D** herein for drawings of the supplemental support system.

As described in **Section 3.6.4**, movement of an approximately 100-foot portion of the Parcel VI building was observed during pre-drilling activities during the week of January 20, 2020 which resulted in suspension of predrilling. In response to this movement, short term mitigative measures were implemented to address observed voids in the fill materials between the bulkhead and building. In late January 2020, the voids were grouted and gutters were installed along the canal side of the Parcel VI building to redirect stormwater away from this area.

A supplemental support system of the Parcel VI building and annex structure was constructed in April 2020. As part of the supplemental support system, pile supported foundation underpinning was constructed along the west face of the main structure. Five 9.625-inch diameter vertical micropiles were constructed along the exterior portion of the Parcel VI building. Individual reinforced concrete pile caps were constructed at each micropile location and connected to the existing footings of the building. Additionally, the annex building was wrapped with four levels of steel wire rope around the exterior portion of the annex building. This consisted of 3/8-inch wire rope bearing against vertical timber posts spaced at 4 feet on center and fastened to the exterior portion of the building. Refer to **Appendix D** for drawings of the supplemental support system.

Between September and December, 2020 improvements to the 525 Union Street building were completed to allow for installation of the barrier wall system. These improvements included the following:

1. Underpinning was performed at two locations along the north wall near the northwest corner of the 525 Union Street building and at four locations along the west. The underpinning piles caps were installed to minimize any downward movement of the building at these locations. Two 11.875-inch diameter micropiles were installed at four pile cap locations along the west wall and four 13.375-inch diameter micropiles were installed along the north wall.
2. Steel beams with tiebacks were installed to underpinning pile caps along the west wall to minimize later movement of the building. Two tieback anchors were drilled and installed at a 45-degree angle between the pile caps. Micropiles were drilled and installed on both sides of each tieback anchor to provide lateral restraint

and vertical load capacity to support the horizontal and vertical forces resulting from post-tensioning of the tieback anchors. A double channel wale system was installed to connect the micropile to the tieback anchor. Subsequent to installation of the tieback anchors and micropiles attaining sufficient strength, the tieback anchors were post-tensioned.

3. A carbon fiber wrap was also installed to structurally repair the wall system where cracking between CMU blocks had been observed near the northwest corner of the 525 building. A Sika 103c carbon fiber wrap was installed in 12" strips at 24" o.c. horizontal and vertical in an area 32 feet from the NW corner along the north wall and 25 feet from the NW corner along the west wall. The carbon fiber wrap extended and wrapped around the northwest corner of the building.

3.6.11 Cathodic Protection System

Cathodic protection systems were installed for the upland sides of the sheet pile wall. The system design was performed by Concorr, Inc., of Sterling, Virginia and consisted of a passive, galvanic system comprised of anode and reference cell wells installed on the upland side of the sheet pile wall. A total of 87 anode wells spaced at approximately 9'-2" on center and 8 reference cell wells were installed utilizing a Fraste Roto Sonic drill rig along the upland area.

The anode wells are comprised of perforated HDPE drainpipe with an end cap and surrounded with a filter sock. 60-lbs Mil-Spec aluminum galvanic nodes, sized at 4" x 4" x 38", were installed at each anode well. The anodes were attached to the sheeting pile wall via pin welded connections.

The reference cell wells are located at the approximate midpoint between anode wells at select locations. The reference cell wells are 3-inch diameter, schedule 40 PVC well screen pipes with 0.01-inch slots located at the bottom 5 feet. Reference cells were installed below the mean low level water line. The reference cell and closest two anodes were connected to a monitoring box for future observations of current flow and potential of the barrier wall system.

The waterside cathodic protection system design consists of forty-seven, 160 lb anodes spaced at 18 ft- 4-inches on center along the canal-side of the barrier wall. These anodes are scheduled to be installed subsequent to completion of the canal remedy within this area being performed by GERT.

Refer to **Appendix A** for layout of cathodic protection system and **Appendix D** for cathodic protection system anode well installation logs.

3.6.12 Excess Material Management and Off-Site Disposal

On-Site management, segregation, stockpiling, testing (if required) and off-Site disposal of excess materials (i.e., debris, sediment, soil, and/or liquids) was performed by Posillico throughout the demolition and construction phases of the project. Excess materials were generated during demolition activities, on-Site dewatering, tieback anchor and micropile drilling (drill spoils), pre-clearing of debris/obstruction removal within the canal, and excavation of on-Site soils not suitable for reuse in accordance with the Specifications.

Excess materials were segregated and characterized prior to off-Site transportation and disposal at the appropriate National Grid- and EPA-approved disposal/recycling facilities. Posillico engaged Eurofins TestAmerica to perform sampling and analytical testing as necessary for waste characterization. Prior to off-Site transportation, Posillico prepared all waste profiles, manifests, and any other required shipping documents in accordance with all federal, state, and local regulations.

The table below summarizes each waste stream, the recycling/disposal facility, and quantity of materials disposed off-Site as part of this project.

WASTE STREAM	RECYCLING/DISPOSAL FACILITY	QUANTITY
Non-RCRA, Non-DOT Regulated Material	Bayshore Soil Management	5,902 Tons
Non-RCRA, Non-DOT Regulated Material	Clean Earth of New Jersey	38 Tons
Non-RCRA, Non-DOT Regulated Oily Water	Clean Water of New York	1,278 Gallons

Disposal documentation, including analytical testing results, waste profiles, and shipping manifests, are included in **Appendix E**.

3.6.13 *Import Fill Testing and Use*

- The following is a summary of import fill materials used in construction of the bulkhead barrier wall: NYSDOT Type 733.0403 – Subbase Course, Type 3
  - Backfill behind the existing bulkhead; and
  - Backfill for voids created around installed piles.
- NYSDOT Type 733.2001 – Underdrain Filter Material, Type 1
  - Backfill between the existing bulkheads and new barrier wall;
  - Backfill around the hydraulic relief system; and
  - Construction of the temporary decontamination pad.
- NYSDOT Type 703.0201, Size No. 3
  - Temporary Site entrance/exit locations; and
  - At the barrier wall upland surface area.

Per the design specifications, all import soils and aggregate were free of chemical impact and obtained from a source consistent with NYSDEC regulations and acceptable by National Grid. Prior to delivery to the Site, Posillico engaged Special Testing & Consulting to perform sampling and geotechnical and chemical laboratory testing of all import materials. The following table summarizes the laboratory testing performed on each import material.

LABORATORY TESTING	IMPORT MATERIAL		
	NYSDOT Type 733.0403	NYSDOT Type 733.2001	NYSDOT Type 703.0201
Geotechnical Testing:			
Particle/Stone Size ASTM D422/ATM C136/C136M)	X	X	X
Material Classification (ASTM D2487)	X	X	X
Modified Proctor (ASTM D1557)	X		
Moisture Content (ASTM D2216)	X		
Weight per Volume (ASTM D698)	X		
Chemical Testing:			
VOCs (USEPA SW-846 Method 8260)	X		
SVOCs (USEPA SW-846 Method 8270)	X		
PCBs (USEPA SW-846 Method 8082)	X		
Pesticides (USEPA SW-846 Method 8081)	X		
Herbicides (USEPA SW-846 Method 6010)	X		

LABORATORY TESTING	IMPORT MATERIAL		
	NYSDOT Type 733.0403	**NYSDOT Type 733.2001**	**NYSDOT Type 703.0201**
Metals (USEPA SW-846 Method 6010)	X		
Mercury (USEPA SW-846 Method 7471)	X		
Cyanide (USEPA SW-846 Method 9012)	X		
1,4 – Dioxane	X	X	X
Per- and Polyfuoroalkyl Substances (USEPA Method 537 Version 1.1 Modified)	X	X	X

Import fill testing was performed in accordance with the NYSDEC Technical Guidance for Site Investigation and Evaluation (DER-10). All analytical chemical results were below the Soil Cleanup Goals (SCGs) for Unrestricted Use. Upon GZA's approval of the laboratory testing results, each material was deemed suitable for use in on-Site backfilling operations. Laboratory testing results are included in **Appendix E**.

3.6.14 Site Restoration

After completion of intrusive activities, areas disturbed for constriction of the bulkhead barrier wall were backfilled to match surrounding grade. Lifts (6- to 12-inch thick) of NYSDOT type 733.0403 were placed and compacted by Posillico. In all disturbed areas a minimum of 1 foot of NYSDOT type 703.2001, meeting the Unrestricted USE SCG's was placed to final grades ranging between El. + 7.0 and El. + 8.0 (NAVD 88).

A mesh wire fence was installed at the northern portion of 525 Union Street, Parcel I, the southern portion of Parcel VI, and Parcel VII by Ponderosa Fence Enterprises. Fencing was installed perpendicular to the barrier wall at 525 Union Street, Parcel VI, and at the northern and southern portion of Parcel I and gates were installed at 525 Union Street and Parcel I. Fencing was also installed parallel to the barrier wall on Parcel I and Parcel VII, offset three feet east from the wall. A man gate was installed at fencing installed on Parcel I and Parcel VII. Refer to **Appendix A** for fencing layout.

A vehicular guardrail was installed by Ponderosa Fence Enterprises east of the headwall located at CSO RH-038. The guardrail extended from the perpendicular fencing on Parcel I to the perpendicular fencing on Parcel I.

Asphalt and concrete located east of the installed noise curtain was damaged during the intrusive work. The damaged asphalt and concrete were removed and replaced with new asphalt. The asphalt was graded to match the existing grades and was sloped west, towards the canal.

All prior signage showing the locations of the NYCDEP CSOs were re-installed. New signage displaying "No Docking or Mooring" were mounted to timber posts or fencing and placed at each parcel and at 525 Union Street.

The noise barrier described in Section 3.6.2.4 remained in place following completion of this bulkhead barrier wall construction to assist in mitigating noise impacts from the ongoing Superfund remedial work. The ownership and responsibility to remove the temporary noise barrier was transferred from National Grid to the GERT.

3.6.15 As-Built Survey Record

At the completion of construction, an as-built survey record drawing was prepared by Posillico and signed and sealed by a surveyor licensed in the State of New York, dated June 10, 2021. The as-built drawing included the final ground surface elevations and as-built locations of the following:

- Final horizontal and vertical limits of the barrier wall;
- Barrier wall pile cap;
- CSO Outfall extensions, invert elevations, and extension support structures;
- Tieback anchors;
- Micropiles;
- Tie rods;
- Deadman concrete cap;
- Layout and elevations of manholes, including well caps;
- Building underpinning;
- Fencing layout;
- Layout and elevation of hydraulic relief system, its vaults, and all other appurtenances;
- Layout of cathodic protection system; and
- Layout of pavement.

The as-built survey record drawing is included in **Appendix A**.

4.0 DESIGN MODIFICATIONS

The following provides a summary of modifications to the EPA approved 100% Design that were required to accommodate field conditions encountered during construction, requests made by property owners, and the requirement imposed by NYCDEP BWSO. All modifications were communicated to and pre-approved by EPA.

4.1 DEMOLITION OF PARCEL I BUILDING ADDITION

Due to the proximity of the existing Parcel I building addition, the design included underpinning this addition to facilitate construction of the new bulkhead barrier wall. Subsequent to EPA's approval of the 100% Design, a decision was made to install a temporary sound curtain between the bulkhead barrier wall alignment and the Parcel I building. Therefore the Parcel I building addition was demolished to facilitate the installation of the sound curtain based on consent from the tenant and property owner (NYCDEP),.

4.2 525 UNION STREET WALL ALIGNMENT AND INSTALLATION

The former bulkheads that fronted the 525 Union Street property consisted of sections of steel H-pile with timber lagging and vertical timber pile walls. Approximately 115 linear feet of vertical timber pile wall was observed to be severely deteriorated/failing and in very poor condition. The majority of vertical timbers exhibited 50% to 100% section loss and were no longer connected to a timber wale system. Portions of the upland area had eroded behind the existing wall system as a result of the deteriorated wall system. Given the condition of these existing bulkheads and observations made during pre-drilling at Parcels I and VI, it was determined that implementation of the design pre-drilling operation (pre-drill wall alignment to the terminus depth of the sheets using 30-inch diameter auger) presented a significant risk for potential bulkhead and building movement in this area.

In order to further evaluate the presence of potential obstructions and facilitate development of a planned approach for barrier wall installation in this area, a pre-probing program was performed between late April and early May 2020. This program was designed to identify the location, frequency and depth of obstructions in the canal fronting this approximately 220 linear feet of wall from north of the 525 Union Street building to the Union Street Bridge. A 8-inch diameter continuous flight auger was used to limit the potential for impacting the existing timber bulkheads and adjacent building. This pre-probing program identified a significant amount of obstructions fronting the length of the 525 Union Street property. In addition, the results of this probing indicated that a portion (approximately 150-foot length along the southern most extent of the bulkhead wall) of the design needed to be adjusted to avoid encountering the existing timber bulkhead and potentially causing damage to this bulkhead and the adjacent structure. The alignment of the wall was modified to avoid encountering the existing wall system and avoid damage to the existing bulkhead and structurally deficient building. It was anticipated that there would be minimal incremental impacts on the canal width and no impact to vessel navigation. National Grid and GZA presented the existing wall conditions and realignment of the barrier wall to the EPA and the EPA approved the new alignment in June 2020. Refer to the attached Fulton Barrier Wall presentation dated June 2020, included in **Appendix B**. As part of EPA's approval in June 2020, EPA requested that Aquablok material be placed between the new and existing wall system in this realigned area prior to backfilling between the two wall systems. This Aquablok was installed per EPA's request.

In addition, as part of National Grid's continued evaluation of options for installing the new bulkhead wall in this area, a pilot program of sheet pile installation was performed on November 5th and 6th, 2020. A sheeting pair was temporarily installed along the proposed barrier wall alignment between building columns 8 and 9 on November 5, 2020 and subsequently a 2nd sheeting pair was installed on November 6th utilizing a variable moment vibratory hammer. The objective of this pilot program was to assess the performance of the vibratory hammer system and evaluate building and Site conditions during pile driving south of building columns 1 through 4. Between November 24th and 25th, steel sheet piling was installed along the southern portion of the Fulton Barrier Wall alignment utilizing a variable moment hammer. The ABI pile driver, supported by the Jack-Up-Barge (JUB), was used to install Sheet Piles Nos. 155 through No. 184 (approximately 179 linear feet) along the 525 Union Street alignment between November 24 and December 30, 2020. The hanging vibratory hammer was used to install Sheet Piles Nos. 184 through No. 191 (approximately 28 linear feet) along the 525 Union Street alignment between December 3 and December 4, 2020. No additional movement or significant vibrations were observed during sheet piling installation using the variable moment vibratory hammer system.

Installation of steel sheeting was paused within the vicinity of the northwest corner while the 525 Union Street building improvements were completed. During this time, steel sheet piling was installed south to north along 525 Union Street where building improvements were deemed unnecessary using a variable moment hammer and hanging hammer. As a result, a steel sheet pile closure was required to be constructed to connect the previously driven sheets. An additional sheet pile 147A was installed between the adjacent sheets (#147 and #148). The annulus between the adjoining sheets was cleared of existing soils and backfilled with Aquablok. Refer to **Appendix A** for closure location.

4.3 TIEBACK ANCHOR MODIFICATIONS

Prior to start of construction, the tieback anchor system was modified from a thread bar system to a strand anchor system along Wall Sections 1, 3, and 5. This modification was proposed by Posillico to address certain constructability, health and safety, and schedule concerns. Unlike the thread bar system, the strand anchors do not require the use of a crane and separate supporting barge during installation because they are manufactured in rolls. Given the limited working area at the Site, elimination of this separate crane and barge resulted in increased construction efficiencies and reduce overall equipment, manhours and health and safety related risks. Refer to Table below for the EPA approved modified design:

Revised Tieback Design

Wall Section	Anchor Type	Strand Number / Size	Design Load	Anchor Test Load	Strand Ultimate Load (GUTs)
Wall Sections 1 and 3	Strand Anchors	Three (3) 0.6-inch diameter, 7 wire strands 270 ksi	86 kips @ 35 deg 100 kips @ 45 deg	114 kips 133 kips	176 kips
Wall Section 5	Strand Anchors	Six (6) 0.6-inch diameter, 7 wire strands 270 ksi	201 kips @ 45 deg	267 kips	352 kips

During installation of tiebacks TB-80 and TB-81, obstructions were encountered 8 to 10 feet into the upland area along the anchor (45 degree) inclination. After several attempts to remove the obstruction, the tieback anchor inclination was modified from 45 degrees to 55 degrees. As a result of the modified angle (55 degrees), an additional tieback anchor, designated as TB-80A, was installed to provide additional lateral capacity in this area. Refer to **Appendix A** for tieback locations.

In addition, two levels of tieback anchors were installed immediately north and south of CSO RH-033 & CSO RH-037. The lower and upper anchors were installed at 45- and 35-degrees, respectively. These modifications were performed to address NYCDEP's comments to the plan set approval described herein. Refer to **Appendix A** for tieback locations.

4.4 CSO MODIFICATIONS

A plan set review of the 95% Design and 100% Design was performed by NYCDEP Bureau of Water and Sewer Operations (BWSO) between July 2018 and June 2020. Plan Set review approval was provided by BWSO in June 2020 subsequent to the start of construction. Concurrent with the BWSO plan set review process, National Grid's contractor (Posillico) performed test pits designed to locate CSO RH-033 which, according to plans provided by NYCDEP, extended to the canal proximate to the property boundary between Parcels VI and VII. The CSO piping was not observed during these test pit explorations. Additional test pit explorations intended to locate CSO RH-033 were performed north and south of the previous test pit locations described above. The CSO cast iron pipe was located approximately 6.5- to 7.0-feet below the top of the existing bulkhead north of the previous test pit locations. The pipe terminated approximately 3.75 feet upland of the existing bulkhead and was oriented on an angle towards the existing bulkhead and not perpendicular to the bulkhead as expected based on drawings provided by the City. Based on the observed depth and angle of the pipe, it was determined that it would interfere with the EPA approved design of the tieback and deadman micropiles in this area.

National Grid communicated these findings to NYCDEP and EPA and developed a plan for extending RH-033 through the new bulkhead wall. National Grid proposed to remove the angled pipe section and replace it with a new straight section of pipe extending through the barrier wall in an east/west orientation. As part of this updated design, the layout of the tieback elements and pile supported deadman system was adjusted as a result of the CSO realignment (straightening of pipe). On March 10, 2020, National Grid submitted the updated drawing Set with these proposed changes to NYCDEP to be coordinated with BWSO for plan set approval.

In April 2020, BWSO comments pertinent to the design that would result in modifications to the barrier wall system and layout included:

- Installation of a manhole chamber along the 60 ft extension at RH-033;
- Support of the 60 ft extension at RH-033 with a cradle system and pile foundations based upon a review of geotechnical subsurface conditions and BWSO requirements;
- Provide 6 feet clearance from barrier wall structural elements from either edge of the existing CSO outfall RH-037 and RH-033 due to possible impacts on future rehabilitation or reconstruction of the existing CSOs; and.

- Upsize the barrier wall opening for the 18-inch sewer at RH-037 to accommodate a future 48-inch CSO pipe to be installed by the City.

Per these comments, conceptual drawings of CSO RH-033 were prepared by GZA on behalf of National Grid and provided to NYCDEP via email on April 27, 2020. The drawings depicted the CSO pipe layout, revised wall alignment and barrier wall penetration. As part of this concept (described in **Section 3.6.8**), the drawings illustrated the use of pile foundations and concrete cradles to support the CSO pipe along with the installation of a tee connection to satisfy BWSO requests. To support potential future excavation, the pile supported concrete deadman system parallel to Wall Sections 1 and 2 was divided into two segments at the location of the RH-033 pipe, see **Appendix A**. Additionally, a double row of angled (35 and 45 deg) tiebacks were added on either side of the RH-033 outfall pipe to support the section of wall where the concrete deadman was divided into two segments. Similarly, a double row of angled (35 and 45 deg) tiebacks were added on either side of the outfall pipe at RH-037. The tiebacks within these areas were offset to accommodate potential future work in this area by the City. The revisions did not result in changes to barrier wall structural element sizes.

On June 5, 2020, National Grid received a letter of acceptance from BWSO Plan Review Section for the Fulton Barrier Wall submission related to CSO RH-033, RH-037, and RH-038.

4.5 HYDRAULIC RELIEF MODIFICATIONS

As described in the 100% Design Report, the barrier wall design included a shallow passive system designed to provide hydraulic relief for wall stability in the event future conditions result in additional hydraulic loads. The hydraulic relief system includes perforated drainage piping installed within crushed stone backfill behind the newly installed wall sections. The system design included three collection vaults and associated 6-inch diameter wall penetrations located at Sackett Street, DeGraw Street, and the extension of Douglass Street between Parcels VI and VII. Per the request of EPA, the invert elevation of the outlet piping for each of the three vaults were set at El +1.0 with the majority of the invert elevations for the hydraulic relief system piping ranging from El +2.0 to +1.5 NAVD 88. Two sections of hydraulic relief piping invert elevations remained between El +6 and +5 due to proximity to existing structures and the associated constructability issues and potential for undermining and damaging these structures.

As described in **Section 4.1,** the Parcel I building addition was demolished at the start of construction of the barrier wall. The demolition of this building addition, allowed for the lowering of approximately 125 feet of the hydraulic relief system piping from between El +6 to +5 ft to EL +2 to +1.5 ft, consistent with EPA's request.

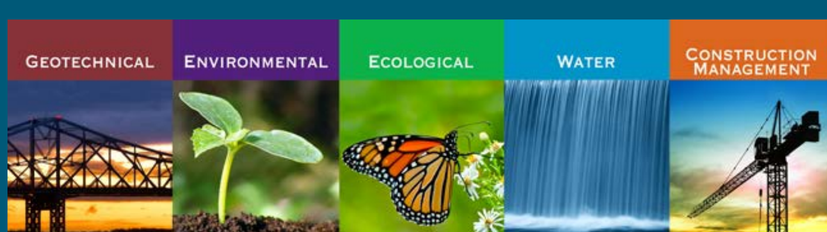
As described in **Section 3.6.4**, movement of the Parcel I building was observed during barrier wall installation necessitating portions of the building to be underpinned. As part of an evaluation of this building movement, it was determined that installation of the hydraulic relief vault near the northwest corner of the Parcel I building could result in damage to the Parcel I building. This condition combined with the lowering of the hydraulic relief piping described above allowed for a reevaluation of the need for this third vault. The Fulton groundwater model was used to confirm that a reconfigured hydraulic relief system with the lowered piping section on Parcel I and two vaults (located along the boundary of Parcels VI and VII and former Sackett Street was adequate to collect the anticipated volumetric flow rates consistent with the design objectives. The as-built drawing in **Appendix A** depicts this hydraulic relief system and vault configuration.

5.0 GROUNDWATER ELEVATION MONITORING

Groundwater modelling performed by GZA, on behalf of National Grid, as part of the barrier wall design process indicated that only limited localized groundwater mounding would result from the construction of this barrier wall. Per Section 44n of the AOC, National Grid collected baseline groundwater elevation readings prior to, during and after construction of this bulkhead barrier wall. This data was collected to document that the construction of this bulkhead barrier wall resulted in no significant modifications to groundwater elevations or flow patterns and therefore no groundwater management measures to address mounding related to this wall are necessary or required. This monitoring program included instrumenting the following three monitoring wells located upgradient of the barrier all alignment with pressure transducers to allow for the continuous collection of groundwater elevation data prior to, during and subsequent to construction of the Fulton wall:

- FW-MW-4R – located within Sackett Street proximate to Parcel I;
- GC-MW-33S - located within Nevins Street adjacent to Parcel VII; and
- FW-MW-1R – located within DeGraw Street adjacent to the canal between Parcels I and VI.

The attached **Figure in Appendix G** shows these well locations. **Appendix G** includes a plot of transducer data collected from these three wells between approximately November 2017 through June 2021. As indicated on this plot, no measurable changes in groundwater elevations were observed during the construction period (August 28, 2019 through April 28, 2021) or after the wall was constructed. Further, plots of groundwater elevation contours from before (October 2016, January 2017, June 2017, and September 2017), during (June 2020 and February 2021) and after (June 2021) the barrier wall was constructed demonstrate that, consistent with the predictive groundwater modelling performed as part of the design, installation of this bulkhead barrier wall had no measurable impact on local groundwater elevations or flow directions.



GZA GeoEnvironmental, Inc.