

**GATEWAY DEVELOPMENT
COMMISSION**

HUDSON TUNNEL PROJECT

**2024 PRE-CONSTRUCTION
MONITORING REPORT
HUDSON RIVER LOW COVER AREA
HUDSON RIVER GROUND STABILIZATION**

Gateway Development Commission

For
United States Army Corps of Engineers
New York State Department of Environmental Conservation

DECEMBER 2024
Version 1.0

Privileged & Confidential/Advisory, Consultative & Deliberative/Proprietary Commercial and Financial Information – Do Not Disclose Subject to FOIA b (4). GDC reserves all potential exemptions under GDC Public Records Access Policy, NJ OPRA and NY FOIL

TABLE OF CONTENTS

VERSION CONTROL I

LIST OF FIGURES II

LIST OF TABLES..... II

APPENDICES..... II

ACRONYMS..... II

1 INTRODUCTION 1

1.1 Purpose 1

2 PROJECT REGULATORY BACKGROUND..... 1

2.1 Project Description 2

2.2 NEPA Compliance..... 2

2.3 Permit Compliance 3

2.4 Monitoring Plan Development and Revisions..... 4

3 MONITORING PLAN SURVEYS AND FIELD METHODS 4

3.1 Benthic Macroinvertebrate Community Surveys..... 4

3.2 Grain Size 4

3.3 Water Quality Monitoring 5

3.4 Fish Community Surveys 5

3.5 Bathymetry 5

4 PRE-CONSTRUCTION MONITORING RESULTS..... 6

4.1 Benthic Macroinvertebrate Survey Results 6

4.2 Grain Size Results 6

4.3 Water Quality Results..... 7

4.4 Fish Community Survey Results 8

4.5 Bathymetry Results 8

5 DISCUSSION..... 8

6 REFERENCES..... 9

VERSION CONTROL

Version	Date	Changes	Created By	Approved By
0.1	December 2024	Version 1		

Table 1: Version Control

LIST OF FIGURES

Figure 1: Low Cover Area

Figure 2: River Monitoring Locations

LIST OF TABLES

Table 1: Version Control (in text)

Table 2: Benthic Macroinvertebrate Community Results

Table 3: Sediment Grain Size Results

Table 4: Water Quality Parameters

Table 5: Otter Trawl Survey Results

APPENDICES

Appendix A: Approved Environmental Permits

Appendix B: Modifications and Approved Monitoring Plan

Appendix C: Otter Trawl Survey Marine Species Photograph Log

Appendix D: Bathymetry Survey

ACRONYMS

%	Percent
ASTM	American Society for Testing and Materials
°C	Degrees Celsius
DO	Dissolved Oxygen
°F	Degrees Fahrenheit
FTA	Federal Transit Administration
FEIS	Final Environmental Impact Statement
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
GDC	Gateway Development Commission
HTP	Hudson Tunnel Project
HRGS	Hudson River Ground Stabilization
mg/L	milligrams per liter
mL	milliliters
NEC	Northeast Corridor
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NRT	North River Tunnel
NTU	Nephelometric Turbidity Units
NYSDEC	New York State Department of Environmental Conservation
ORP	Oxidative Reduction Potential
PANYNJ	Port Authority of New York and New Jersey
ROD	Record of Decision
USACE	United States Army Corps of Engineers

1 INTRODUCTION

The Gateway Development Commission (“GDC”) has prepared this report for the Hudson Tunnel Project (“HTP” or “Project”) to document the pre-construction aquatic habitat conditions and ecological communities present within the Low Cover Area¹ and to summarize the biological monitoring observations conducted during in-water construction activities in 2024 associated with the development of a new rail tunnel under the Hudson River and the rehabilitation of the North River Tunnel (“NRT”). The monitoring activities were conducted in accordance with the modified Five-Year Monitoring Plan for Hudson River Low Cover Area (“Monitoring Plan”) (GDC 2024a) which was approved by the National Oceanic Atmospheric Administration (“NOAA”)/ National Marine Fisheries Service (“NMFS”), New York State Department of Environmental Conservation (“NYSDEC”), and United States Army Corps of Engineers (“USACE”). The Monitoring Plan was prepared to describe and fulfill monitoring requirements for environmental permits (NYSDEC Permit No. 2-6205-01829/00005 and USACE Permit No. NAN-2020-00835) issued for construction activities related to the deep soil hardening and mixing processes implemented in the Low Cover Area (Appendix A).

1.1 Purpose

The purpose of this report is to provide a summary of the pre-construction ecological community and habitat data collected in 2024 under the approved Monitoring Plan. This data represents the baseline monitoring collected to document pre-construction conditions which will be compared to post-construction results in future years.

The report includes the following elements:

- Project description and environmental permitting requirements
- A summary of the Monitoring Plan development and modifications
- Regulatory background for the overall HTP construction activities requiring review under National Environmental Policy Act (“NEPA”) and consultation with federal and state agencies
- Methods used to characterize the pre-construction habitat and ecological communities in the Project area and reference areas
- Results of the 2024 sampling performed to document baseline conditions.

2 PROJECT REGULATORY BACKGROUND

The purpose of the HTP is to preserve the current functionality of Amtrak’s Northeast Corridor (“NEC”) service and NJ TRANSIT’s commuter passenger rail service between New Jersey and Pennsylvania Station New York (“PSNY”) by repairing the deteriorating NRT, and to strengthen the NEC’s resiliency to support reliable service by providing redundant capability under the Hudson River for Amtrak and NJ TRANSIT NEC trains between New Jersey and PSNY.

The HTP consists of a new two-track tunnel together with rehabilitation of the existing NRT. The new tunnel would have two new tracks extending from the NEC in Secaucus, New Jersey, beneath the Palisades (North Bergen and Union City, New Jersey) and the Hoboken/Weehawken, New Jersey waterfront area, and beneath the Hudson River to connect to the existing tracks in PSNY. Upon completion of the HTP, the NEC would have four tracks (two in the new Hudson

¹ The FEIS/ROD refers to this area as the “low-cover area.” However, as part of the HTP’s procurement and contracting processes, the low-cover area is also referred to as the “Hudson River Ground Stabilization (“HRGS”).”

River Tunnel and two in the North River Tunnel) between New Jersey and New York under the Hudson River, which would provide operational flexibility and redundancy for Amtrak and NJ TRANSIT rail operations.

The Federal Railroad Administration (“FRA”) was the lead federal agency for the HTP’s environmental review, in accordance with the NEPA. The Federal Transit Administration (“FTA”) was a Cooperating Agency for the Final Environmental Impact Statement (“FEIS”)/Record of Decision (“ROD”) and as such, FTA issued the ROD jointly with the FRA in May 2021. The Port Authority of New York and New Jersey (“PANYNJ”) was the Project Sponsor at the time the FEIS/ROD was issued on May 28, 2021. On October 21, 2022, PANYNJ and the GDC formally notified FRA and FTA that GDC was assuming the role of NEPA Project Sponsor. FRA coordinated compliance with Section 106 of the National Historic Preservation Act (Section 106) with the NEPA process.

The NYSDEC issued Permit No. 2-6205-01829 to Amtrak on October 1, 2021. The USACE issued Permit No. NAN-2020-00835 to Amtrak and NJ TRANSIT, as joint co-permittees, on November 17, 2021.

2.1 Project Description

The construction activities within the Low Cover Area will impact 3.03 acres of the Hudson River where deep soil mixing is required to strengthen the river substrate to minimize risk during tunnel boring operations (Figure 1). Deep soil mixing is a ground improvement method where in-place native soils are mixed or blended with cement. This technique creates columns of soil-cement with increased strength and reduced compressibility. Deep soil mixing involves the introduction of large diameter augers or paddles which are advanced to a maximum design coverage depth. As the augers or paddles turn, cement or cement grout is introduced and is mixed with the native soils to create a “soilcrete.” The result is a series of overlapping soilcrete columns that together create a hardened volume of soil.

2.2 NEPA Compliance

As the NEPA Project Sponsor, GDC is responsible for ensuring the Project meets all federal and state requirements. GDC has prepared this report to comply with the following requirements and environmental commitments specified in the FEIS/ROD.

- FEIS/ROD Section 11.7.3.1.3 *Aquatic Biota*. The Project Sponsor will also monitor the recovery of the remaining 2.3 acres of soilcrete for five years post-construction.
- FEIS/ROD Section 11.7.3.1.3 *Aquatic Biota*. As compensation for the change in the nature and elevation of bottom habitat within the 0.7 acres, the Project Sponsor will monitor this area, in coordination with the USACE, NMFS and NYSDEC, for five years to assess its recovery as fish foraging habitat and will include the submittal of regular monitoring reports.
- FEIS/ROD Section 11.7.3.2 *Essential Fish Habitat*. As compensation for the change in the nature and elevation of bottom habitat within the 0.7 acres, the Project Sponsor will monitor this area, in coordination with the USACE, NMFS and NYSDEC, for five years to assess its recovery as fish foraging habitat. The Project Sponsor will also monitor the recovery of the remaining 2.3 acres of soilcrete for five years post-construction.
- FEIS/ROD Section 11.7.3.4 *Threatened, Endangered or Special Concern Species*. After construction is complete, the Project Sponsor will monitor the recovery of the 0.7 acres of elevated soilcrete and the remaining 2.3 acres of soilcrete for five years as foraging

habitat. Monitoring of this area will be conducted in consultation with the USACE, NMFS, and NYSDEC and will include the submittal of regular monitoring reports.

- FEIS/ROD Section 11.7.3.5 *Significant Coastal Fish and Wildlife Habitat*. After construction is complete, the Project Sponsor will monitor the recovery of the 0.7 acres of elevated soilcrete and the remaining 2.3 acres of soilcrete for five years to assess the habitat use and re-sedimentation of the modified river bottom. Monitoring of this area will be conducted in consultation with the USACE, NMFS, and NYSDEC and will include the submittal of regular monitoring reports. With implementation of measures recommended through these consultations, the permanent operation of the Preferred Alternative would not adversely affect the designation of this portion of the Hudson River as a Significant Coastal Fish and Wildlife Habitat.
- FEIS/ROD Attachment A: Mitigation Commitments (Natural Resources): Monitoring of the recovery of the 0.7 acres of affected river bottom, as well as the remaining 2.3 acres of ground improvement, for five years, in consultation with the USACE, NMFS, and the NYSDEC, to assess the recovery of the area as foraging habitat. Monitoring reports will be available on the Project website.
- FEIS/ROD Attachment A: Mitigation Commitments (Natural Resources): In the 0.7-acre area of the river bottom where the soilcrete would extend above the existing mudline, the Project Sponsor will implement a five-year monitoring program following completion of construction, in consultation with the USACE, NMFS, and the NYSDEC, to assess the recovery of the area as fish foraging habitat. The Project Sponsor will also monitor the recovery of the remaining 2.3 acres of soilcrete for five years post-construction. Regular monitoring reports will be submitted to the USACE, NMFS, and NYSDEC and will be made available on the Project website.

2.3 Permit Compliance

GDC has prepared this report to comply with requirements specified in the following federal and state permit conditions.

NYSDEC Natural Resources Permit Condition No. 8

On October 1, 2021, the NYSDEC authorized the proposed work in the low cover area through the issuance of NYSDEC Permit No. 2-6205-01829/00005 (Appendix A). The NYSDEC Natural Resources Permit Condition No. 8 identified that within ninety (90) days of issuance, the Permittee must submit a low cover section Monitoring Plan to the NYSDEC for review and approval prior to commencing work and within one year prior to commencement of work conduct pre-construction survey data to include, at a minimum, physical monitoring bathymetry, water quality, and sediment characteristics), benthic invertebrate monitoring, and fish community monitoring.

USACE Special Permit Condition (D)

On November 15, 2021, the USACE authorized the work in the low cover area through the issuance of USACE Permit No. NAN-2020-00835 (Appendix A). The USACE Special Permit Condition (D) included a stipulation that a river-bottom Monitoring Plan needed to be approved prior to commencing any in-water or in-wetlands work and submit a Monitoring Plan to assess the on-going recovery of fish foraging habitat of the 3.1-acre ground treatment in the Hudson River. A Monitoring Plan was to be developed in concert with the NOAA NFMS and the NYSDEC and incorporates up to five (5) years of post-construction surveys after the removal of the last of the two cofferdams. An annual report must be submitted in triplicate no than December 31 of each year.

2.4 Monitoring Plan Development and Revisions

A Five-Year Monitoring Plan for Hudson River Low Cover Area was prepared and submitted to NOAA/NMFS, USACE, and NYSDEC for review and approval. The Monitoring Plan was prepared to monitor Project impacts on the fish and macroinvertebrate communities as well as the physical habitat within the Low Cover Area. The Monitoring Plan was approved by USACE on September 8, 2022, NOAA/NMFS on September 9, 2022, and NYSDEC on September 12, 2022. The Monitoring Plan was revised on November 8, 2022, to address regulatory agency comments and resubmitted on November 9, 2022.

On May 22, 2024, a request to modify the Monitoring Plan was made prior to in-water construction, to meet the state and federal agencies permit conditions and to more effectively monitor the ecological communities and physical habitat conditions within the Low Cover Area and reference areas to assess potential impacts from the Project. These modifications to the Monitoring Plan were submitted to the agencies on May 22, 2024, via email (GDC 2024b) and were approved by the agencies on May 31, 2024. Associated correspondence and approvals for the modified Monitoring Plan are provided in Appendix B.

3 MONITORING PLAN SURVEYS AND FIELD METHODS

The modified Monitoring Plan (GDC 2024b) details the collection of pre-construction baseline aquatic community and habitat data within the Low Cover Area and associated reference areas (Figure 2). In accordance with the agency modified Monitoring Plan (GDC 2024b), pre-construction baseline aquatic community and habitat data collection included the collection of benthic invertebrate community data and sediment grain size data using a petite Ponar dredge, water quality parameter data collection using a multiparameter sonde and bottom trawl surveys to assess the fish community. Additionally, bathymetry surveys were conducted as part of pre-construction activities within the Low Cover Area to document pre-construction bottom contours.

In addition to the field data collection, during the in-water construction activities (i.e. pile driving and sheeting installation) agency approved biological monitors were present to document and report any potential incidental take of listed species, specifically Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*).

3.1 Benthic Macroinvertebrate Community Surveys

Prior to the start of construction at the Low Cover Area, baseline macroinvertebrate community surveys were conducted on June 18, 2024, at each of the 10 (ten) monitoring locations (site and reference) identified in Figure 2. Monitoring locations were selected to get spatial coverage of both the Low Cover Area as well as upstream and downstream reference areas.

At each of the monitoring locations, three replicate grab samples were collected using a petite Ponar dredge to characterize the benthic macroinvertebrate community. Each dredge was brought to the surface, the volume of the recovered sediment in each grab was noted, and the sediment composition was visually estimated. The three (3) benthic community grabs were combined, rinsed through a 500-micron sieve and placed in a labelled sample jar and preserved with 91 percent (%) isopropanol for a single sample per location. Since benthic organisms can be patchily distributed, combining three replicates into a single sample allows for better data comparability between locations. Samples were sent to Normandeau Associates, Inc.'s laboratory in Bedford, New Hampshire where organisms were identified to the lowest practical taxonomic level and enumerated.

3.2 Grain Size

Sediment grabs were collected as part of the pre-construction survey at both the site and

reference monitoring locations to document grain size and habitat conditions in the Low Cover Area prior to construction. Following the collection of the benthic macroinvertebrate community samples, a single petite Ponar grab was taken at each location for grain size analysis. The sediment from each grab was placed in a labelled, sealable plastic bag, allowed to settle, and the overlying water was decanted prior to shipping samples to Eurofins in South Burlington, Vermont for grain size analysis using gravimetric processes following the American Society for Testing and Materials method (ASTM) D422.

3.3 Water Quality Monitoring

During the benthic invertebrate and sediment sampling, water quality monitoring was also conducted using a multiparameter sonde at two depth intervals at each monitoring location. Water quality parameters including temperature, pH, Oxidative Reduction Potential (“ORP”), Dissolved Oxygen (“DO”), turbidity, and conductivity were collected from the middle of the water column and approximately one meter above the river bottom at each monitoring location.

3.4 Fish Community Surveys

The pre-construction fish community surveys were performed on June 19, 2024, using a 20-foot otter trawl that was towed parallel to the river flow adjacent to the monitoring locations as shown on Figure 2. A total of three representative otter trawl tows were performed within the Low Cover Area and two otter trawl tows within both the upstream and downstream reference area for a total of seven total trawls (3 site, 4 reference).

At each of the target monitoring locations, the otter trawl was deployed and allowed to settle to the river bottom. Tows were conducted into the current and were timed to allow a uniform collection effort between locations. After completion of the tow, the trawl was hoisted back to the boat using an onboard winch system and the net contents were poured into a large collection container for processing. Fish collected during the survey were identified to the lowest taxonomic level possible, enumerated, measured, and a representative photo was taken of each species. All fish collected during the surveys were released after processing. Other benthic fauna that was collected in the trawls such as shrimp and crabs were also identified, counted and released.

3.5 Bathymetry

Bathymetry was conducted as part of the pre-construction survey at both the sampling and reference locations prior to construction activities. The Project utilized Multibeam Bathymetry to obtain a geophysical survey that includes a swath bathymetric survey providing high-resolution multibeam data to develop contours of the water depths and the general shape of the river bottom. Horizontal accuracy of the multibeam bathymetry was approximately 0.2 feet and vertical accuracy will be approximately 0.2 feet. Survey lines had a minimum of 50% overlap to ensure 200% coverage. In addition, digital side-scan sonar survey was provided to obtain more detailed information on the character of the riverbed. The side-scan sonar supplemented the multibeam bathymetry data in locating and identifying debris on the river bottom as well as scars, old pilings, and areas of scour due to past storm surges. The side-scan ortho sonograph accuracy is approximately 6.0 feet horizontally.

In the fall of each year of the 5-year monitoring event, the bathymetry of the Low Cover Area will be mapped to identify changes in river bottom from the previous year. Within the Low Cover Area, the mapping will occur from the pier headline to the boundaries of State water in the middle of the Hudson River. Bathymetric mapping will utilize high resolution side-scan sonar to allow for the analysis of annual variation of the sea floor.

4 PRE-CONSTRUCTION MONITORING RESULTS

The benthic macroinvertebrate community results are presented in Table 2, results of the sediment grain size analysis are presented in Table 3, the water quality monitoring results are presented in Table 4, and the fish community results are presented in Table 5 and. A photolog of the otter trawl results and invertebrate sampling are presented in Appendix C.

4.1 Benthic Macroinvertebrate Survey Results

Benthic invertebrate community samples were collected at four reference locations (BC-R-01 to BC-R-04) and four site locations within the Low Cover Area (BC-S-01 to BC-S-04), and two near-shore locations near the bulkhead of the West 30th Street Heliport Pier on June 18, 2024. The results of the benthic invertebrate community surveys are presented in Table 2.

Across all ten monitoring locations, the number of taxa per sample ranged from 13 to 39, with a total of 77 different invertebrate taxa observed. Total abundance ranged from 105 individuals at MBH-01(bulkhead) to 1,349 individuals at BC-S-02 (site). Blue mussel (*Mytilus edulis*) was the most abundant species, collected at seven out of ten locations with a total of 1,767 individuals. The second most abundant species was a sand-builder worm (*Sabellaria vulgaris*) which was collected at seven locations with 929 total individuals. The third most abundant taxa were oligochaetes (*oligochaeta*) which were collected at 9 locations with 425 total individuals. These three taxa accounted for 76% of the total number of individuals collected during the baseline monitoring. The most widespread taxa were the polychaeta (*Mediomastus ambiseta*) and mud worm (*Streblospio benedicti*) which were collected at all ten locations.

The four (4) site locations had a mean abundance of 802 individuals per sample, while the four reference locations had a mean abundance of 170 individuals. The variance in mean abundance between the site and reference locations was due to the high counts of blue mussels found at two of the site locations (BC-S-01 and BC-S-02). Species richness was higher at the site monitoring locations than the Reference monitoring locations with a mean of 32 and 21 taxa, respectively. Mean density was also higher at the site locations (34,870 organisms per meter squared (m²)) than at the reference monitoring locations (7,370 organisms/m²). Similarly, the elevated mean density at the Project locations was due to the high abundance of mussels at the two (2) site locations. The Shannon-Weiner Diversity Index is a commonly used metric to assess invertebrate populations where higher scores equal a more diverse community. Diversity scores overall were relatively low, ranging from 1.05 at BC-R-04 to 2.22 at MBH-01. The mean diversity index was slightly higher at the Reference locations (1.82) compared to the site locations (1.52). Evenness was also higher at the Reference locations than the site with scores of 0.596 and 0.450 respectively.

Invertebrate species collected during the baseline monitoring are typical of the soft sediment habitat found in the Hudson River estuary and consisted primarily of bivalves, amphipods, polychaetas and various types of worms adapted to burrowing into the sediment. Abundance varied greatly between monitoring locations, but this is not unusual of benthic invertebrate organisms which are often patchily distributed (Bascompte, et al. 2002). Diversity and species richness were relatively low with many samples dominated by one or a few taxa.

4.2 Grain Size Results

Co-located sediment grain size data was collected to evaluate substrate conditions associated with the benthic community. Table 3 presents the results of the grain size collected at each sample location.

The substrate throughout the Project area was predominantly fine grained. Silt was the dominant grain size class observed across most benthic locations, except for BC-R-02 and BC-S-02 where sand was dominant. Of the grain sizes measured, gravel and coarse sands were observed the least, occurring at only three locations (BC-R-02, BC-S-01, BC-S-02). The substrate within the Low Cover Area was predominantly fines with three locations (BC-S-01, -03, and -04) consisting predominantly of silt/clay and only one location (BC-S-02) having more than 30% gravel and sands present in addition to fines. The reference locations were also primarily fines, but there was some spatial variation with more coarse grain sizes present at the upstream reference locations, especially BC-R-2, and no gravel or coarse sand observed at the downstream reference locations (BC-R-3 and 4). The grain sizes classified as gravel appeared to be cinders, likely from historic anthropogenic activity on the river, and did not appear to be native material such as stone.

4.3 Water Quality Results

The water quality results are presented in Table 4.

The sampling locations on the lower Hudson River fall within the jurisdiction of both New York and New Jersey. On the New Jersey side of the river, water is classified as saline estuarine waters that support aquatic life and recreation activities ("SE2"). The water quality standards for SE2 waters are as follows:

- Dissolved Oxygen (DO): must be at least 5.0 milligrams/liter (mg/L)
- Turbidity: may not exceed 10 Nephelometric Turbidity Units (NTU)
- Temperature: should not exceed 89.6 degrees Fahrenheit (°F) or 32 degrees Celsius (°C)
- pH: should be within the range of 6.5 to 8.5

The Project area is located between the Battery and the Bronx in New York which falls under Class I water quality criteria. Class I waters in New York are designated for secondary contact recreation such as boating or fishing. The water quality standards for Class I Waters are as follows:

- Fecal coliform monthly geometric mean should not exceed 200 CFU/100 milliliters (mL) and total coliform should not exceed 2,400 CFU/ 100 mL
- The DO concentration must be at least 4.0 mg/L at any time
- The temperature should not exceed 83 °F or 28.3 °C at any time
- pH should be within the range of 6.5 to 8.5
- Turbidity may not exceed 5 NTU.

As shown in Table 4, turbidity, dissolved oxygen, pH and temperature at the 10 monitoring locations are generally within the parameters set for Class I waters, with some exceptions. During the pre-construction baseline monitoring, waterbodies were not monitored for bacteria; therefore, a comparison to these water quality standards cannot be made. Deviations in pH and turbidity were observed at several locations.

Exceedances (above the 8.5 threshold for SE2 and Class I) for pH were observed at the following locations:

- BC-R-01 Bottom Depth
- BC-R-03 Bottom Depth

- BC-R-04 both Bottom and Mid-Column Depths
- BC-MBH-02 Bottom Depth

Exceedances (above 5 NTU for Class I) for turbidity were observed at the following locations:

- BC-R-04 Bottom Depth
- BC-MBH-01 Mid-Column Depth
- BC-MBH-02 both Bottom and Mid-Column Depths

Turbidity at BC-R-04 within the mid-column depth was 13.45 NTU which is also above the SE2 threshold of 10 NTU.

Water temperatures observed during the survey ranged from 18.0 to 22.8°C and did not exceed the 28.3°C Class I threshold or 32°C SE2 threshold. At all locations, the DO levels were above 8 mg/L (ranging from 8.00 to 9.25 mg/L) and above the minimum 4 mg/L threshold value for Class I waters and minimum 5 mg/L threshold for SE2 waters. Water quality parameters were generally similar between the Low Cover Area and reference locations and were suitable of supporting aquatic life.

4.4 Fish Community Survey Results

The results of the otter trawl surveys are presented in Table 5. Representative photographs of the marine life observed within the trawl surveys are presented in Appendix C.

Fish species, along with crustaceans, cephalopods, and ctenophores were collected during the trawl surveys performed on June 19, 2024. Across all seven locations, the number of fish species per tow ranged from 3 to 8, with a total of 11 different fish species observed. Tomcod (*Microgadus proximus*) was the most abundant species, collected at all seven locations with a total of 171 individuals followed in abundance by hogchoker (*Trinectes maculatus*) which was collected at five locations (18 total individuals). Although most of the fish collected were bottom dwelling species, some sportfish including striped bass (*Morone saxatilis*) and weakfish (*Cynoscion regalis*) were also collected.

Across all seven fish community survey locations, the number of invertebrate taxa per tow ranged from 2 to 4, with a total of 6 invertebrate taxa observed during the trawl surveys. Sand shrimp (*Crangon septemspinosa*) and jellyfish (*Ctenophora*) were the most abundant invertebrate taxa observed and were collected at all locations with a total of 223 individual shrimp (jellyfish were not individually counted). Overall, 17 different taxa were collected in the trawl surveys.

The community observed during the otter trawls was relatively similar between the site and Reference locations. The total number of organisms (fish and invertebrates) was similar with an average of 75 individuals at the site and 73 individuals at Reference. The total number of combined taxa was slightly lower at the site with an average of 6.7 taxa per location compared to 8.5 at the Reference but the number of fish per location was greater at the site with an average of 39 compared to 27 at the Reference.

4.5 Bathymetry Results

Results of the bathymetry performed within the Low Cover Area are provided in Appendix D.

5 DISCUSSION

Pre-construction environmental monitoring was completed in 2024 in accordance with the modified Monitoring Plan (GDC 2024b) to collect data on ecological communities and habitat present within the Low Cover Area and appropriate reference locations. The monitoring included

macroinvertebrate grab sampling and fish community trawl surveys which documented a fish and invertebrate community typical of the lower Hudson River. The abundance and diversity varied between samples, but results were generally similar between site and Reference locations. The sediment grain size sampling showed the physical habitat in the Low Cover Area was primarily fine-grained substrate consisting of silt and clay and generally consistent with the surrounding reference areas within the Lower Hudson. The water quality monitoring identified a few parameters which were outside the regional water quality standards which is not surprising given the site's location within a very developed and urban area, but overall water quality was generally consistent with state standards and suitable for supporting aquatic life.

FEIS/ROD Section 3.3.5.7 explains installation and removal of cofferdams ("HRGS In-Water Work") would occur only within an authorized work window from July 1 to January 20. As such, HRGS in-water work including the installation and removal of the cofferdams is strictly prohibited between January 21 and June 30 of each calendar year.

The HRGS In-Water Work within the Low Cover Area is strictly prohibited between January 21 and June 30 of each calendar year. To adhere to the seasonal restrictions identified in the FEIS/ROD, HRGS In-Water work within the Low Cover Area is planned to occur in three (3) seasons:

1. Season 1: July 1, 2024, to January 20, 2025
2. Season 2: July 1, 2025, to January 20, 2026
3. Season 3: July 1, 2026, to January 20, 2027

This 2024 data will serve as the baseline dataset describing pre-construction conditions within the Low Cover Area to which future data will be compared to assess potential Project impacts. Five (5) years of post-construction surveys including physical monitoring bathymetry, water quality, and sediment characteristics, benthic invertebrate monitoring, and fish community monitoring after the removal of the last of the two cofferdams will be conducted. An annual report will be submitted in triplicate no than December 31 of each year.

6 REFERENCES

- Bascompte, Jordi, et al. "Patchy Populations in Stochastic Environments: Critical Number of Patches for Persistence." *The American Naturalist*, vol. 159, no. 2, 2002, pp. 128–37. JSTOR, <https://doi.org/10.1086/324793>. Accessed 19 Dec. 2024.
- GDC 2024a. Gateway Development Commission (GDC) *Five Year Monitoring Plan for Hudson River Low Cover Area (Monitoring Plan)* Submitted electronically, 2024
- GDC 2024b. Gateway Development Commission (GDC) *Modifications of Five-Year Monitoring Plan for Hudson River Low Cover Area (Revised)* Submitted electronically, June 2024.

TABLES

**Table 2. Benthic Community Survey Results
Hudson Tunnel Project
Low Cover Area Pre-Construction Monitoring Report
Gateway Development Commission**

Taxon Classification				Common Name	Site Locations				Reference Locations			
Class	Order	Family	Lowest Practical Taxon Level		BC-S-01	BC-S-02	BC-S03	BC-S-04	BC-R-01	BC-R-02	BC-R-03	BC-R-04
Asciacea												
	Pleurogona											
		Molgulidae										
			<i>Molgula manhattensis</i>	Sea grapes	6	8	2	--	--	1	--	
Bacillariophyceae												
	Centrohelida											
		Carinomidae										
			<i>Carinoma tremaphoros</i>	Protist	--	--	--	--	1	--	1	
Bivalva												
	Arcida											
		Arcidae										
			<i>Anadara transversa</i>	Transverse ark clam	1	3	--	--	--	--	--	
	Cardiida											
		Tellinidae										
			<i>Macoma petalum</i>	Atlantic macoma	--	--	--	--	--	--	--	
			<i>Macoploma tenta</i>	Elongated macoma	--	--	--	--	1	--	2	
			<i>Tellinidae</i>	Tellin clam	--	2	3	1	--	3	4	
	Chaetocerotales											
		Lyonsiidae										
			<i>Lyonsia hyalina</i>	Glassy lyonsia	9	--	--	--	--	--	--	
	Grammysioidea											
		Myidae										
			<i>Mya arenaria</i>	Soft-shell clam	1	4	--	--	--	--	--	
		Mytilidae										
			<i>Mytilidae</i>	Mussel	--	--	--	--	--	--	1	
			<i>Mytilus edulis</i>	Blue mussel	962	611	100	1	5	36	52	
	Nuculida											
		Nuculidae										
			<i>Nucula proxima</i>	Atlantic nut clam	1	--	--	--	1	--	--	
	Venerida											
		Mactridae										
			<i>Mulinia lateralis</i>	Dwarf surf clam	--	--	--	--	--	--	--	
		Petricolidae										
			<i>Petricolaria pholadiformis</i>	False angelwing	5	40	8	--	1	52	1	
				Unknown bivalva species	1	8	--	--	1	--	--	
Gastropoda												
	Neogastropoda											
		Muricidae										
			<i>Urosalpinx cinerea</i>	Eastern oyster drill	1	1	1	--	--	--	--	
		Nassariidae										
			<i>Ilyanassa obsoleta</i>	Eastern mud snail	--	--	--	--	--	--	1	
			<i>Ilyanassa trivittata</i>	Three line mud snail	--	--	--	--	--	--	--	

**Table 2. Benthic Community Survey Results
Hudson Tunnel Project
Low Cover Area Pre-Construction Monitoring Report
Gateway Development Commission**

Taxon Classification				Common Name	Site Locations				Reference Locations			
Class	Order	Family	Lowest Practical Taxon Level		BC-S-01	BC-S-02	BC-S-03	BC-S-04	BC-R-01	BC-R-02	BC-R-03	BC-R-04
Gastropoda (continued)												
Pylopulmonata												
Pyramidalidae												
			<i>Odostomia eburnea</i>	Sea snail	5	4	2	--	--	3	--	--
			<i>Turbonilla interrupta</i>	Interrupted turbonille	--	1	--	--	1	1	--	--
				Unknown gastropoda species	--	--	--	--	--	--	1	1
Malacostraca												
Amphipoda												
Oedicerotidae												
			<i>Ameroculodes edwardsi</i>	Scud	--	--	--	--	--	--	--	--
Ampeliscidae												
			<i>Ampelisca abdita</i>	Amphipod	--	3	1	--	--	--	--	--
			<i>Ampelisca vadorum</i>	Amphipod	1	1	1					
Aoridae												
			<i>Grandidierella japonica</i>	Japanese skeleton shrimp	1	2	1	--	1	2	--	--
Caprellidae												
			<i>Caprella penantis</i>	Skeleton shrimp	--	--	--	--	--	--	--	1
Corophiidae												
			<i>Monocorophium acherusicum</i>	Tube-building amphipod	4	--	--	--	--	--	--	--
Ischyroceridae												
			<i>Jassa marmorata</i>	Marbled scud	--	--	--	--	--	1	--	--
Leuconidae												
			<i>Leucon americanus</i>	Scud	--	--	--	--	--	--	--	5
Melitidae												
			<i>Melita nitida</i>	Striped amphipod	--	--	1	--	--	--	--	--
Pleustidae												
			<i>Incisocalloipe aestuarius</i>	Estuarine amphipod	8	9	3	--	--	1	--	--
Unciolidae												
			<i>Unciola irrorata</i>	Scud	--	--	1	--	--	--	--	--
			<i>Unciola serrata</i>	Scud	--	2	2	--	2	--	--	--
Cumacea												
Diastylidae												
			<i>Oxyurostylis smithi</i>	Sharp-tailed cumacean	--	1	--	--	1	--	--	1
Decapoda												
Crangonidae												
			<i>Crangon septemspinosa</i>	Sand shrimp	--	1	1	1	2	--	--	--
Paguridae												
			<i>Pagurus sp.</i>	Hermit crab	--	--	--	--	--	1	--	--
Panopeidae												
			<i>Dyspanopeus sayi</i>	Say mud crab	1	--	1	--	--	--	--	--
Isopoda												
Anthuridae												
			<i>Cyathura burbancki</i>	Isopod	3	2	--	--	--	1	--	--

**Table 2. Benthic Community Survey Results
Hudson Tunnel Project
Low Cover Area Pre-Construction Monitoring Report
Gateway Development Commission**

Taxon Classification				Common Name	Site Locations				Reference Locations			
Class	Order	Family	Lowest Practical Taxon Level		BC-S-01	BC-S-02	BC-S-03	BC-S-04	BC-R-01	BC-R-02	BC-R-03	BC-R-04
Malacostraca (continued)												
		Idoteidae										
			<i>Edotia triloba</i>	Isopod	--	--	1	--	--	--	1	1
			<i>Synidotea laevidorsalis</i>	Asian isopod	2	1	--	--	1	2	2	--
	Mysida											
		Mysidae										
			<i>Neomysis americana</i>	Opposum shrimp	--	--	--	--	--	--	3	--
Palaeonemertea												
	Tubulaniformes											
		Tubulanidae										
			<i>Tubulanus sp.</i>	Nemertean worm	2	--	3	1	--	--	1	--
Oligochaeta												
				Unknown oligochaeta species	1	--	52	76	49	7	97	106
Polychaeta												
	Achnanthes											
		Orbiniidae										
			<i>Leitoscoloplos fragilis</i>	Diatom	--	--	--	--	--	--	--	--
			<i>Leitoscoloplos robustus</i>	Diatom	--	--	--	--	--	--	--	--
	Capitellida											
		Capitellidae										
			<i>Heteromastus filiformis</i>	Polychaete worm	--	2	1	1	--	--	3	3
			<i>Mediomastus ambiseta</i>	Polychaete worm	1	3	4	17	3	1	20	13
Crassieclitellata												
	Maldanidae											
			<i>Euclymene collaris</i>	Polychaete worm	10	5	5	1	1	1	--	--
Eunicida												
	Dorvilleidae											
			<i>Schistomeringos rudolphi</i>	Four-eyed dorvillea	--	1	1	--	--	--	--	--
	Eunicidae											
			<i>Lysidice unicornis</i>	Polychaete worm	1	--	--	--	--	--	--	--
			<i>Marphysa sanguinea</i>	Blood worm	--	6	--	--	--	--	--	--
Phyllodocida												
	Goniadidae											
			<i>Glycinde multicens</i>	Polychaete worm	--	--	--	--	--	--	--	--
	Hesionidae											
			<i>Oxydromus obscurus</i>	Polychaete worm	8	--	2	--	--	--	--	--
			<i>Podarkeopsis levifuscina</i>	Polychaete worm	--	--	6	--	2	1	1	--
	Nereididae											
			<i>Alitta succinea</i>	Clam worm	4	4	3	1	--	--	--	--
	Phyllodocidae											
			<i>Eumida sanguinea</i>	Bristle worm	1	2	--	--	--	1	--	--
			<i>Hypereteone heteropoda</i>	Polychaete worm	11	4	18	3	9	3	8	--
			<i>Paranaitis speciosa</i>	Polychaete worm	--	--	--	--	--	--	2	--

Table 2. Benthic Community Survey Results
Hudson Tunnel Project
Low Cover Area Pre-Construction Monitoring Report
Gateway Development Commission

Taxon Classification				Common Name	Site Locations				Reference Locations			
Class	Order	Family	Lowest Practical Taxon Level		BC-S-01	BC-S-02	BC-S03	BC-S-04	BC-R-01	BC-R-02	BC-R-03	BC-R-04
Polychaeta (continued)												
		Polynoidae										
			<i>Eunoe oerstedii</i>	Multi-pronged scaleworm	2	3	--	--	--	--	--	
			<i>Lepidonotus sp.</i>	Scale worm	--	--	--	1	1	--	5	
		Syllidae										
			<i>Myrianida prolifera</i>	Polychaete worm	1	--	2	--	--	--	--	
			<i>Streptosyllis verrilli</i>	Polychaete worm	--	--	--	--	--	--	2	
			<i>Syllidae</i>	Necklace worm	--	--	1	--	--	2	--	
			<i>Syllis gracilis</i>	Polychaete worm	2	--	--	--	--	--	--	
		Spionida										
		Sabellidae										
			<i>Parasabella microphthalma</i>	Polychaete worm	1	3	--	--	--	--	--	
			<i>Sabellaria vulgaris</i>	Sand builder worm	137	578	162	1	37	12	2	
		Spionidae										
			<i>Dipolydora socialis</i>	Polychaete worm	1	--	--	--	--	--	--	
			<i>Marenzelleria viridis</i>	Red-gilled mudworm	--	--	--	--	--	--	--	
			<i>Polydora cornuta</i>	Whip mudworm	12	--	8	2	2	5	1	
			<i>Pygospio elegans</i>	Bristle worm	--	3	--	--	--	--	--	
			<i>Spionidae</i>	Mud worm	--	--	1	--	--	--	--	
			<i>Streblospio benedicti</i>	Bar-gilled mudworm	4	3	10	22	3	3	36	
		Terebellida										
		Ampharetidae										
			<i>Ampharete oculata</i>	Polychaete worm	5	2	4	1	--	1	2	
		Cirratulidae										
			<i>Cirratulidae</i>	Hair worm	3	4	1	2	1	--	5	
			<i>Cirriformia grandis</i>	Polychaete worm	--	1	--	--	--	--	--	
		Terebelidae										
			<i>Polycirrus eximius</i>	Polychaete worm	6	--	--	--	--	--	--	
			<i>Polycirrus phosphoreus</i>	Polychaete worm	1	--	--	--	--	--	--	
			<i>Polycirrus sp.</i>	Polychaete worm	83	21	4	1	13	5	--	
			Abundance (N)		1309	1349	417	133	139	146	253	
			Species Richness (S)		39	36	35	17	23	24	24	
			Density (organisms/m ²)		56,913	58,652	18,130	5,783	6,043	6,348	11,000	
			Diversity (H')		1.18	1.32	2.07	1.50	2.07	2.17	2.01	
			Evenness (J')		0.321	0.369	0.581	0.528	0.661	0.682	0.633	

Notes:

1. Benthic community samples collected on June 18, 2024 using a petite ponar dredge.
2. Benthic taxonomy identification performed by Normandeau Associates, Inc. in Bedford, New Hampshire.
3. Diversity calculated using Shannon-Weiner index using base e method as:

$$H' = - \sum p_i \ln(p_i)$$

4. Evenness calculated using Pielou's index as:

$$J' = \frac{H'}{\ln(S)}$$

Table 3. Sediment Grain Size Results
Hudson Tunnel Project
Low Cover Area Pre-Construction Monitoring Report
Gateway Development Commission

Location	BC-R-01	BC-R-02	BC-R-03	BC-R-04	BC-S-01	BC-S-02	BC-S-03	BC-S-04
Particle Size Category Classification								
Gravel	--	14.1	--	--	15.8	37.0	--	--
Sand	21.0	57.7	23.3	27.6	12.3	49.7	18.8	29.0
Coarse Sand	--	14.7	--	--	0.8	12.1	--	--
Medium Sand	6.9	13.2	5.9	7.7	4.3	13.1	7.1	9.4
Fine Sand	14.1	29.8	17.4	19.9	7.2	24.5	11.7	19.6
Silt	55.0	19.3	55.4	49.2	66.1	8.2	59.2	46.9
Clay	24.0	8.9	21.3	23.2	5.8	5.1	22.0	24.1
Individual Sieve Size - Incremental Percentages								
Sieve 3 inch	--	--	--	--	--	--	--	--
Sieve 2 inch	--	--	--	--	--	--	--	--
Sieve 1.5 inch	--	--	--	--	--	--	--	--
Sieve 1 inch	--	--	--	--	--	--	--	--
Sieve .75 inch	--	--	--	--	--	--	--	--
Sieve .375 inch	--	6.7	--	--	12.5	28.5	--	--
Sieve #4	--	7.4	--	--	3.3	8.5	--	--
Sieve#10	--	14.7	--	--	0.8	12.1	--	--
Sieve #20	3.1	6.4	3.4	4.6	2.2	3.6	3.8	3.0
Sieve #40	3.8	6.8	2.5	3.1	2.1	9.5	3.3	6.4
Sieve #60	2.7	5.9	3.0	3.8	2.4	12.5	3.7	5.8
Sieve #80	2.7	4.0	1.8	2.4	1.1	3.9	1.9	4.8
Sieve #100	2.2	3.3	1.7	2.0	0.9	2.1	1.6	3.3
Sieve #200	6.5	16.6	10.9	11.7	2.8	6.0	4.5	5.7
Hydrometer 1	20.3	3.8	22.8	22.6	59.4	1.9	30.2	16.8
Hydrometer 2	10	2.5	4.2	5.0	1.9	1.9	7.3	10.0
Hydrometer 3	13.2	5.6	14.2	11.6	1.2	1.9	8.9	6.1
Hydrometer 4	8.2	3.3	7.1	3.3	1.8	1.3	5.5	6.0
Hydrometer 5	3.3	4.1	7.1	6.7	1.9	1.3	7.3	8.0
Hydrometer 6	3.8	1.6	4.3	4.9	--	0.6	1.8	2.0
Hydrometer 7	4.9	2.6	7.3	8.6	2.1	2.6	9.5	12.4

Notes:

1. Sediment grain size samples collected with a petite ponar grab sampler at each benthic community location on June 18, 2024.

Table 4. Water Quality Parameters
Hudson Tunnel Project
Low Cover Area Pre-Construction Monitoring Report
Gateway Development Commission

Sample Location	Water Column Depth	Conductivity (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	pH	ORP (mV)	Temperature (°C)
BC-R-01	Bottom	21.57	3.40	9.44	8.66	433	22.7
	Mid-Column	31.15	2.52	8.49	8.15	445	19.1
BC-R-02	Bottom	21.22	2.87	8.28	8.28	416	22.8
	Mid-Column	32.62	2.30	8.72	8.08	432	18.8
BC-R-03	Bottom	21.35	2.51	9.37	8.76	436	22.6
	Mid-Column	34.09	2.58	8.30	8.18	452	18.4
BC-R-04	Bottom	23.26	3.83	9.17	9.25	456	22.4
	Mid-Column	28.66	13.45	8.84	8.63	461	20.7
BC-S-01	Bottom	27.50	2.32	8.75	7.95	158	20.8
	Mid-Column	35.27	1.87	8.14	7.90	194	18.5
BC-S-02	Bottom	27.94	2.72	8.92	7.95	153	20.6
	Mid-Column	36.78	2.06	8.24	7.90	191	18.2
BC-S-03	Bottom	26.74	2.23	9.01	8.06	197	21.1
	Mid-Column	37.02	1.64	8.32	7.93	218	18.1
BC-S-04	Bottom	25.42	1.81	9.10	8.00	216	21.3
	Mid-Column	36.04	4.67	8.18	7.86	239	18.0

Notes:

1. Water quality data collected during aquatic surveys performed on June 18, 2024.

Acronyms:

°C = degrees Celsius	mV = millivolts
BC = benthic community	NTU = Nephelometric Turbidity Units
MBH = Middle Bulkhead	ORP = Oxidative Reduction Potential
mg/L = milligrams per liter	R = Reference Location
mS/cm = milliSiemens per centimeter	S = Site Location

Table 5. Otter Trawl Survey Results
Hudson Tunnel Project
Low Cover Area Pre-Construction Monitoring Report
Gateway Development Commission

Location (Area):	Site (Between 1 & 2)	Site (Between 2 & 3)	Site (Between 3 & 4)	Upstream Reference (Inside)	Upstream Reference (Outside)	Downstream Reference (Inside)	Downstream Reference (Outside)	All Locations
Marine Life Species: Common Name (Scientific Name)	Count	Count	Count	Count	Count	Count	Count	Count
Bay anchovy (<i>Anchoa mitchilli</i>)	1	--	6	--	1	1	--	9
Black sea bass (<i>Centropristis striata</i>)	1	--	--	--	--	--	--	1
Clearnose skate (<i>Raja eglanteria</i>)	1	--	--	--	1	--	--	2
Hogchoker (<i>Trinectes maculatus</i>)	1	1	--	--	3	2	11	18
Northern sea robin (<i>Prionotus carolinus</i>)	--	--	--	1	1	--	1	3
Oyster toadfish (<i>Opsanus tau</i>)	--	--	5	1	4	--	2	12
Spotted hake (<i>Urophycis regia</i>)	--	1	--	1	1	--	1	4
Striped bass (<i>Morone saxatilis</i>)	--	--	--	--	1	--	--	1
Tomcod (<i>Microgadus proximus</i>)	35	54	11	5	1	2	63	171
Weakfish (<i>Cynoscion regalis</i>)	--	--	--	--	--	1	--	1
White perch (<i>Morone americana</i>)	--	--	--	1	--	--	--	1
Blue crab (<i>Callinectes sapidus</i>)	--	1	--	--	1	--	1	3
Jellyfish ² (<i>Ctenophora</i>)	Many	Many	Many	Many	Many	Many	Many	Many
Sand shrimp (<i>Crangon septemspinosa</i>)	28	55	24	28	74	29	49	287
Hermit crab (<i>Pagurus bernhardus</i>)	--	1	--	--	1	--	--	2
Longfin squid (<i>Pandalus borealis</i>)	1	--	--	--	--	--	--	1
Oyster crab (<i>Zaops ostreus</i>)	--	--	--	--	--	--	1	1
Total Count of Fish	39	56	22	9	13	6	78	223
Total Fish Taxa	5	3	3	5	8	4	5	11
Total Count of Invertebrates	29	57	24	28	76	29	51	294
Total Invertebrate Taxa	3	4	2	2	4	2	4	6
Total Organisms	68	113	46	37	89	35	129	517
Total Taxa	8	7	5	7	12	6	9	17

Notes:

1. Otter trawl surveys performed on June 19, 2024.
2. Jellyfish were not individually counted

FIGURES

Creator: NCozman, Last Saved: 1/13/2025 2:29 PM
 Location: T. Epp/ Gateway Hudson Tunnel New York, State MxD (Point, Water, Eco, Survey, arxiv/Figure 1 - Overview)
 Disclaimer: The information shown in this map was assembled from GIS data created and/or acquired by Arcadis. The data is not to survey accuracy and is meant for planning and visualization purposes only.

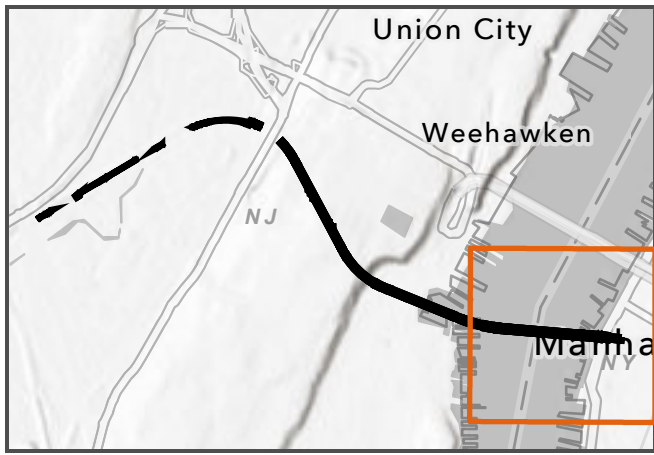
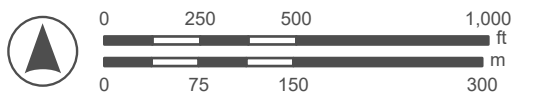


FIGURE 1
LOW COVER AREA
 Gateway Development Commission
 New York County, NY

- Legend**
- Federal Navigation Channel
 - HTP Alignment
 - 12th Avenue Shaft
 - Low Cover Area



GATEWAY DEVELOPMENT COMMISSION

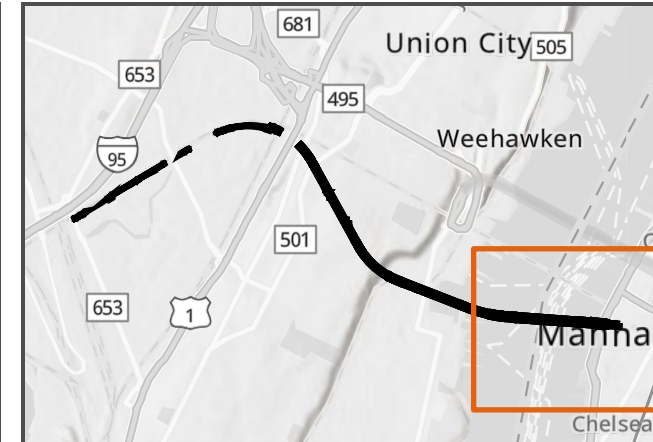
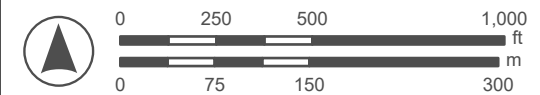


FIGURE 2
RIVER MONITORING LOCATIONS
 Gateway Development Commission
 New York County, NY

Legend

- Benthic Macroinvertebrate Monitoring Location
- Approximate Fish Trawling Location



GATEWAY DEVELOPMENT COMMISSION

Creator: Noohman, Last Saved: 1/13/2025 2:38 PM
 Location: T:\EPP\Gateway\Hudson_Tunnel\New_York_Side\MXD\Pool\Water_Eco_Survey.aprx\Figure 2 - River Monitoring Locations
 Disclaimer: The information shown in this map was assembled from GIS data created and/or acquired by Arcadis. The data is not to survey accuracy and is meant for planning and visualization purposes only.