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New York District

Shore Based Measures Sub-Appendix

Annex A – Flood Maps (FWOP and FWP)

DRAFT

New York – New Jersey Harbor and Tributaries Coastal Storm Risk Management Feasibility Study

Annex B1.A

September 2022

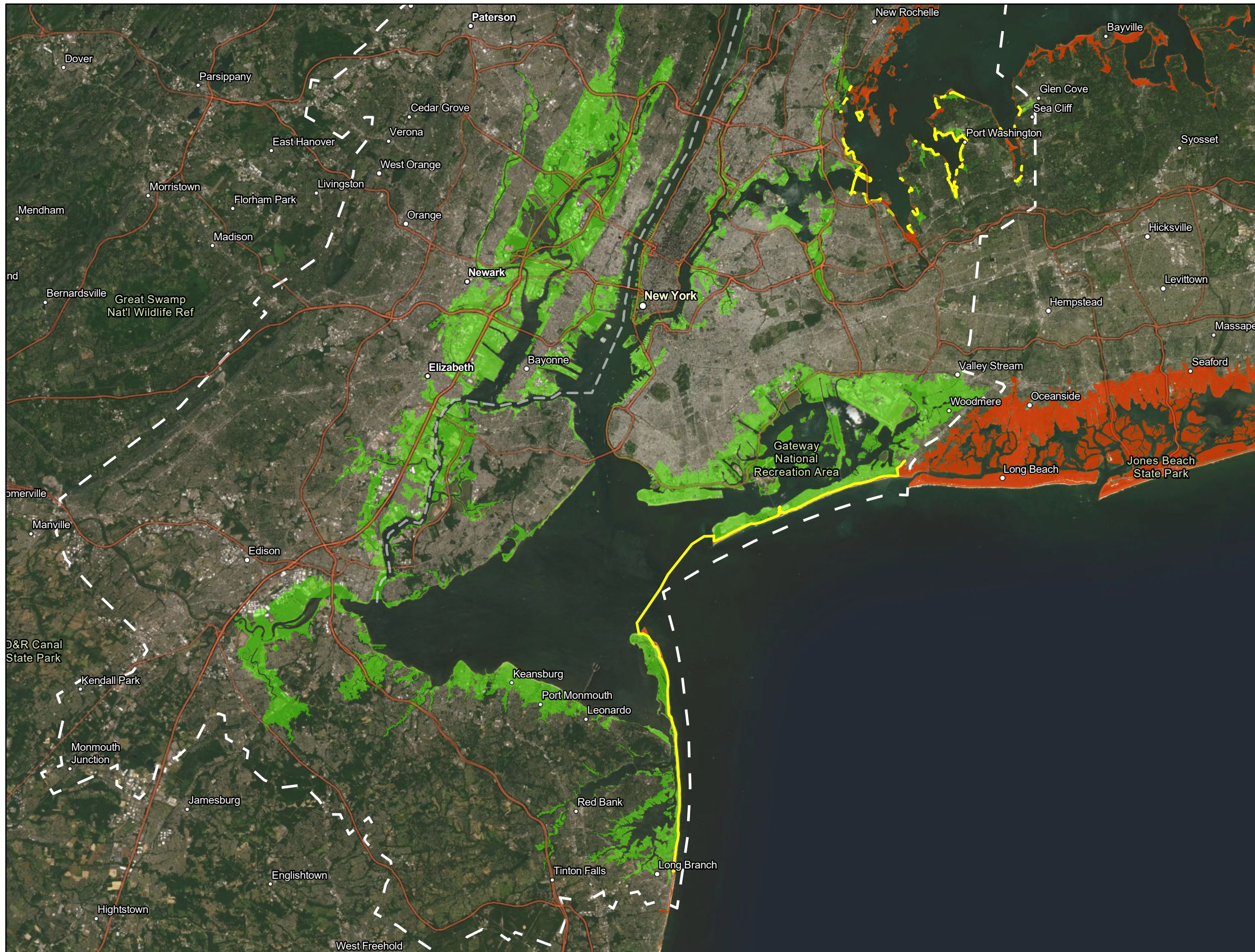
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A. Flood Extents

Flood extents were created for the 1% AEP conditions (100-year return period storm conditions) including sea level rise from 1992 to 2095. The flooding extents together with the project alignments per alternative are shown in the following attachments added to this annex:

- Flooding extents for alternative 2 with and without project conditions
- Flooding extents for alternative 3A with and without project conditions
- Flooding extents for alternative 3B with and without project conditions
- Flooding extents for alternative 4 with and without project conditions
- Flooding extents for alternative 5 with and without project conditions



Legend

- Alternative 2 - SSB/SBM and IFF's
- Study Area
- Reduced Risk Area with Project Alt2
- 100-year (w/ Int SLR)
- Future with Project Alt2 Flood Extent

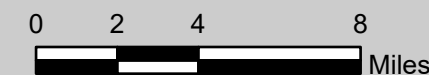
Sources:

World Imagery:
 Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Reference Map:
 Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Coordinate System:
 NAD83 StatePlane New York Long Island FIPS 3104 Feet

Scale: 1:300,000



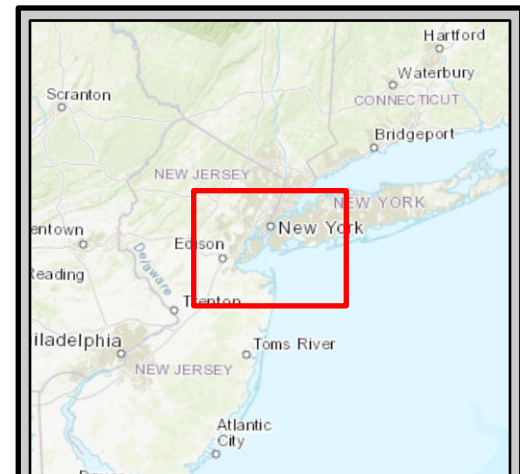
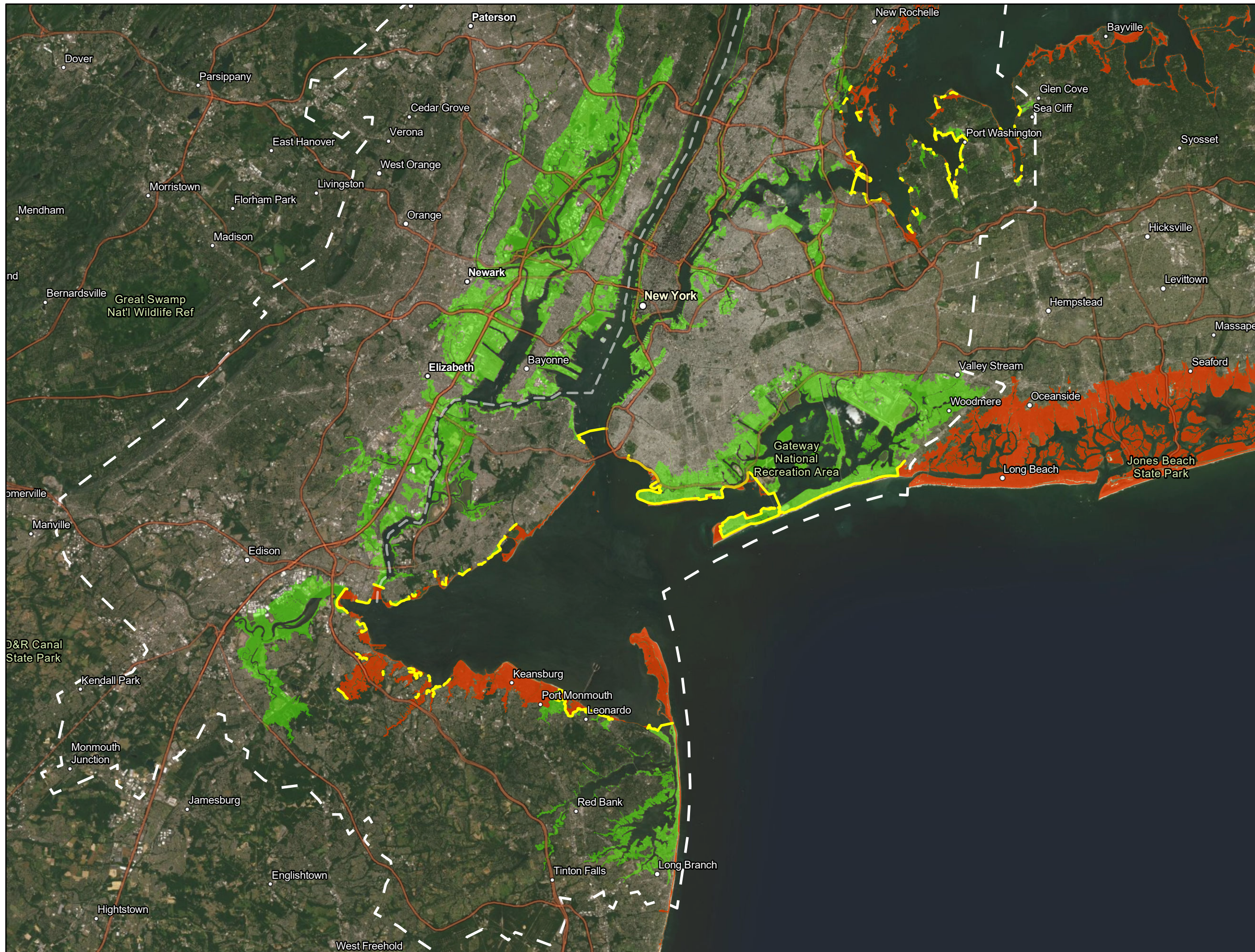
HARBOR AND TRIBUTARIES STUDY

**Alternative 2
 With and Without
 Project Flood Extents**

Date: 7/19/2022



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Legend

- SSB/SBM and IFF's
- Future with Project Alt3a Flood Extent
- Study Area
- Risk Reduced Area with Project Alt2

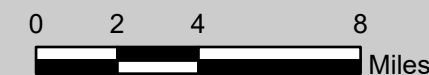
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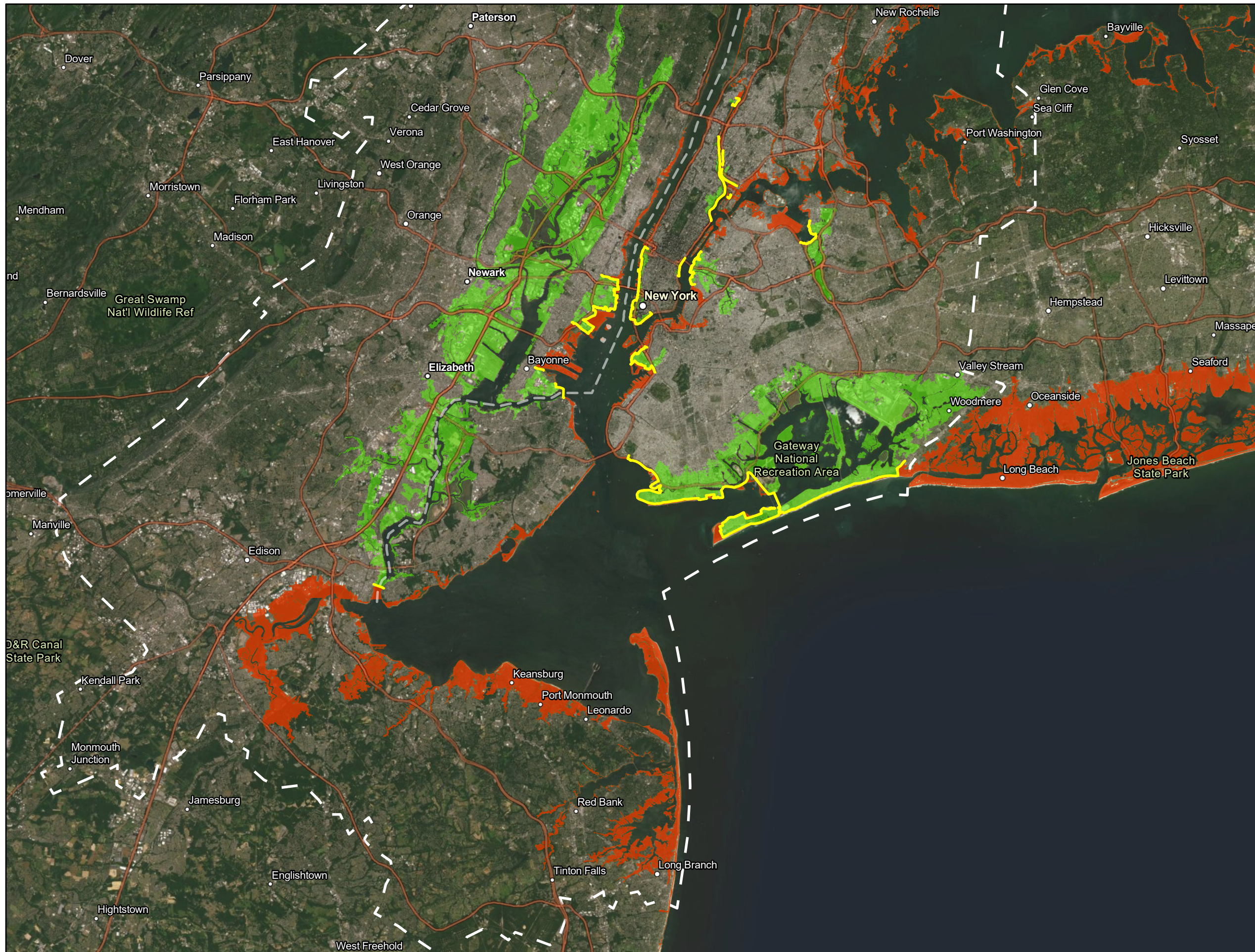
HARBOR AND TRIBUTARIES STUDY

**Alternative 3a
 With and Without
 Project Flood Extents**






Date: 7/19/2022



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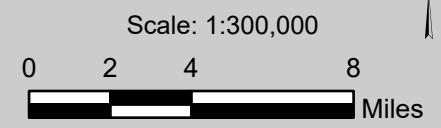
Legend

-  - SSB/SBM and IFF's
-  Future with Project Alt3b Flood Extent
-  Study Area
-  Reduced Risk Area with Project Alt3b
-  100-year (w/ Int SLR)

Sources:
 World Imagery:
 Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Reference Map:
 Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Coordinate System:
 NAD83 StatePlane New York Long Island FIPS 3104 Feet



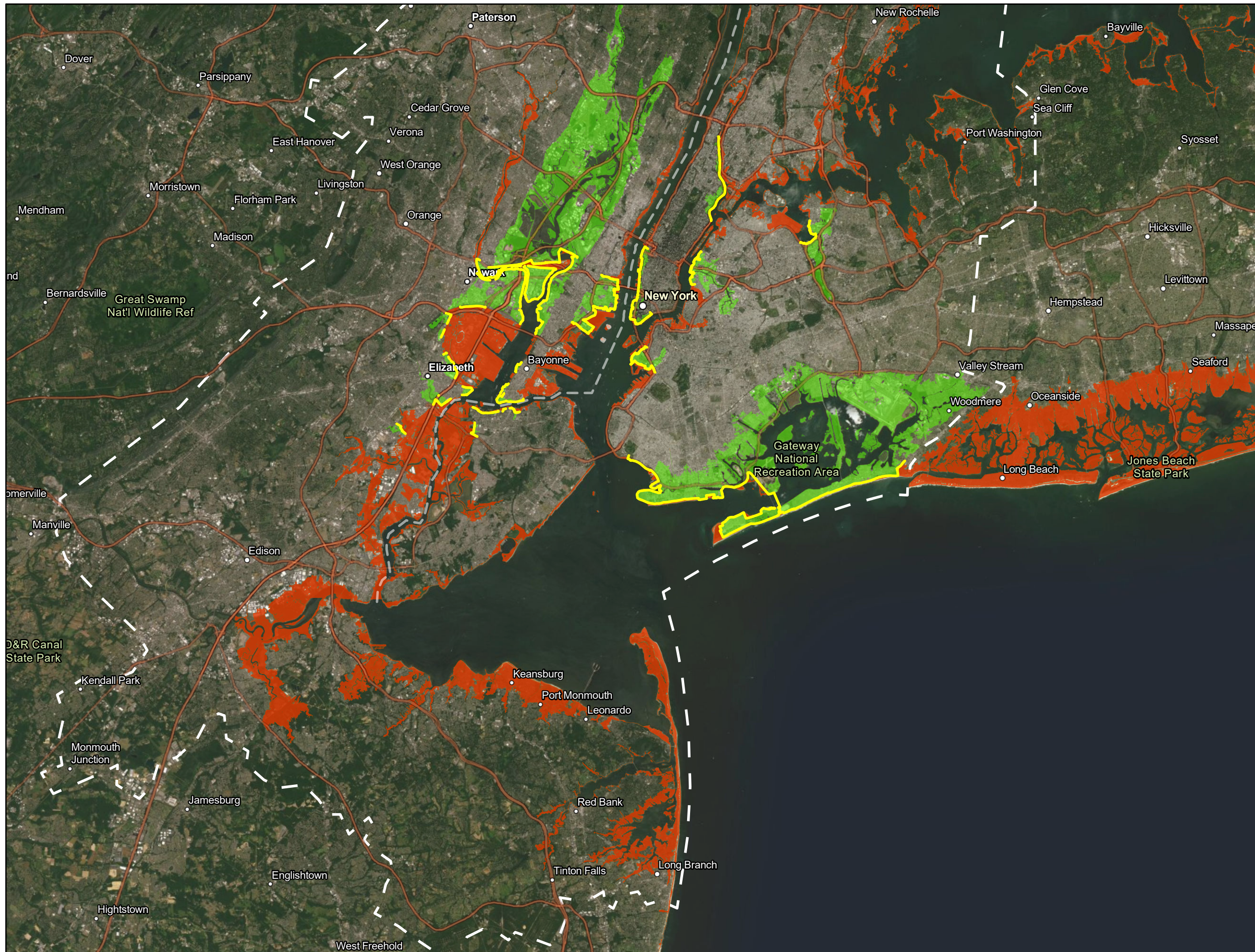
HARBOR AND TRIBUTARIES STUDY

**Alternative 3b
 With and Without
 Project Flood Extents**

Date: 7/19/2022



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Legend

- Alternative 4 - SBM and IFF's
- Study Area
- Reduced Risk Area with Project Alt4
- 100-year (w/ Int SLR) Future with Project Alt4 Flood Extent

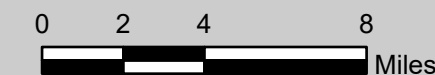
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World Imagery:
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Reference Map:
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Coordinate System:
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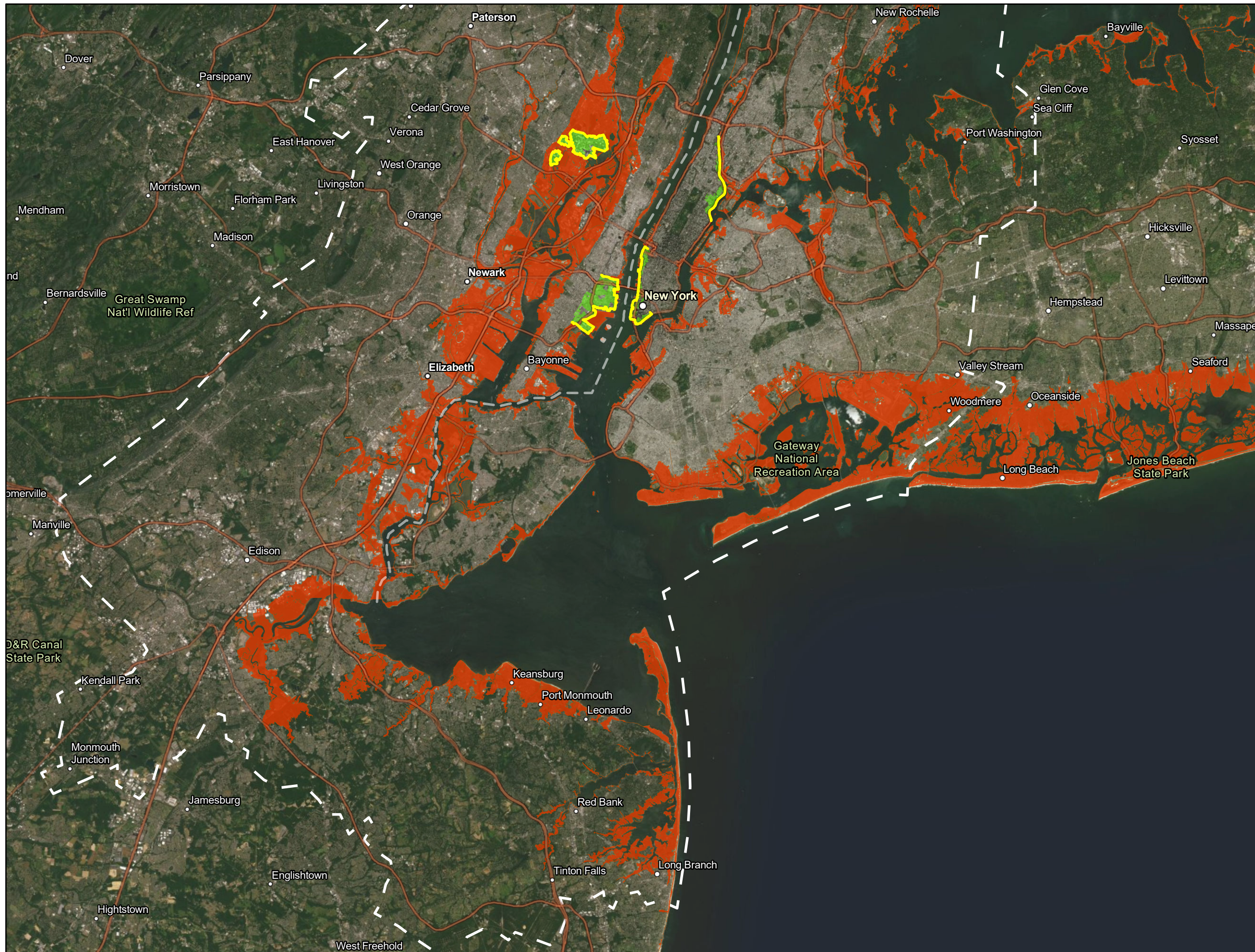
HARBOR AND TRIBUTARIES STUDY

**Alternative 4
 With and Without
 Project Flood Extents**

Date: 7/19/2022



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Legend

- Alternative 5 - SBM's
- Study Area
- 100-year (w/ Int SLR) Future with Project Alt5 Flood Extent
- Reduced Risk Area with Project Alt5

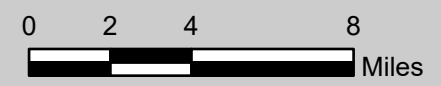
Sources:

World Imagery:
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 NAD83 StatePlane New York Long Island FIPS 3104 Feet

Scale: 1:300,000



HARBOR AND TRIBUTARIES STUDY

**Alternative 5
 With and Without
 Project Flood Extents**

Date: 7/19/2022



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Shore Based Measures Sub-Appendix

Annex B – Induced Flooding Analysis and Induced Flooding Maps

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New York – New Jersey Harbor and Tributaries Coastal Storm Risk Management Feasibility Study

Annex B1.B

September 2022

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B. Induced Flooding

Induced flooding in context of this study is referred to as increase in flood levels resulting from the proposed project. For example, the presence of a structural measure acting as an effective impediment to the storm surge (e.g., storm surge barriers) as part of a HAT study alternative can cause peak storm surge levels on the ocean side of the storm surge barriers to go up marginally compared to the conditions without the storm surge barrier being present.

Advanced Circulation (ADCIRC) model simulations were performed by USACE to investigate still water levels with the project alternatives in place. Out of the 1050 synthetic tropical storms developed for the NACCS, 20 storms were selected for use as proxy storms for representing the annual exceedance probabilities curves for water levels within the study area. The simulations result in water levels at various output point locations across the study area. Stage frequency statistics were produced by ERDC for each modeled project alternative. A detailed description of the ADCIRC simulations is provided in the *ERDC ADCIRC model report Sub-Appendix*. The data sets generated allowed to establish the differences in the 1% AEP Still Water Level throughout the study area with and without project. The ADCIRC output data was provided at a select set of output locations throughout the study area. The water level differences are provided as dot-plots in which each dot represents the water level change between with and without project conditions at the selected NACCS output points, and as linear interpolations in between the output points for the areas in which induced flooding was identified to show induced flooding extents for elevations smaller than 0.47ft, between 0.47-0.5ft and above 0.5 ft. These induced flooding extents together with the project alignments per alternative as well as the 1% AEP Water Levels in 2095 for comparison are shown in the following attachments added to this annex:

- 1% AEP Water Level in 2095 – Future Without Project (Section B.1)
- Induced Flooding Extents for Alternative 2 (Section B.2)
- Induced Flooding Extents for Alternative 3A (Section B.3)
- Induced Flooding Extents for Alternative 3B (Section B.4)
- Induced Flooding Extents for Alternative 4 (Section B.5)

B.1 1% AEP Water Levels in 2095 (Future Without Project)

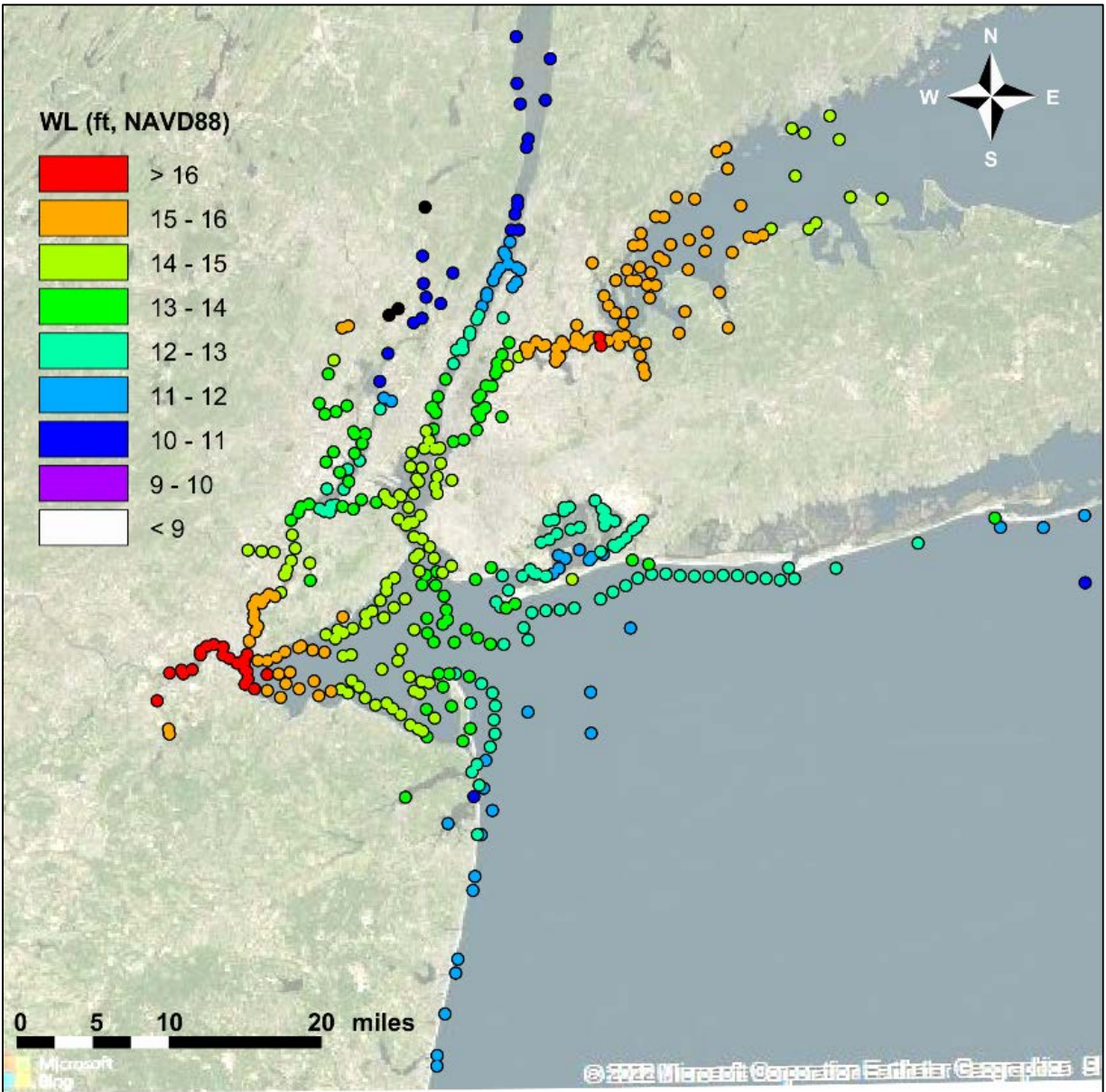


Figure B-1: 1% AEP Water Level in 2095 (50% Confidence Limit) – Future Without Project (FWOP)

B.2 Induced Flooding Extents for Alternative 2

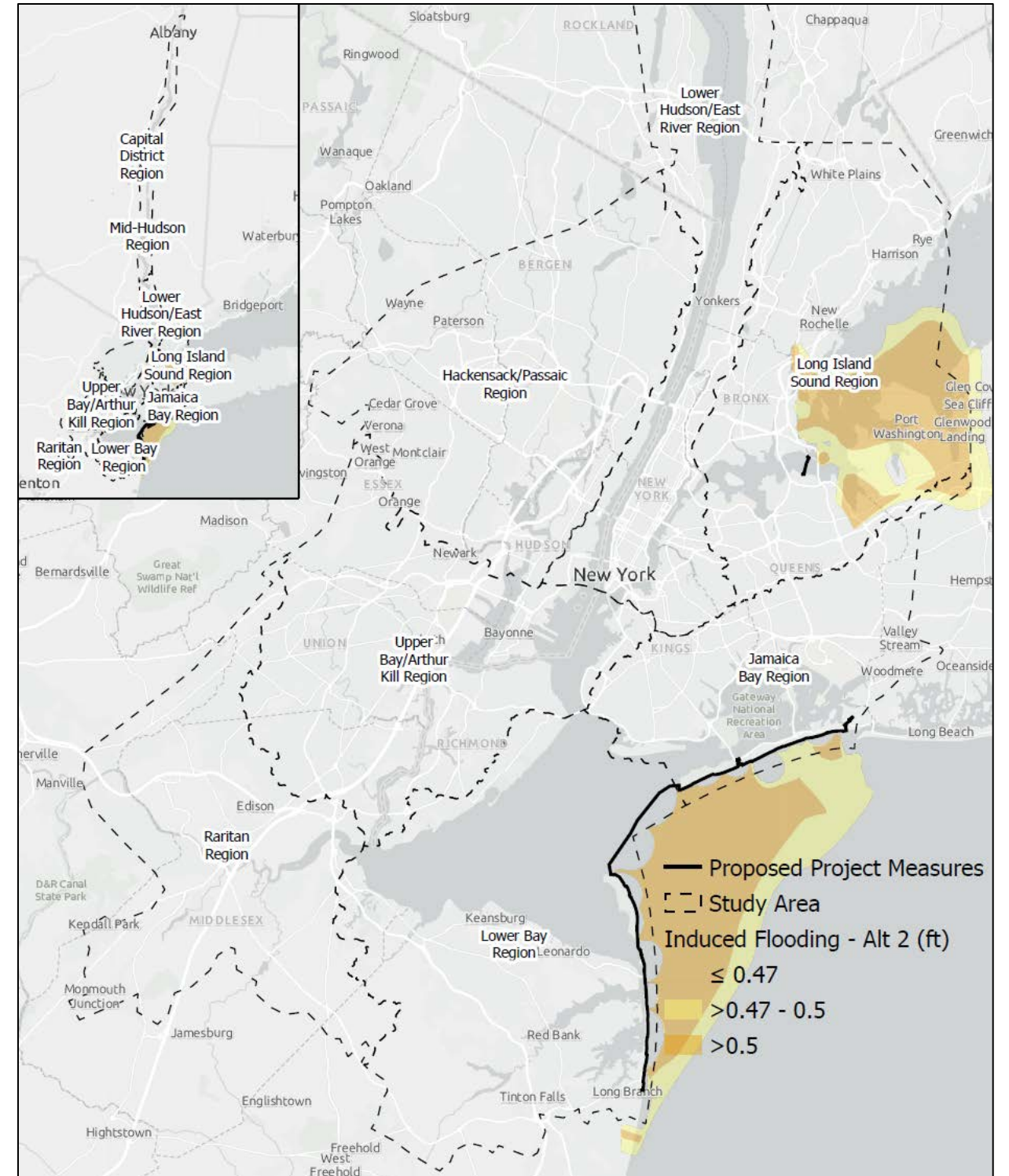
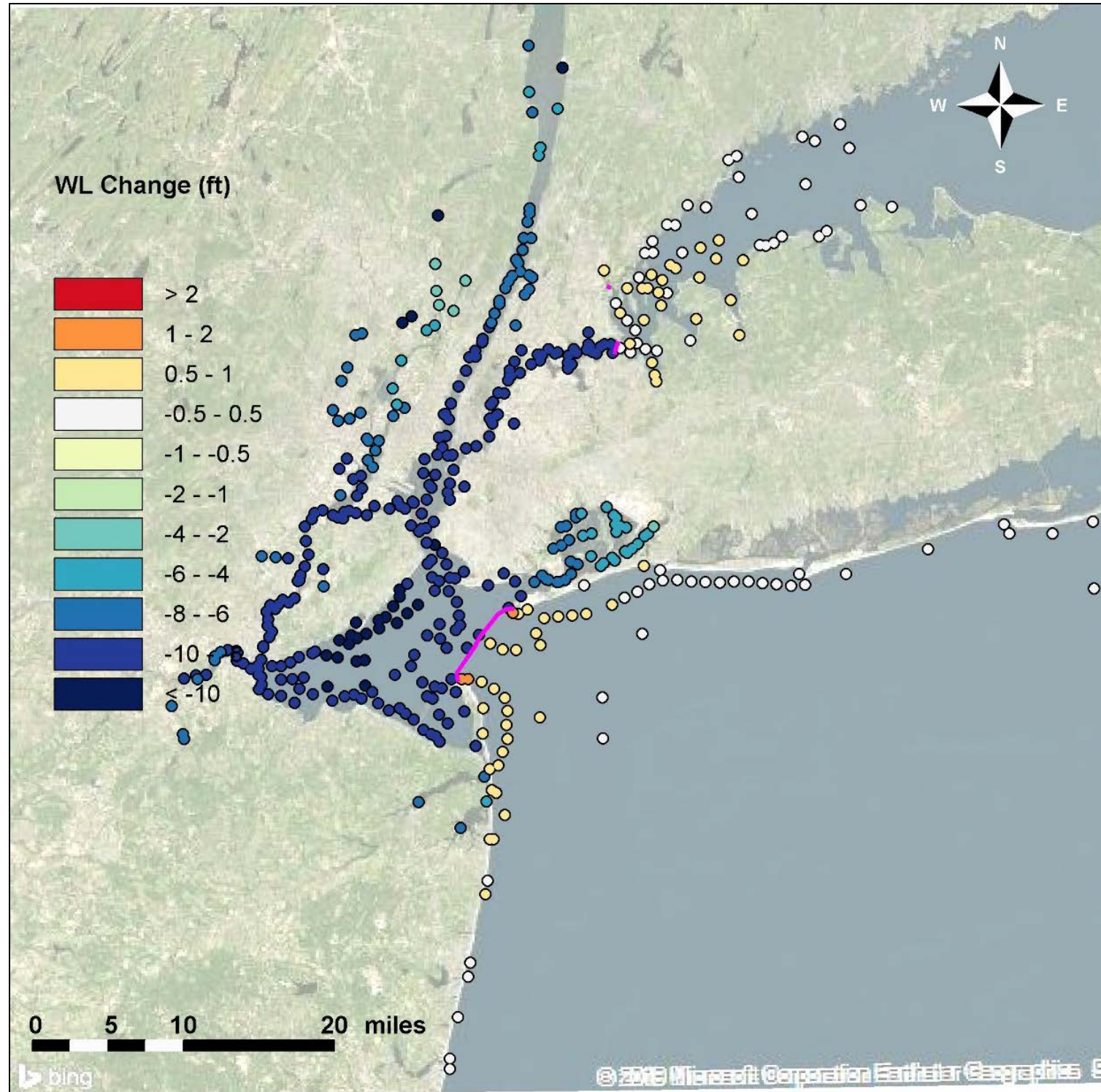


Figure B-2: Change in 1% AEP Water Level from FWOP to Alternative 2 (Left: Values at NACCS Output Points, Right: Linear Interpolation at Points where Induced Flooding is Expected to Occur)

B.3 Induced Flooding Extents for Alternative 3A

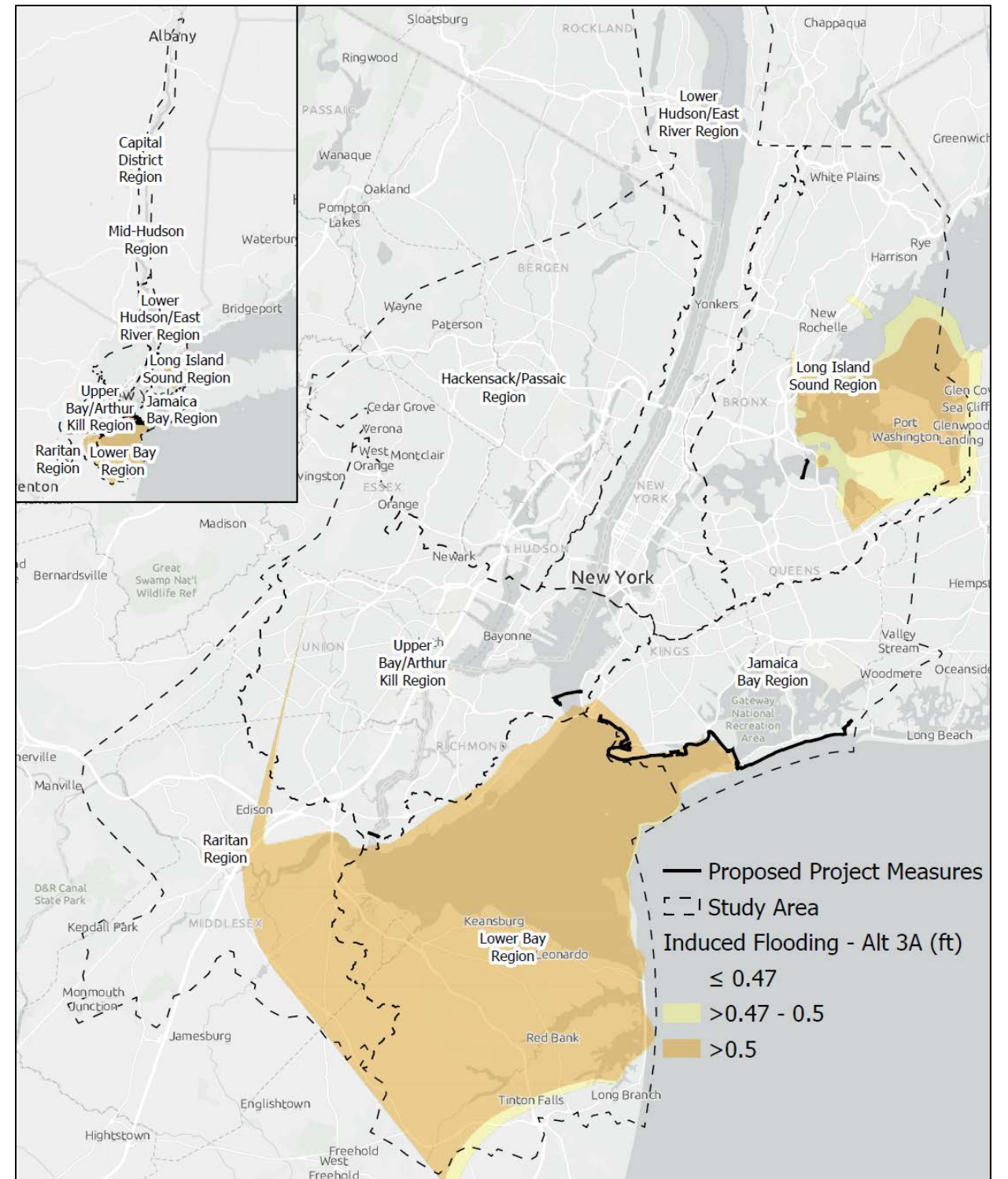
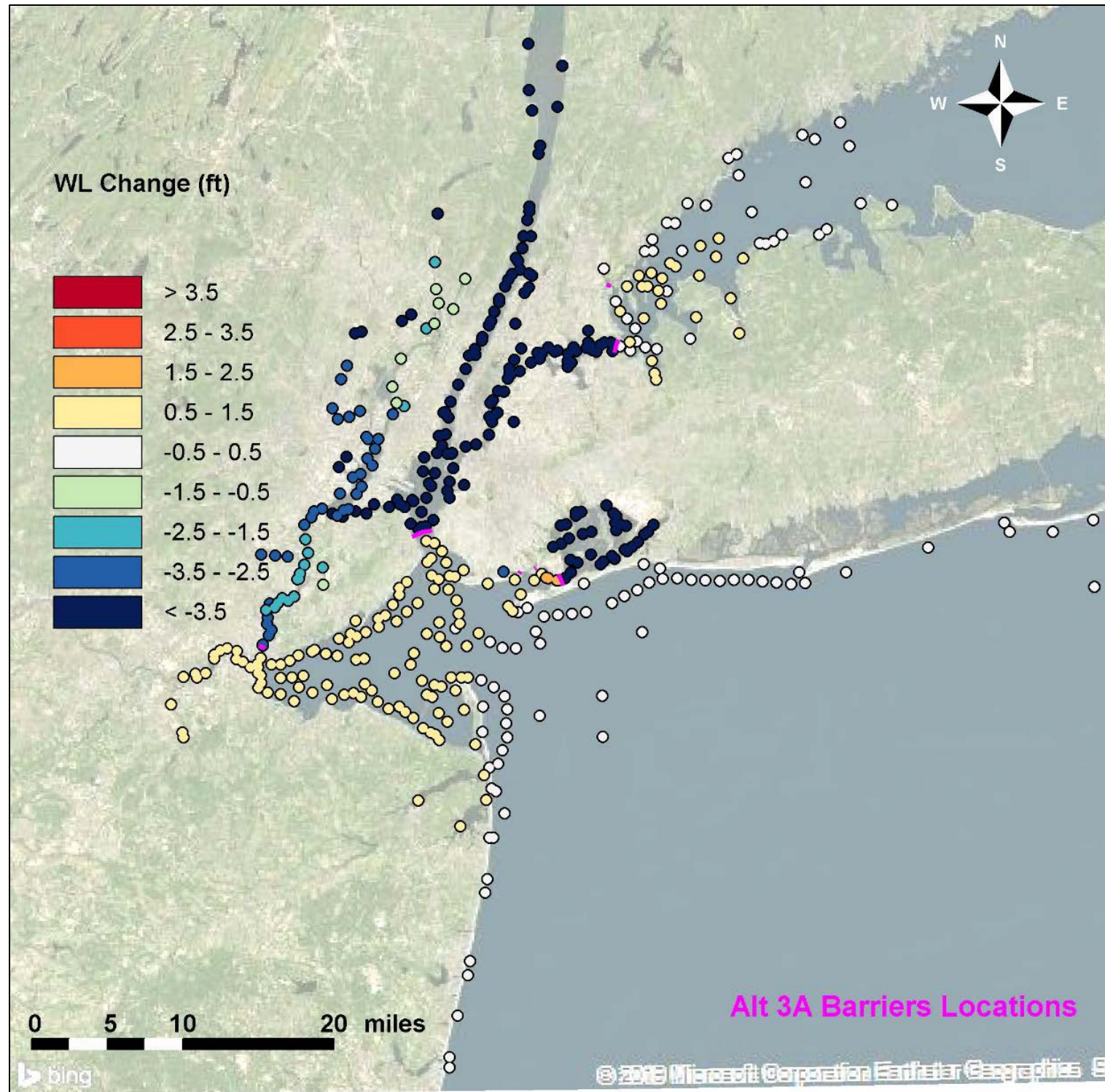


Figure B-3: Change in 1% AEP Water Level from FWOP to Alternative 3A (Left: Values at NACCS Output Points, Right: Linear Interpolation at Points where Induced Flooding is Expected to Occur)

B.4 Induced Flooding Extents for Alternative 3B

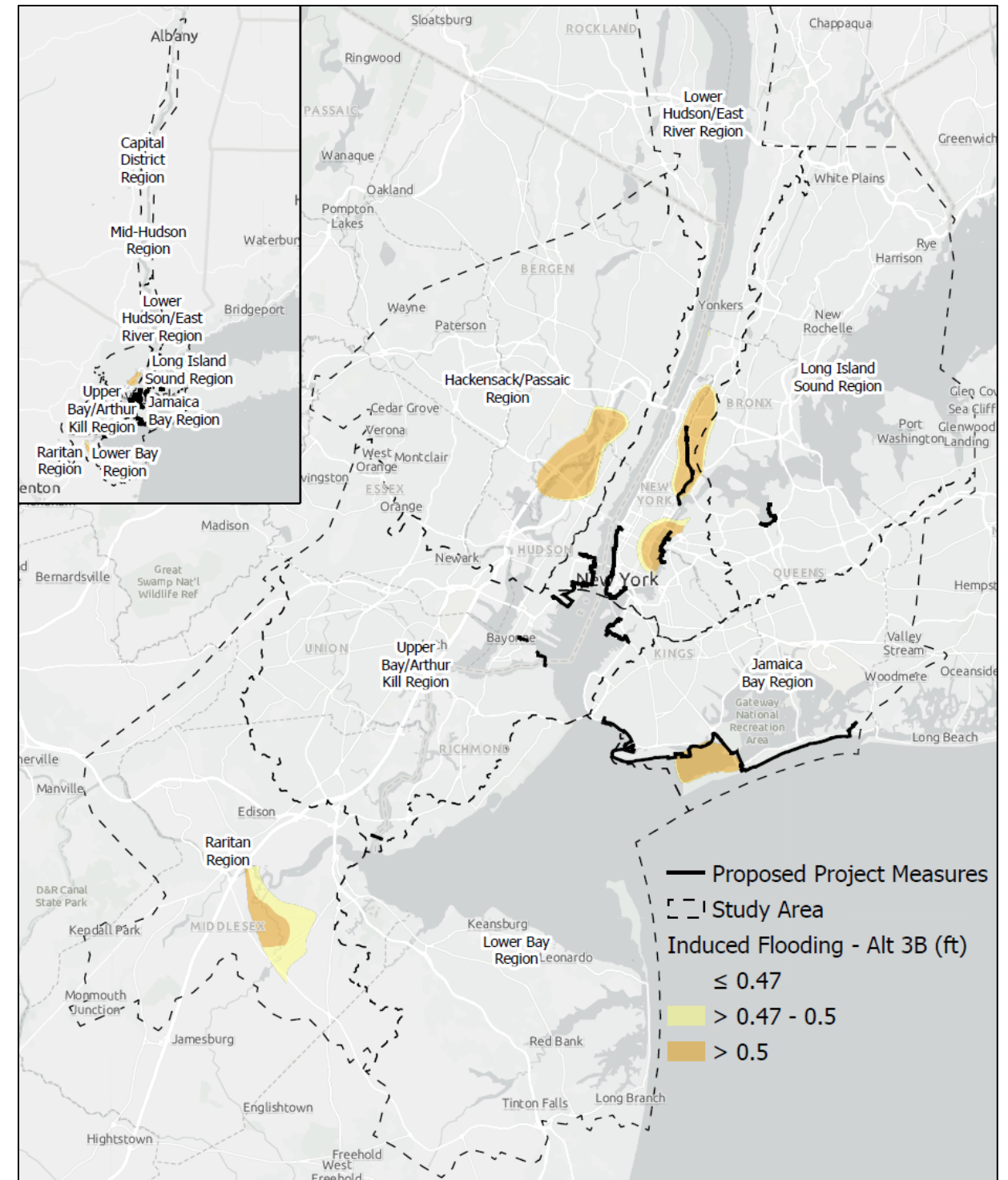
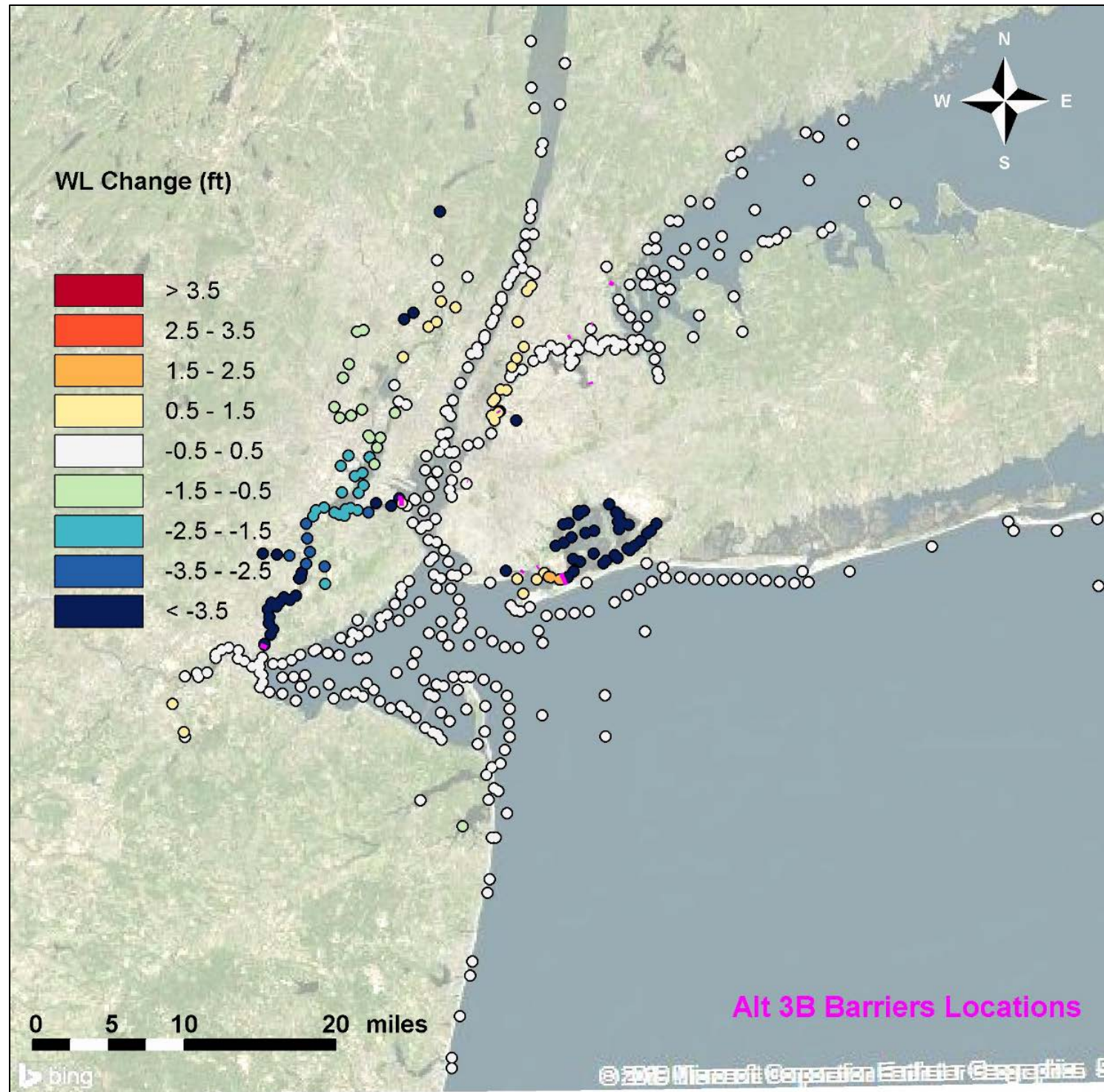


Figure B-4: Change in 1% AEP Water Level from FWOP to Alternative 3B (Left: Values at NACCS Output Points, Right: Linear Interpolation at Points where Induced Flooding is Expected to Occur)

B.5 Induced Flooding Extents for Alternative 4

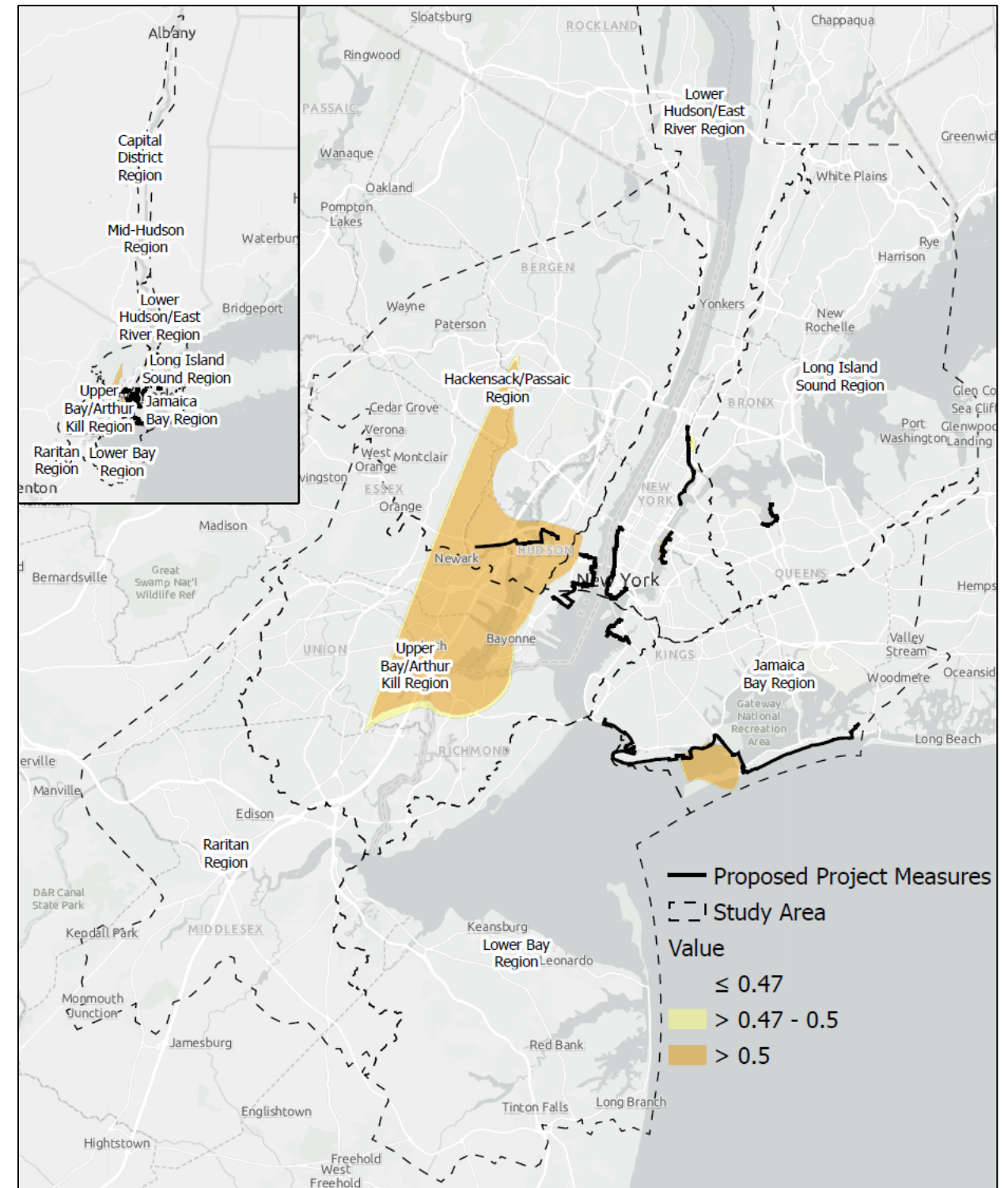
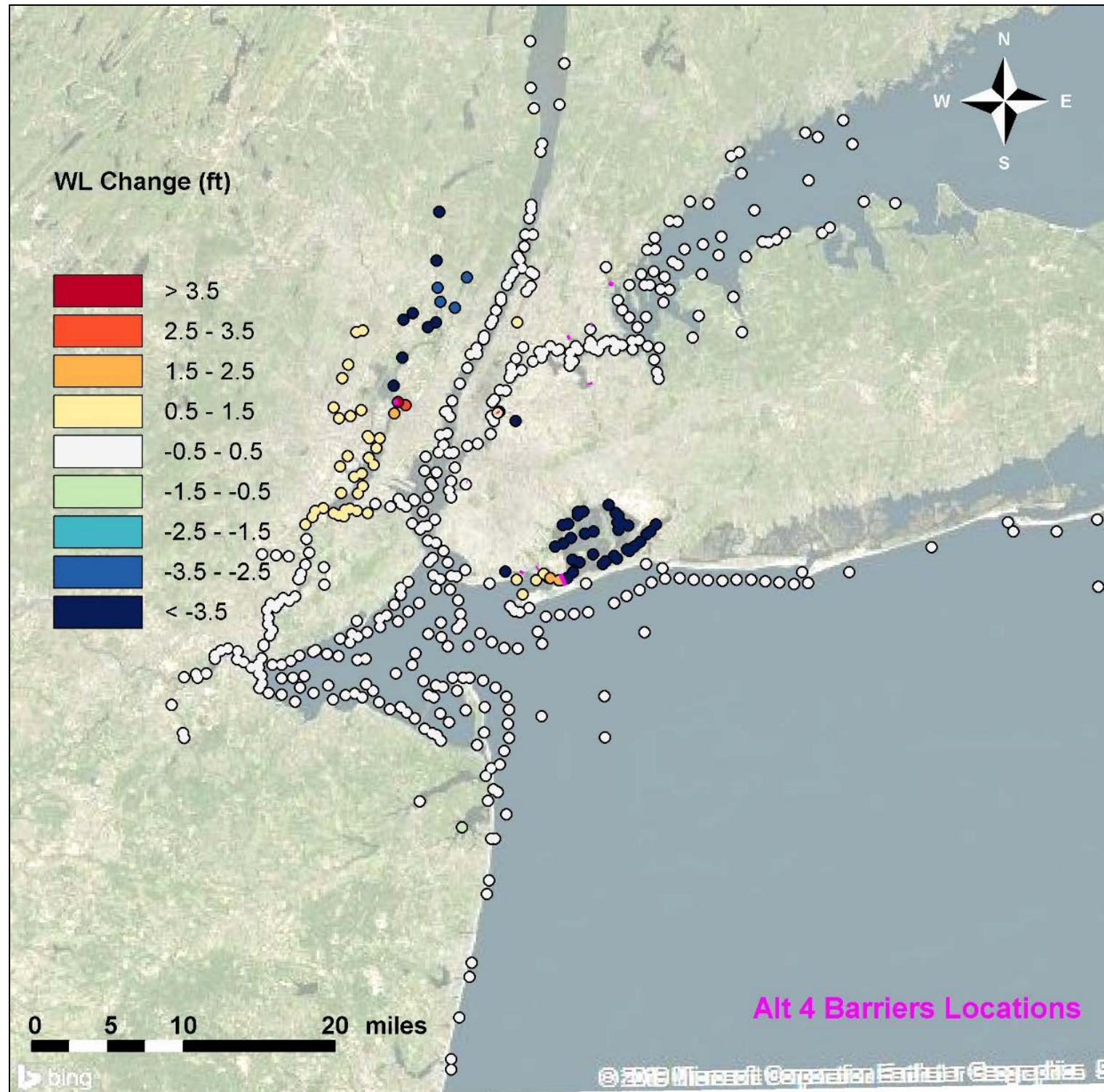


Figure B-5: Change in 1% AEP Water Level from FWOP to Alternative 4 (Left: Values at NACCS Output Points, Right: Linear Interpolation at Points where Induced Flooding is Expected to Occur)



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Shore Based Measures Sub-Appendix

Annex C – Wave Height Analysis

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New York – New Jersey Harbor and Tributaries Coastal Storm Risk Management Feasibility Study

Annex B1.C

September 2022

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C. Wave and Freeboard Analysis for Shore Based Measures	3
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C. WAVE AND FREEBOARD ANALYSIS FOR SHORE BASED MEASURES

The wave analysis, and analysis to determine the required functional freeboard for the Shore Based Measures (SBMs) for HATS is described in this appendix. This analysis was originally performed for the SBM alignments delineated as part of the land-based Coastal Storm Risk Management (CSRМ) study interim report for HATS in 2019. The present positions of the SBM alignments include some minor updates at a couple of locations following subsequent stakeholder comments and review. However, given the magnitude of these updates and the scale of this study, the underlying inputs and assumptions (for water-levels, wave-heights etc.) for the individual measures are expected to still remain valid. Regardless of this difference, the computed freeboards for the individual SBMs as described below for the interim study are applied to the current version of the SBM alignments.

An allowable overtopping threshold of 0.0108 cubic foot per second per foot (cfs/ft) or 1 liter per second per meter (l/s/m) was adopted for all land-based structural features, with the exception of the composite seawall sections in the Rockaway peninsula (USACE, 2016). The 100-year (1% Annual Exceedance Probability) still water levels and wave conditions were used to inform the determination of the design freeboard for the individual project features. These input conditions were derived from the corresponding statistics obtained from the USACE (2015) North Atlantic Comprehensive Coastal Study (NACCS) database.

C1. North Atlantic Comprehensive Coastal Study

The wave-height annual exceedance statistics available from NACCS were used as the basis for the freeboard requirement for the Shore Based Measures to meet the functional design criteria, as well as to inform the structural basis of design. The modeling analysis conducted as part of NACCS consisted of the application of a suite of models including an offshore wave model (WAM) for simulation of deep-water waves, and a near-shore steady state wave model STWAVE using WAM results for boundary conditions. The STWAVE model for near-shore waves also allowed for simulation of local wind-generated waves, and was paired with the hydrodynamic circulation model ADCIRC to allow for dynamic interaction between surge and waves. A large set of tropical and extra-tropical storms were simulated using the NACCS modeling system to characterize the regional storm hazard by forming a database for computing the joint probability of coastal storm forcing parameters for the U.S. North Atlantic Coast. The high-frequency outputs and statistical products including Average Recurrence Intervals (ARIs) from the modeling are publicly archived for a relatively small number of 18,000 ‘Save Points’.

The expected significant wave-heights for the 100-year ARI were extracted from NACCS at available Save Points near the shoreline of the HATS study area. The expected wave-heights at the project features were estimated after accounting for the wave transformation that might occur between the NACCS Save Point close to the shoreline and the toe of the structure of the individual project features located on or landward of the shoreline using a simple 1-D wave model. This analysis is further elaborated in the following section

C2. Wave Conditions

The Simulation of Waves Nearshore (SWAN) model (Booij et al, 1996) was used to simulate the transformation of waves along 1-D transects from boundary points near NACCS save points to the corresponding project alignment features. The model as applied here accounts for the wave transformation over nearshore bathymetry due to shoaling, bottom-friction, and depth-induced

wave-breaking. The bathymetric data for the modeling was derived from high-resolution (1/9 arc seconds or 10 feet) resolution topo-bathy Digital Elevation Models (DEMs) developed by NOAA, post- Hurricane Sandy in 2012. The map of the DEM in the HATS Study Area is shown in Figure C-1. The expected significant wave heights for the 100-year return period (i.e., 1% AEP) were extracted from NACCS at several Save Points within New York Harbor and are shown in Figure C-2.

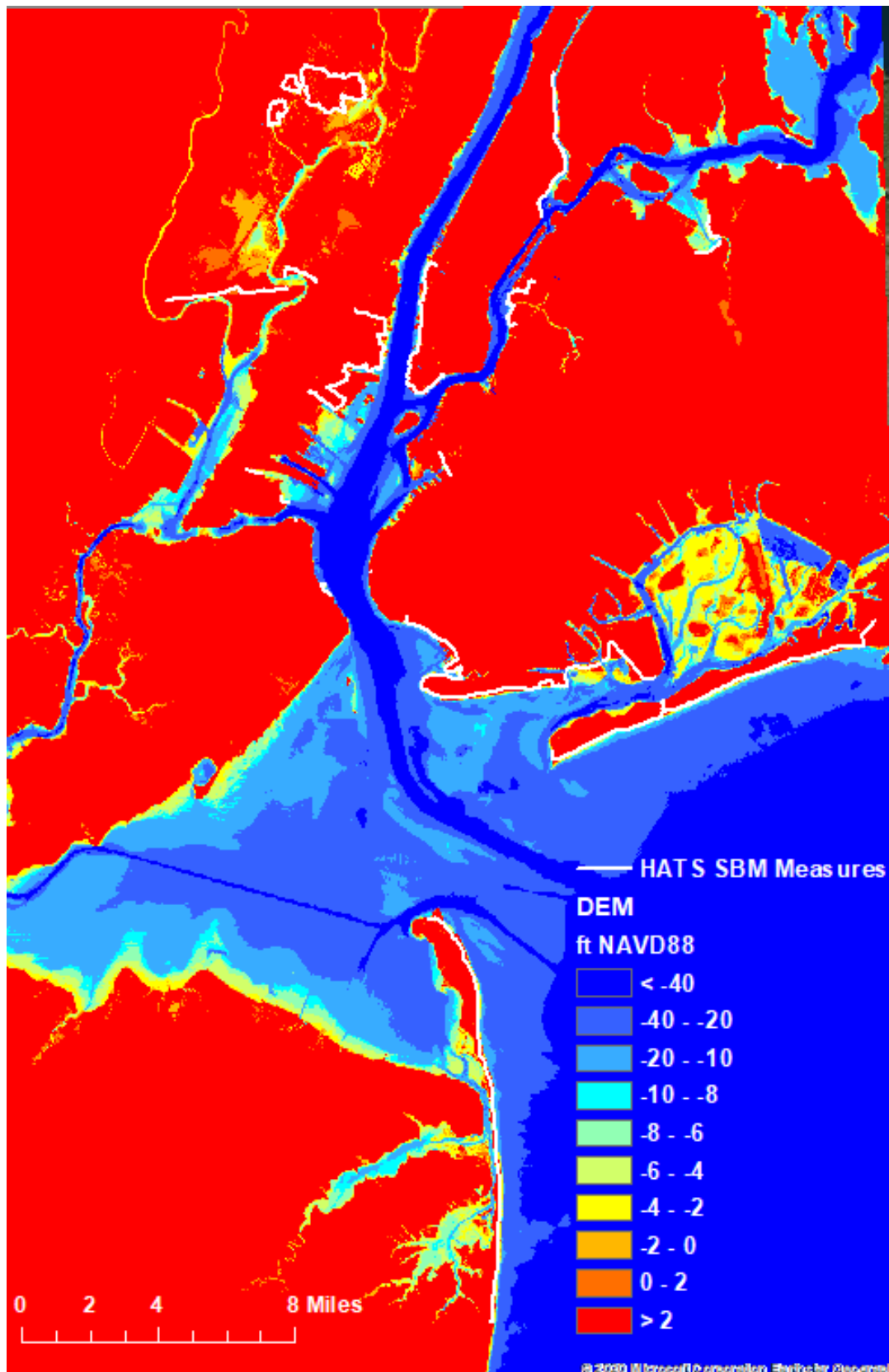


Figure C-1: NOAA High-resolution DEM in HATS Study Area

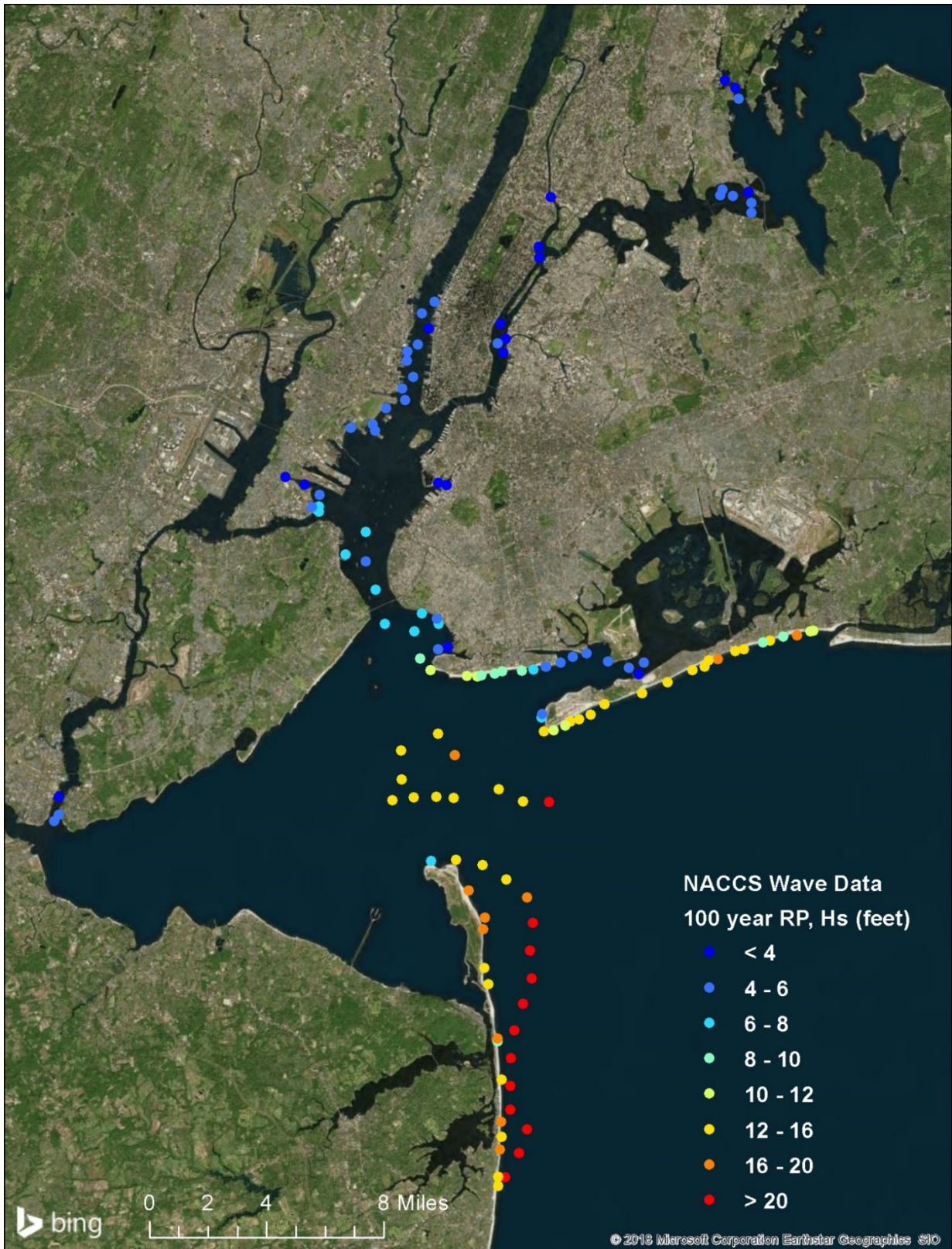


Figure C-2: 100-yr wave-heights extracted from NACCS model Save Points

C3. Modeling wave-heights for project features

Based on the available resolution of NACCS wave statistics across the study area, transects were drawn to model wave-transformation at several HATS locations using the 100-year return period (1% AEP) wave-height as boundary condition. Figure C-3 shows these transect locations with respect to the HATS alignments for the SBMs.

At each of these transects, the bottom elevation profile was extracted from the DEM every 6 feet to specify the model bathymetry. A model still-water elevation corresponding to the respective 100-year return period (1% AEP) Still Water-Level plus the Sea Level Rise (SLR) corresponding to the USACE intermediate projection was applied. A typical JONSWAP wave spectrum centered on the 100-year NACCS wave-height at the boundary point, and a corresponding peak wave-period according to typical fetch and depth limited wave growth (CERC, 1984) was assumed. The SWAN model was run in stationary mode, which means that the wave conditions within the 1-D model domain were allowed to evolve to a steady-state with the input conditions. The colors along the transects in Figure C-3 represent the magnitude of the simulated wave-heights.

The design wave-height at each HATS SBM alignment was updated using the simulated wave-height at the feature from the nearest model transect point. A map of the features denoting the updated wave-heights is shown in Figure C-4 and peak periods in Figure C-5. The corresponding required freeboards for the HATS SBMs were set using the overtopping criterion of one liter per second per meter.

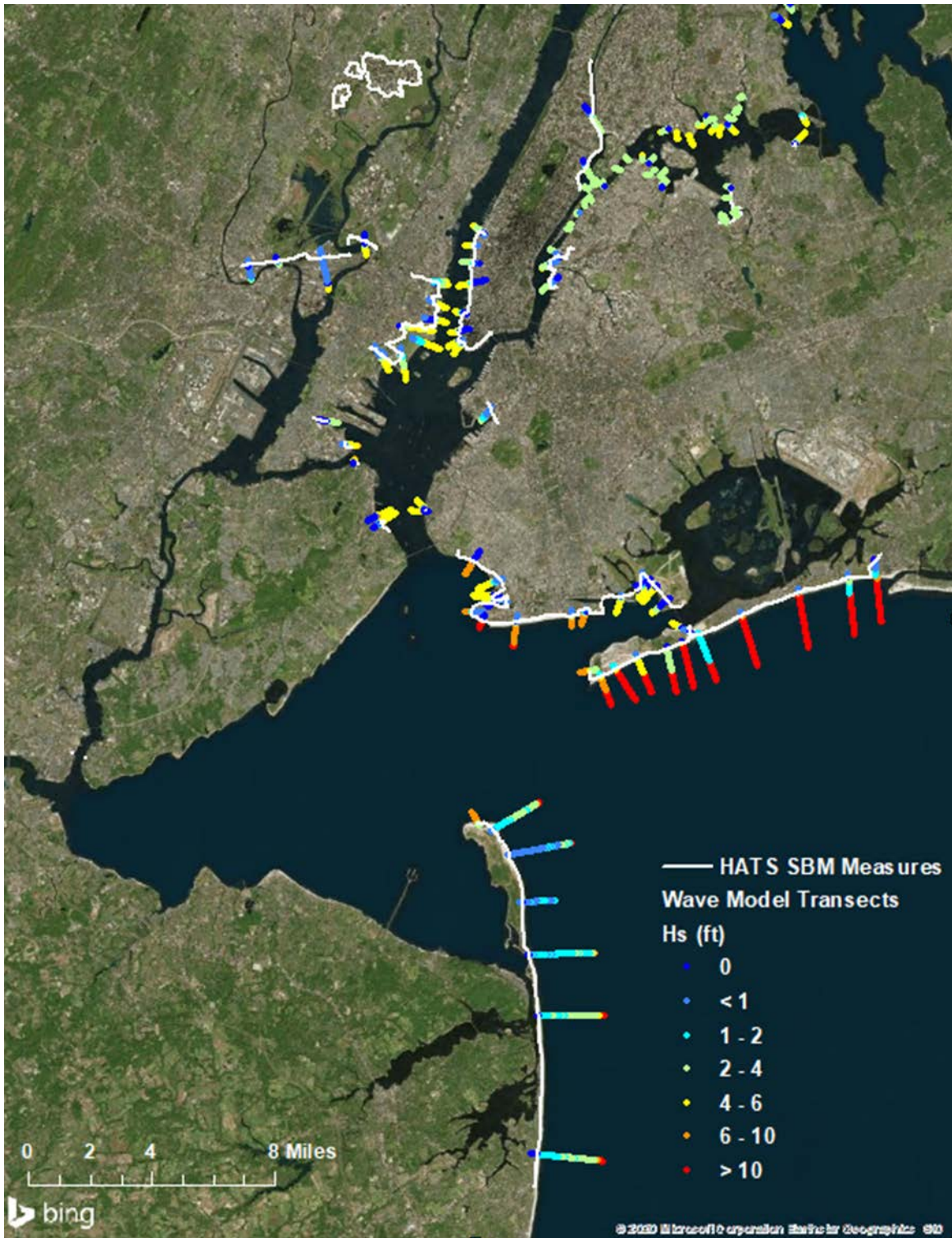


Figure C-3: 1-D wave model transects to estimate wave conditions at SBMs

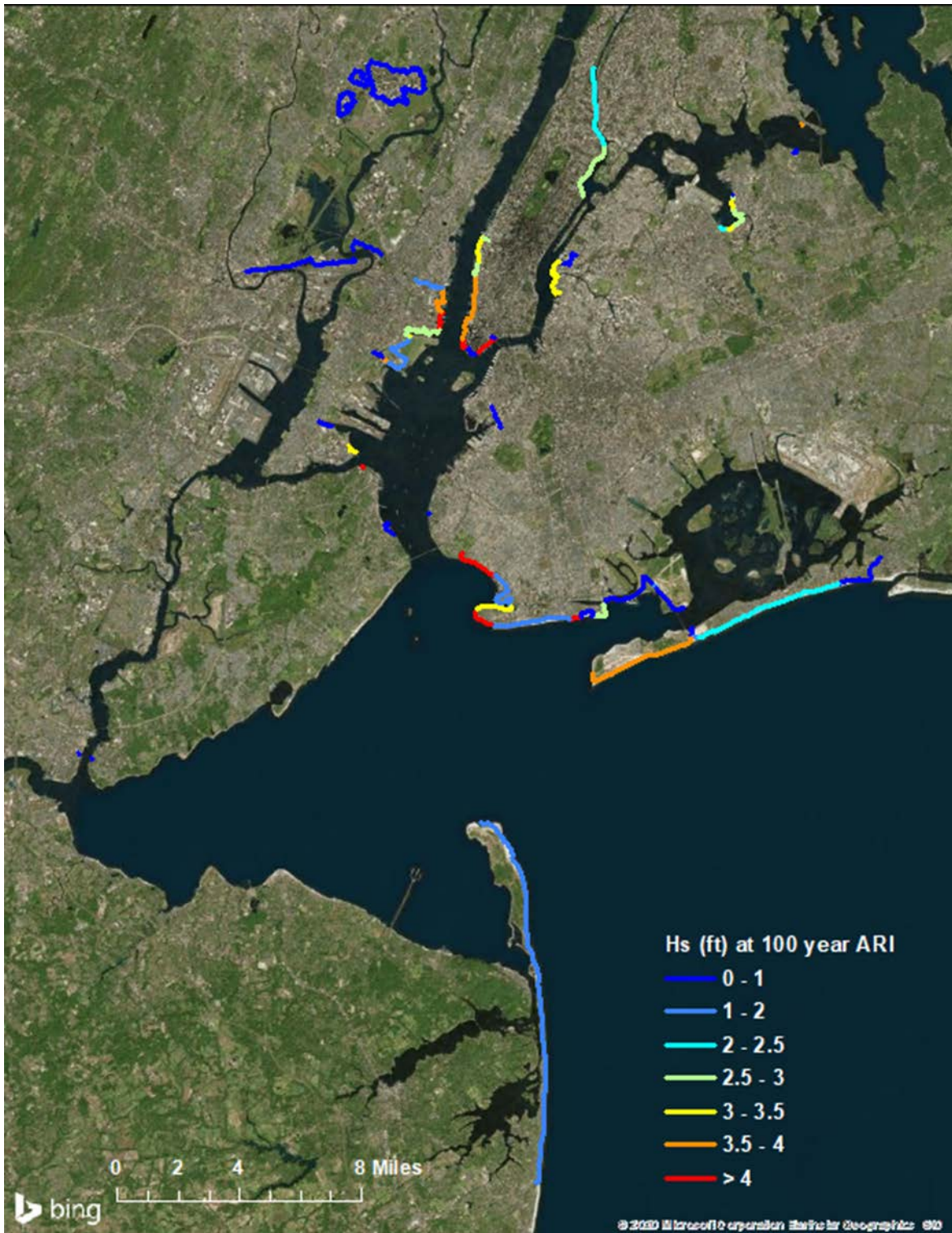


Figure C-4: Design wave-heights at HATS alignments



Figure C-5: Design peak-periods at HATS alignments

C4. Required Freeboard

The required freeboard for the SBM features were estimated based on a 1 liter per second per meter threshold at 90% statistical confidence limit. A probabilistic approach was applied using the

equations for overtopping from EurOtop II manual, which also specifies mean and standard deviation of overtopping coefficients. The freeboards for levees were calculated based on equations for sloping walls for floodwalls, while the freeboards for the remaining feature types were calculated using equations for vertical walls. The buried seawall/dune features along the Rockaway were ignored in the analysis as the design of those features is expected to be determined separately. Allowances were made for project features that are relatively sheltered or set back from the shoreline, and might thereby be less exposed to the bay, by assigning a minimum design freeboard of one (1) foot for such features.

The calculated freeboard was subsequently added to the still-water elevation corresponding to the respective 100-year ARI Still Water-Level plus the Sea Level Rise (SLR) based on the USACE intermediate projection for year 2095, to determine the SBM structure top elevations, which are shown in Figure C-6. Where this was exceeded by the future 500-year ARI Still Water Level with the same SLR (and no freeboard), the latter was used as the top of structure elevation. The ground elevations along the SBM features were analyzed from 2014 Lidar for New York City, and the typical ground elevation along each feature was subtracted from the top of structure elevation to determine expected feature heights.

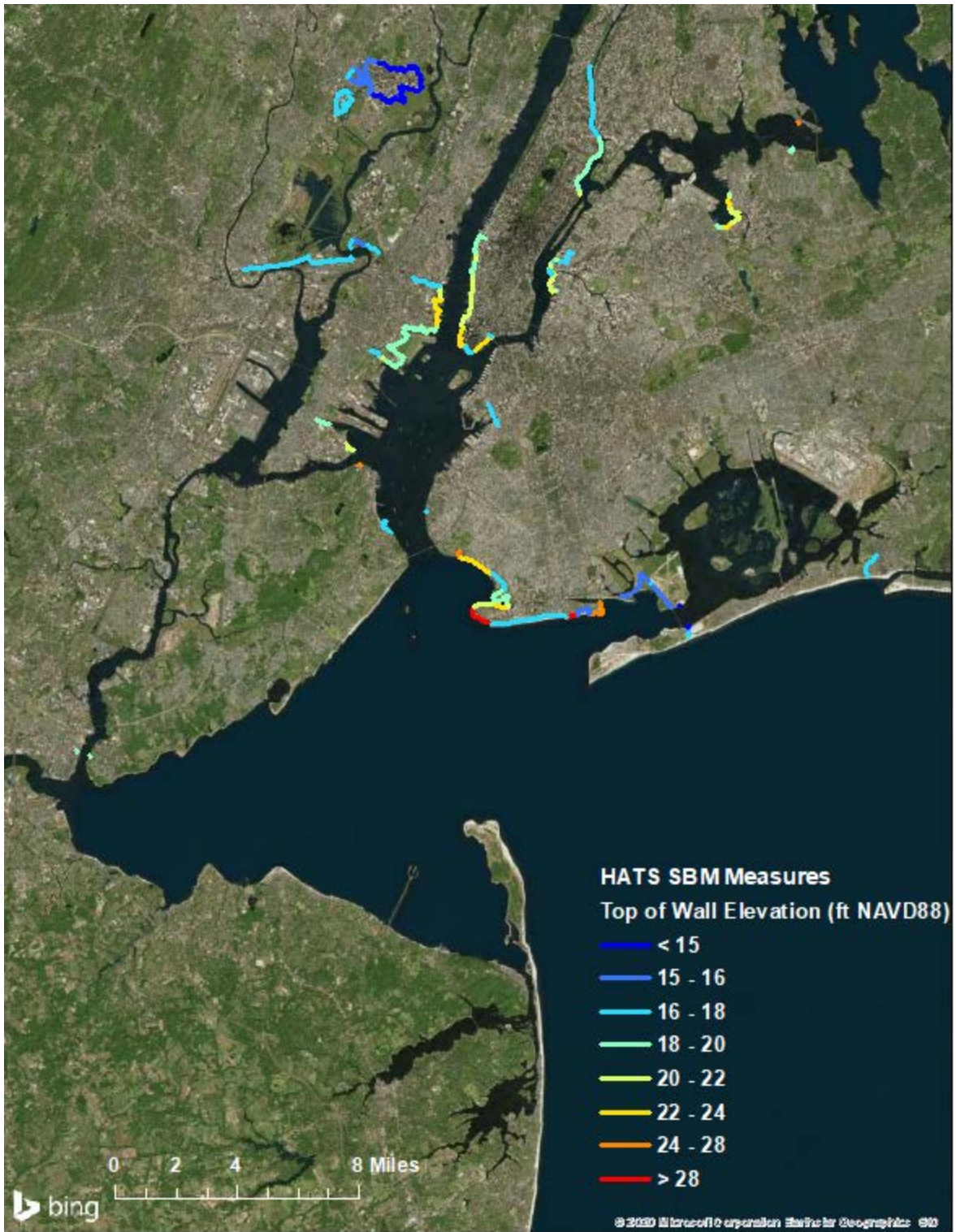


Figure C-6: Calculated SBM top elevations based on functional design criteria

C5. Summary of SBM design wave conditions and feature dimensions

The modeled wave-heights and periods at structure toe as well as the expected top of wall and ground elevations for every SBM feature were analyzed to compute representative values by measure type. Table C-1 shows the summary of representative 100-year design coastal conditions at the SBM features, and the SBM elevations, for each measure type.

Table C-1: Summary of 100-year design conditions and structure elevations for SBMs

Measure Type	Measure Sub-type	Wave-Height (ft)	Peak Period (s)	Ground Elevation (ft NAVD88)	Top of Wall (ft NAVD88)	Measure Height (ft)
Seawall		4.5	5.5	7.0	27.0	20.0
Elevated Promenade		3.0	5.0	9.0	21.0	12.0
Buried Seawall		2.0	6.5	7.5	19.0	11.5
Floodwall	Park Integration	3.5	3.0	10.0	23.0	13.0
Floodwall	Extra Large	3.5	4.0	6.0	22.5	16.5
Floodwall	Large	2.5	3.5	9.0	21.0	12.0
Floodwall	Medium	1.5	2.5	12.0	18.5	6.5
Flip-up Barrier		3.5	4.0	6.0	22.5	16.5
Gate		2.5	3.5	9.0	21.0	12.0
Levee	Large	1.5	3.0	6.0	18.0	12.0
Levee	Medium	1.5	1.5	11.0	18.0	7.0

C6. SBM wave conditions for structural design

The wave conditions for structural design for each measure type were derived following the procedure outlined in above sections for the 500 year and 750-year average recurrence intervals (ARI). The wave model transects for the 500-year used the 500-year ARI wave statistics from NACCS as input, while the 750-year wave conditions were derived by log interpolation between the 500 and 1000-year ARI conditions. The estimated wave conditions for each measure type are summarized in Table C-2.

Table C-2: Summary of wave conditions for structural design input

Measure Type	Measure Sub-type	500-year Wave-Height (ft)	500-year Peak Period (s)	750-year Wave-Height (ft)	750-year Peak Period (s)
Seawall		5.5	6.5	5.5	6.5
Elevated Promenade		3.5	5.5	4.0	5.5

Measure Type	Measure Sub-type	500-year Wave-Height (ft)	500-year Peak Period (s)	750-year Wave-Height (ft)	750-year Peak Period (s)
Buried Seawall		2.5	4.5	3.0	4.5
Floodwall	Park Integration	4.0	5.5	4.0	5.5
Floodwall	Extra Large	4.0	5.5	4.5	6.0
Floodwall	Large	3.0	5.0	3.5	5.0
Floodwall	Medium	2.0	3.5	2.0	4.0
Flip-up Barrier		4.0	5.5	4.5	6.0
Gate		3.0	5.0	3.5	5.0
Levee	Large	2.0	4.0	2.0	4.0
Levee	Medium	1.5	3.5	2.0	3.5

C7. Conclusion

The 100-year wave conditions derived as summarized above are used as the basis for the calculation of the freeboard requirements of the SBMs, to meet the specified overtopping thresholds. Additionally, wave conditions at 500-year and 750-year ARI were also calculated using the same methodology for structural design input.

The NACCS analysis of wave statistics forms the basis of the current study, as it is used to provide boundary conditions for the 1-D wave transformation to the shoreline features. The expected annual exceedance probabilities for different wave conditions for the HATS SBMs are therefore based on the NACCS analysis. However, the 1-D wave transformation model parameters were not calibrated or validated for lack of wave data at the shoreline. Additional sensitivity analysis to model parameters or more detailed analysis using a 2-D wave model could help further improve confidence in the model results.

An additional source of uncertainty in the wave transect modeling analysis derives from the limitations of the input bathymetric DEM from NOAA, which is based on interpolation of several data sources including some historical data.



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Shore Based Measures Sub-Appendix

Annex D – Map Sets for SBMs, IFFs, and RRFs for each Alternative

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New York – New Jersey Harbor and Tributaries Coastal Storm Risk Management Feasibility Study

Annex B1.D

September 2022

D. SBM, IFF, and RRF Maps

Map sets were created for Shore Based Measure (SBM), Induced Flooding mitigation Feature¹ (IFF), and Risk Reduction Feature² (RRF) alignments. These map sets show the feature alignments developed for the New York – New Jersey Harbor and Tributaries Study per location and alternative.

The map sets were separated into two map books, the SBM/IFF alignment (1) and the RRF alignment (2) maps. SBMs and IFFs share the same project features (such as “Medium Floodwall”, “Large Floodwall”, “Extra Large Floodwall”) and are included in one map set. However, a separate set of features was developed for the RRFs (such as “Low Floodwall”, “Standard Floodwall”, “High Floodwall”). To assure legibility, RRFs were therefore added in a separate map set to this annex.

A more detailed depiction for the Tentatively Selected Plan (TSP) alternative 3B is included in the TSP plan set. The map sets per alternative are shown in the following attachments added to this annex:

- SBM/IFF maps and RRF for alternatives 2
- SBM/IFF maps and RRF for alternatives 3A
- SBM/IFF maps and RRF for alternatives 3B
- SBM/IFF maps and RRF for alternatives 4
- SBM maps for alternatives 5

It can be noted that there are no IFFs and RRFs associated with alternative 5.

¹ Formerly also referred to as induced flooding feature.

² Formerly also referred to as residual risk feature.



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Shore Based Measures Sub-Appendix

Annex E – Miles (and Count) of Structural Measures per Reach per Alternative

DRAFT

New York – New Jersey Harbor and Tributaries Coastal Storm Risk Management Feasibility Study

Annex B1.E

September 2022

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E. Mileage per Reach per Alternative

An inventory of total lengths and counts of each different type of Shore-Based Measure (SBM), Induced Flooding mitigation Feature¹ (IFF), and Risk Reduction Feature² (RRFs) within the reaches of each HAT Study Alternative was determined. Table E-1 below shows that, for example, the Kill van Kull barrier Tie-In (Separated) reach includes two vehicular gates spanning a total length of 206 feet, one railroad gate, spanning a total length of 67 feet, 178 feet of medium floodwalls, and 2,048 feet of large floodwalls with a total length of 2,499 feet.

Table E-1: Length in feet of Shoreline Based Measures by Type and Location – Alternative 3B

	Medium Floodwall	Large Floodwall	Railroad Gate	Vehicle Gate	Grand Total
Kill Van Kull Barrier Tie-In Separated	178	2048	67	206	2499

The inventory of SBMs, IFFs, and RRFs per alternative is shown in the following tables within this annex:

- Shore Based Measures by Type and Location for Alternatives 2 to 5:
 - Measure lengths listed in Table E-2 through Table E-6.
 - Measure Counts listed in Table E-7.
- Induced Flooding Features by Type and Location for Alternatives 2 to 4 (note that Alternative 5 does not include any IFFs):
 - Measure lengths listed in Table E-8 through Table E-11.
 - Measure Counts listed in Table E-12.
- Residual Risk Features by Type and Location for Alternatives 2 to 4 (note that Alternative 5 does not include any RRFs):
 - Measure lengths listed in Table-E-13 through Table-E-16.
 - Measure Counts listed in Table-E-17.

¹ Formerly also referred to as induced flooding feature.

² Formerly also referred to as residual risk feature.

E.1 SHORE BASED MEASURES

Table E-2: Length in feet of Shore Based Measures (SBMs) by Type and Location – Alternative 2

	Medium Floodwall	Large Floodwall	Extra Large Floodwall	Medium Levee	Large Levee	Reinforced Dune - Natural Dune Cover	Reinforced Dune - Partial Dune Cover	Flip Up Barrier	Pedestrian Gate	Railroad Gate	Vehicle Gate	Elevated Promenade	Floodwall with Park	Sea-wall	Tide Gate	Storm Surge Barrier	Grand Total
Arthur Kill Barrier Tie-In	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
East Harlem SBM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Flushing Creek Barrier Tie-in	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gowanus Canal Barrier Tie-in	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hackensack Perimeter Lower Area - Polygon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hackensack Perimeter Middle Area - Polygon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hackensack Perimeter Upper Area - Polygon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hackensack River Barrier Tie-in	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Jamaica Bay Barrier Tie-In	0	2922	0	0	1502	1502	32484	0	0	0	329	0	0	0	0	0	39836
Kill Van Kull Barrier Tie-In	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kill Van Kull Barrier Tie-In Separated	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New Jersey along Hudson River SBM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New York City West Side SBM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Newtown Creek Barrier Tie-in	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sandy Hook-Rockaway Barrier Tie-in	0	0	0	0	0	51064	37045	0	0	0	0	0	0	0	0	34600	122709
Throgs Neck Barrier Tie-in	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4508	4508
Verrazano Narrows Barrier Tie-in	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	0	2922	0	0	1502	53664	69528	0	0	0	329	0	0	0	0	39108	167053

Table E-3: Length in feet of Shore Based Measures (SBMs) by Type and Location – Alternative 3A

	Medium Floodwall	Large Floodwall	Extra Large Floodwall	Medium Levee	Large Levee	Reinforced Dune - Natural Dune Cover	Reinforced Dune - Partial Dune Cover	Flip Up Barrier	Pedestrian Gate	Railroad Gate	Vehicle Gate	Elevated Promenade	Floodwall with Park	Sea-wall	Tide Gate	Storm Surge Barrier	Grand Total
Arthur Kill Barrier Tie-In	726	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2142	2868
East Harlem SBM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Flushing Creek Barrier Tie-in	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gowanus Canal Barrier Tie-in	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hackensack Perimeter Lower Area - Polygon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hackensack Perimeter Middle Area - Polygon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hackensack Perimeter Upper Area - Polygon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hackensack River Barrier Tie-in	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Jamaica Bay Barrier Tie-In	10079	14606	0	14623	8041	3970	36667	0	50	0	726	13941	0	12844	552	4938	121038
Kill Van Kull Barrier Tie-In	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kill Van Kull Barrier Tie-In Separated	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New Jersey along Hudson River SBM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New York City West Side SBM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Newtown Creek Barrier Tie-in	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sandy Hook-Rockaway Barrier Tie-in	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Throgs Neck Barrier Tie-in	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4508	4508
Verrazano Narrows Barrier Tie-in	0	2931	0	185	0	0	0	0	0	0	111	0	0	0	0	7819	11046
TOTAL	10805	17537	0	14808	8041	3970	36667	0	50	0	837	13941	0	12844	552	19408	139461

Table E-4: Length in feet of Shore Based Measures (SBMs) by Type and Location – Alternative 3B

	Medium Floodwall	Large Floodwall	Extra Large Floodwall	Medium Levee	Large Levee	Reinforced Dune - Natural Dune Cover	Reinforced Dune - Partial Dune Cover	Flip Up Barrier	Pedestrian Gate	Railroad Gate	Vehicle Gate	Elevated Promenade	Floodwall with Park	Sea-wall	Tide Gate	Storm Surge Barrier	Grand Total
Arthur Kill Barrier Tie-In	726	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2142	2868
East Harlem SBM	411	6431	0	0	0	0	0	0	0	0	126	14038	0	3907	0	0	24912
Flushing Creek Barrier Tie-in	2705	2413	87	0	0	0	0	0	0	0	296	968	1842	3009	0	480	11801
Gowanus Canal Barrier Tie-in	1915	10172	0	636	0	0	0	0	0	0	1041	0	0	4788	0	131	18683
Hackensack Perimeter Lower Area - Polygon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hackensack Perimeter Middle Area - Polygon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hackensack Perimeter Upper Area - Polygon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hackensack River Barrier Tie-in	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Jamaica Bay Barrier Tie-In	10079	14606	0	14623	8041	3970	36667	0	50	0	726	13941	0	12844	552	4938	121038
Kill Van Kull Barrier Tie-In	0	0	2363	0	0	0	0	0	0	0	0	0	0	0	0	3322	5686
Kill Van Kull Barrier Tie-In Separated	178	2048	0	0	0	0	0	0	0	67	206	0	0	0	0	0	2499
New Jersey along Hudson River SBM	3233	7177	4151	935	17304	0	0	0	225	153	570	9278	0	182	0	0	43207
New York City West Side SBM	1705	6116	9542	1675	0	0	0	1456	1182	0	909	6257	1387	1584	0	0	31814
Newtown Creek Barrier Tie-in	0	7800	0	1576	704	0	0	0	76	0	55	509	0	5088	0	370	16178
Sandy Hook-Rockaway Barrier Tie-in	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Throgs Neck Barrier Tie-in	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Verrazano Narrows Barrier Tie-in	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	20951	56763	16144	19445	26050	3970	36667	1456	1532	219	3929	44991	3229	31402	552	11385	278686

Table E-5: Length in feet of Shore Based Measures (SBMs) by Type and Location – Alternative 4

	Medium Floodwall	Large Floodwall	Extra Large Floodwall	Medium Levee	Large Levee	Reinforced Dune - Natural Dune Cover	Reinforced Dune - Partial Dune Cover	Flip Up Barrier	Pedestrian Gate	Railroad Gate	Vehicle Gate	Elevated Promenade	Floodwall with Park	Sea-wall	Tide Gate	Storm Surge Barrier	Grand Total
Arthur Kill Barrier Tie-In	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
East Harlem SBM	411	6431	0	0	0	0	0	0	0	0	126	14038	0	3907	0	0	24912
Flushing Creek Barrier Tie-in	2705	2413	87	0	0	0	0	0	0	0	296	968	1842	3009	0	480	11801
Gowanus Canal Barrier Tie-in	1915	10172	0	636	0	0	0	0	0	0	1041	0	0	4788	0	131	18683
Hackensack Perimeter Lower Area - Polygon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hackensack Perimeter Middle Area - Polygon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hackensack Perimeter Upper Area - Polygon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hackensack River Barrier Tie-in	7814	8021	654	10250	107	0	0	0	61	161	32	0	0	0	174	1568	28843
Jamaica Bay Barrier Tie-In	10079	14606	0	14623	8041	3970	36667	0	50	0	726	13941	0	12844	552	4938	121038
Kill Van Kull Barrier Tie-In	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kill Van Kull Barrier Tie-In Separated	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New Jersey along Hudson River SBM	3233	7177	4151	935	17304	0	0	0	225	153	570	9278	0	182	0	0	43207
New York City West Side SBM	1705	6116	9542	1675	0	0	0	1456	1182	0	909	6257	1387	1584	0	0	31814
Newtown Creek Barrier Tie-in	0	7800	0	1576	704	0	0	0	76	0	55	509	0	5088	0	370	16178
Sandy Hook-Rockaway Barrier Tie-in	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Throgs Neck Barrier Tie-in	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Verrazano Narrows Barrier Tie-in	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	27861	62736	14435	29695	26156	3970	36667	1456	1593	314	3756	44991	3229	31402	727	7489	296477

Table E-6: Length in feet of Shore Based Measures (SBMs) by Type and Location – Alternative 5

	Medium Floodwall	Large Floodwall	Extra Large Floodwall	Medium Levee	Large Levee	Reinforced Dune - Natural Dune Cover	Reinforced Dune - Partial Dune Cover	Flip Up Barrier	Pedestrian Gate	Railroad Gate	Vehicle Gate	Elevated Promenade	Floodwall with Park	Sea-wall	Tide Gate	Storm Surge Barrier	Grand Total
Arthur Kill Barrier Tie-In	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
East Harlem SBM	411	6431	0	0	0	0	0	0	0	0	126	14038	0	3907	0	0	24912
Flushing Creek Barrier Tie-in	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gowanus Canal Barrier Tie-in	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hackensack Perimeter Lower Area - Polygon	0	0	0	0	13732	0	0	0	0	0	135	0	0	0	0	0	13868
Hackensack Perimeter Middle Area - Polygon	0	0	0	338	9860	0	0	0	0	0	128	0	0	0	0	0	10325
Hackensack Perimeter Upper Area - Polygon	0	0	0	93	39805	0	0	0	0	48	150	0	0	0	107	0	40204
Hackensack River Barrier Tie-in	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Jamaica Bay Barrier Tie-In	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kill Van Kull Barrier Tie-In	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kill Van Kull Barrier Tie-In Separated	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New Jersey along Hudson River SBM	3233	7177	4151	935	17304	0	0	0	225	153	570	9278	0	182	0	0	43207
New York City West Side SBM	1705	6116	9542	1675	0	0	0	1456	1182	0	909	6257	1387	1584	0	0	31814
Newtown Creek Barrier Tie-in	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sandy Hook-Rockaway Barrier Tie-in	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Throgs Neck Barrier Tie-in	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Verrazano Narrows Barrier Tie-in	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	5348	19724	13693	3040	80702	0	0	1456	1407	201	2019	29573	1387	5673	107	0	164330

Table E-7: Shore Based Measure (SBM) count by Type and Location for Alternatives 2-5

	Flip Up Barrier	Pedestrian Gate	Railroad Gate	Vehicle Gate	Tide Gate	Storm Surge Barrier	Levee – Road Ramp	Grand Total
ALTERNATIVE 2								
Arthur Kill Barrier Tie-In	-	-	-	-	-	-	-	-
East Harlem SBM	-	-	-	-	-	-	-	-
Flushing Creek Barrier Tie-in	-	-	-	-	-	-	-	-
Gowanus Canal Barrier Tie-in	-	-	-	-	-	-	-	-
Hackensack Perimeter Lower Area - Polygon	-	-	-	-	-	-	-	-
Hackensack Perimeter Middle Area - Polygon	-	-	-	-	-	-	-	-
Hackensack Perimeter Upper Area - Polygon	-	-	-	-	-	-	-	-
Hackensack River Barrier Tie-in	-	-	-	-	-	-	-	-
Jamaica Bay Barrier Tie-In	-	-	-	4	-	-	3	7
Kill Van Kull Barrier Tie-In	-	-	-	-	-	-	-	-
Kill Van Kull Barrier Tie-In Separated	-	-	-	-	-	-	-	-
New Jersey along Hudson River SBM	-	-	-	-	-	-	-	-
New York City West Side SBM	-	-	-	-	-	-	-	-
Newtown Creek Barrier Tie-in	-	-	-	-	-	-	-	-
Sandy Hook-Rockaway Barrier Tie-in	-	-	-	-	-	1	-	1
Throgs Neck Barrier Tie-in	-	-	-	-	-	1	-	1
Verrazano Narrows Barrier Tie-in	-	-	-	-	-	-	-	-
TOTAL	-	-	-	4	-	2	3	9
ALTERNATIVE 3A								
Arthur Kill Barrier Tie-In	-	-	-	-	-	1	-	1
East Harlem SBM	-	-	-	-	-	-	-	-
Flushing Creek Barrier Tie-in	-	-	-	-	-	-	-	-
Gowanus Canal Barrier Tie-in	-	-	-	-	-	-	-	-
Hackensack Perimeter Lower Area - Polygon	-	-	-	-	-	-	-	-
Hackensack Perimeter Middle Area - Polygon	-	-	-	-	-	-	-	-
Hackensack Perimeter Upper Area - Polygon	-	-	-	-	-	-	-	-
Hackensack River Barrier Tie-in	-	-	-	-	-	-	-	-
Jamaica Bay Barrier Tie-In	-	1	-	10	1	3	6	21
Kill Van Kull Barrier Tie-In	-	-	-	-	-	-	-	-
Kill Van Kull Barrier Tie-In Separated	-	-	-	-	-	-	-	-
New Jersey along Hudson River SBM	-	-	-	-	-	-	-	-
New York City West Side SBM	-	-	-	-	-	-	-	-
Newtown Creek Barrier Tie-in	-	-	-	-	-	-	-	-
Sandy Hook-Rockaway Barrier Tie-in	-	-	-	-	-	-	-	-
Throgs Neck Barrier Tie-in	-	-	-	-	-	1	-	1
Verrazano Narrows Barrier Tie-in	-	-	-	4	-	1	1	6
TOTAL	-	1	-	14	1	6	7	29
ALTERNATIVE 3B								
Arthur Kill Barrier Tie-In	-	-	-	-	-	1	-	1
East Harlem SBM	-	-	-	3	-	-	-	3
Flushing Creek Barrier Tie-in	-	-	-	6	-	1	-	7
Gowanus Canal Barrier Tie-in	-	-	-	17	-	1	-	18
Hackensack Perimeter Lower Area - Polygon	-	-	-	-	-	-	-	-
Hackensack Perimeter Middle Area - Polygon	-	-	-	-	-	-	-	-
Hackensack Perimeter Upper Area - Polygon	-	-	-	-	-	-	-	-
Hackensack River Barrier Tie-in	-	-	-	-	-	-	-	-
Jamaica Bay Barrier Tie-In	-	1	-	10	1	3	6	21
Kill Van Kull Barrier Tie-In	-	-	-	-	-	1	-	1
Kill Van Kull Barrier Tie-In Separated	-	-	1	2	-	-	-	3
New Jersey along Hudson River SBM	-	8	3	9	-	-	4	24
New York City West Side SBM	4	41	-	16	-	-	-	61
Newtown Creek Barrier Tie-in	-	3	-	1	-	1	-	5
Sandy Hook-Rockaway Barrier Tie-in	-	-	-	-	-	-	-	-
Throgs Neck Barrier Tie-in	-	-	-	-	-	-	-	-
Verrazano Narrows Barrier Tie-in	-	-	-	-	-	-	-	-
TOTAL	4	53	4	64	1	8	10	144

	Flip Up Barrier	Pedestrian Gate	Railroad Gate	Vehicle Gate	Tide Gate	Storm Surge Barrier	Levee – Road Ramp	Grand Total
ALTERNATIVE 4								
Arthur Kill Barrier Tie-In	-	-	-	-	-	-	-	-
East Harlem SBM	-	-	-	3	-	-	-	3
Flushing Creek Barrier Tie-in	-	-	-	6	-	1	-	7
Gowanus Canal Barrier Tie-in	-	-	-	17	-	1	-	18
Hackensack Perimeter Lower Area - Polygon	-	-	-	-	-	-	-	-
Hackensack Perimeter Middle Area - Polygon	-	-	-	-	-	-	-	-
Hackensack Perimeter Upper Area - Polygon	-	-	-	-	-	-	-	-
Hackensack River Barrier Tie-in	-	1	2	1	2	1	1	8
Jamaica Bay Barrier Tie-In	-	1	-	10	1	3	6	21
Kill Van Kull Barrier Tie-In	-	-	-	-	-	-	-	-
Kill Van Kull Barrier Tie-In Separated	-	-	-	-	-	-	-	-
New Jersey along Hudson River SBM	-	8	3	9	-	-	4	24
New York City West Side SBM	4	41	-	16	-	-	-	61
Newtown Creek Barrier Tie-in	-	3	-	1	-	1	-	5
Sandy Hook-Rockaway Barrier Tie-in	-	-	-	-	-	-	-	-
Throgs Neck Barrier Tie-in	-	-	-	-	-	-	-	-
Verrazano Narrows Barrier Tie-in	-	-	-	-	-	-	-	-
TOTAL	4	54	5	63	3	7	11	147
ALTERNATIVE 5								
Arthur Kill Barrier Tie-In	-	-	-	-	-	-	-	-
East Harlem SBM	-	-	-	3	-	-	-	3
Flushing Creek Barrier Tie-in	-	-	-	-	-	-	-	-
Gowanus Canal Barrier Tie-in	-	-	-	-	-	-	-	-
Hackensack Perimeter Lower Area - Polygon	-	-	-	2	-	-	1	3
Hackensack Perimeter Middle Area - Polygon	-	-	-	3	-	-	3	6
Hackensack Perimeter Upper Area - Polygon	-	-	1	3	2	-	7	13
Hackensack River Barrier Tie-in	-	-	-	-	-	-	-	-
Jamaica Bay Barrier Tie-In	-	-	-	-	-	-	-	-
Kill Van Kull Barrier Tie-In	-	-	-	-	-	-	-	-
Kill Van Kull Barrier Tie-In Separated	-	-	-	-	-	-	-	-
New Jersey along Hudson River SBM	-	8	3	9	-	-	4	24
New York City West Side SBM	4	41	-	16	-	-	-	61
Newtown Creek Barrier Tie-in	-	-	-	-	-	-	-	-
Sandy Hook-Rockaway Barrier Tie-in	-	-	-	-	-	-	-	-
Throgs Neck Barrier Tie-in	-	-	-	-	-	-	-	-
Verrazano Narrows Barrier Tie-in	-	-	-	-	-	-	-	-
TOTAL	4	49	4	36	2	-	15	110

E.2 INDUCED FLOODING FEATURES

Table E-8: Length in feet of Induced Flooding Features (IFFs) by Type and Location – Alternative 2

	Medium Floodwall	Large Floodwall	Extra Large Floodwall	Medium Levee	Large Levee	Reinforced Dune - Natural Dune Cover	Reinforced Dune - Partial Dune Cover	Flip Up Barrier	Pedestrian Gate	Railroad Gate	Vehicle Gate	Elevated Promenade	Floodwall with Park	Sea-wall	Tide Gate	Storm Surge Barrier	Grand Total
Breezy Point	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Highlands	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kips Bay	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eastchester Bay	0	0	962	0	0	0	0	0	0	0	57	2713	0	7541	0	0	11273
Throgs Neck	0	0	3632	0	0	0	0	0	0	0	36	0	0	8765	0	181	12614
Sands Point	0	0	0	0	1814	0	0	0	0	0	0	0	0	6621	226	0	8661
Great Neck	0	0	3754	0	345	876	0	0	0	0	0	0	0	3470	341	0	8787
Hutchinson River	0	0	0	0	2386	0	0	0	0	0	0	0	0	0	0	822	3208
Little Neck Bay	0	498	155	0	5735	0	0	0	0	0	0	0	0	1904	154	0	8447
Rodman Neck	0	0	0	0	1469	0	0	0	0	0	0	0	0	4904	0	0	6374
Port Washington	0	0	3276	0	654	0	0	0	0	0	0	0	0	17972	112	285	22299
Roslyn Harbor	0	0	0	0	3440	0	0	0	0	0	0	0	0	369	126	0	3935
Hempstead Harbor	0	0	1481	0	1988	0	0	0	0	0	125	0	0	3560	0	194	7349
Bronx	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Inwood	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sandy Hook Bay	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Keyport - Cheesquake	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Raritan River	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
South Staten Island	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Great Kills	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Harrison	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Newark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kearny Point	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Elizabeth	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bergen Point	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hackensack-Jersey City	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Port Richmond	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Plandome	0	240	2506	0	9010	0	0	0	0	0	0	0	0	7057	65	0	18877
Little Bay	0	4991	0	0	3543	0	0	0	0	0	0	0	0	0	0	0	8534
TOTAL	0	5730	15766	0	30384	876	0	0	0	0	219	2713	0	62164	1024	1483	120358

Table E-9: Length in feet of Induced Flooding Features (IFFs) by Type and Location – Alternative 3A

	Medium Floodwall	Large Floodwall	Extra Large Floodwall	Medium Levee	Large Levee	Reinforced Dune - Natural Dune Cover	Reinforced Dune - Partial Dune Cover	Flip Up Barrier	Pedestrian Gate	Railroad Gate	Vehicle Gate	Elevated Promenade	Floodwall with Park	Sea-wall	Tide Gate	Storm Surge Barrier	Grand Total
Breezy Point	0	2249	0	0	11700	16499	9142	0	0	0	21	0	0	0	0	0	39610
Highlands	0	0	0	0	693	0	0	0	0	0	32	0	0	4063	0	4400	9188
Kips Bay	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eastchester Bay	0	0	962	0	0	0	0	0	0	0	57	2713	0	7541	0	0	11273
Throgs Neck	0	0	3632	0	0	0	0	0	0	0	36	0	0	8765	0	181	12614
Sands Point	0	0	0	0	1814	0	0	0	0	0	0	0	0	6621	226	0	8661
Great Neck	0	0	3754	0	345	876	0	0	0	0	0	0	0	3470	341	0	8787
Hutchinson River	0	0	0	0	2386	0	0	0	0	0	0	0	0	0	0	822	3208
Little Neck Bay	0	498	155	0	5735	0	0	0	0	0	0	0	0	1904	154	0	8447
Rodman Neck	0	0	0	0	1469	0	0	0	0	0	0	0	0	4904	0	0	6374
Port Washington	0	0	3436	0	654	0	0	0	0	0	0	0	0	17972	112	285	22459
Roslyn Harbor	0	0	0	0	3440	0	0	0	0	0	0	0	0	369	126	0	3935
Hempstead Harbor	0	0	1481	0	1988	0	0	0	0	0	125	0	0	3560	0	194	7349
Bronx	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Inwood	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sandy Hook Bay	0	4067	0	0	18360	481	1240	0	35	0	222	0	0	4834	205	0	29445
Keyport - Cheesquake	0	6040	0	0	14553	0	0	0	0	0	311	0	0	9476	119	0	30498
Raritan River	0	3051	0	0	9309	0	0	0	0	0	0	3949	0	1957	0	1568	19834
South Staten Island	0	1396	0	0	7527	0	10043	0	0	0	0	0	0	0	99	0	19065
Great Kills	0	0	4325	0	3005	0	3417	0	0	0	0	0	0	632	0	0	11379
Harrison	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Newark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kearny Point	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Elizabeth	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bergen Point	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hackensack-Jersey City	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Port Richmond	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Plandome	0	240	2506	0	9010	0	0	0	0	0	0	0	0	7057	65	0	18877
Little Bay	0	4991	0	0	3543	0	0	0	0	0	0	0	0	0	0	0	8534
TOTAL	0	22532	20251	0	95531	17856	23842	0	35	0	804	6661	0	83127	1446	7451	279537

Table E-10: Length in feet of Induced Flooding Features (IFFs) by Type and Location – Alternative 3B

	Medium Floodwall	Large Floodwall	Extra Large Floodwall	Medium Levee	Large Levee	Reinforced Dune - Natural Dune Cover	Reinforced Dune - Partial Dune Cover	Flip Up Barrier	Pedestrian Gate	Railroad Gate	Vehicle Gate	Elevated Promenade	Floodwall with Park	Sea-wall	Tide Gate	Storm Surge Barrier	Grand Total
Breezy Point	0	2249	0	0	11700	16499	9142	0	0	0	21	0	0	0	0	0	39610
Highlands	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kips Bay	213	0	0	0	0	0	0	0	0	0	0	2412	0	3021	0	0	5646
Eastchester Bay	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Throgs Neck	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sands Point	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Great Neck	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hutchinson River	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Little Neck Bay	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rodman Neck	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Port Washington	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Roslyn Harbor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hempstead Harbor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bronx	0	7532	4302	0	0	0	0	0	0	0	501	0	0	0	0	0	12336
Inwood	0	3665	0	0	819	0	0	0	0	0	0	0	0	0	0	0	4484
Sandy Hook Bay	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Keyport - Cheesquake	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Raritan River	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
South Staten Island	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Great Kills	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Harrison	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Newark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kearny Point	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Elizabeth	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bergen Point	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hackensack-Jersey City	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Port Richmond	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Plandome	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Little Bay	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	213	13446	4302	0	12519	16499	9142	0	0	0	522	2412	0	3021	0	0	62076

Table E-11: Length in feet of Induced Flooding Features (IFFs) by Type and Location – Alternative 4

	Medium Floodwall	Large Floodwall	Extra Large Floodwall	Medium Levee	Large Levee	Reinforced Dune - Natural Dune Cover	Reinforced Dune - Partial Dune Cover	Flip Up Barrier	Pedestrian Gate	Railroad Gate	Vehicle Gate	Elevated Promenade	Floodwall with Park	Sea-wall	Tide Gate	Storm Surge Barrier	Grand Total
Breezy Point	0	2249	0	0	11700	16499	9142	0	0	0	21	0	0	0	0	0	39610
Highlands	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kips Bay	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eastchester Bay	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Throgs Neck	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sands Point	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Great Neck	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hutchinson River	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Little Neck Bay	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rodman Neck	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Port Washington	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Roslyn Harbor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hempstead Harbor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bronx	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Inwood	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sandy Hook Bay	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Keyport - Cheesquake	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Raritan River	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
South Staten Island	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Great Kills	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Harrison	0	17305	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17305
Newark	2243	38396	0	0	0	0	0	0	0	0	86	0	0	0	0	0	40725
Kearny Point	0	31579	0	0	0	0	0	0	0	0	0	0	0	0	0	0	31579
Elizabeth	9972	9835	0	0	0	0	0	0	0	0	1009	0	0	1205	231	0	22252
Bergen Point	0	2082	0	0	3293	0	0	0	0	0	99	0	0	14006	0	0	19479
Hackensack-Jersey City	0	3332	14000	0	8079	0	0	0	0	0	144	0	0	4502	364	0	30420
Port Richmond	0	7529	7812	0	630	0	0	0	0	0	1292	0	0	0	0	0	17263
Plandome	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Little Bay	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	12215	112307	21811	0	23703	16499	9142	0	0	0	2650	0	0	19712	595	0	218634

Table E-12: Induced Flooding Features (IFF) count by Type and Location for Alternatives 2-4

	Flip Up Barrier	Pedestrian Gate	Railroad Gate	Vehicle Gate	Tide Gate	Storm Surge Barrier	Grand Total
ALTERNATIVE 2							
Breezy Point	-	-	-	-	-	-	-
Highlands	-	-	-	-	-	-	-
Kips Bay	-	-	-	-	-	-	-
Eastchester Bay	-	-	-	2	-	-	2
Throgs Neck	-	-	-	1	-	1	2
Sands Point	-	-	-	-	1	-	1
Great Neck	-	-	-	-	5	-	5
Hutchinson River	-	-	-	-	-	1	1
Little Neck Bay	-	-	-	-	1	-	1
Rodman Neck	-	-	-	-	-	-	-
Port Washington	-	-	-	-	1	1	2
Roslyn Harbor	-	-	-	-	2	-	2
Hempstead Harbor	-	-	-	2	-	1	3
Bronx	-	-	-	-	-	-	-
Inwood	-	-	-	-	-	-	-
Sandy Hook Bay	-	-	-	-	-	-	-
Keyport - Cheesquake	-	-	-	-	-	-	-
Raritan River	-	-	-	-	-	-	-
South Staten Island	-	-	-	-	-	-	-
Great Kills	-	-	-	-	-	-	-
Harrison	-	-	-	-	-	-	-
Newark	-	-	-	-	-	-	-
Kearny Point	-	-	-	-	-	-	-
Elizabeth	-	-	-	-	-	-	-
Bergen Point	-	-	-	-	-	-	-
Hackensack-Jersey City	-	-	-	-	-	-	-
Port Richmond	-	-	-	-	-	-	-
Plandome	-	-	-	-	2	-	2
Little Bay	-	-	-	-	-	-	-
TOTAL	-	-	-	5	12	4	21
ALTERNATIVE 3A							
Breezy Point	-	-	-	1	-	-	1
Highlands	-	-	-	1	-	2	3
Kips Bay	-	-	-	-	-	-	-
Eastchester Bay	-	-	-	2	-	-	2
Throgs Neck	-	-	-	1	-	1	2
Sands Point	-	-	-	-	1	-	1
Great Neck	-	-	-	-	5	-	5
Hutchinson River	-	-	-	-	-	1	1
Little Neck Bay	-	-	-	-	1	-	1
Rodman Neck	-	-	-	-	-	-	-
Port Washington	-	-	-	-	1	1	2
Roslyn Harbor	-	-	-	-	2	-	2
Hempstead Harbor	-	-	-	2	-	1	3
Bronx	-	-	-	-	-	-	-
Inwood	-	-	-	-	-	-	-
Sandy Hook Bay	-	4	-	5	5	-	14
Keyport - Cheesquake	-	-	-	8	2	-	10
Raritan River	-	-	-	-	-	1	1
South Staten Island	-	-	-	-	1	-	1
Great Kills	-	-	-	-	-	-	-
Harrison	-	-	-	-	-	-	-
Newark	-	-	-	-	-	-	-
Kearny Point	-	-	-	-	-	-	-
Elizabeth	-	-	-	-	-	-	-
Bergen Point	-	-	-	-	-	-	-
Hackensack-Jersey City	-	-	-	-	-	-	-
Port Richmond	-	-	-	-	-	-	-
Plandome	-	-	-	-	2	-	2
Little Bay	-	-	-	-	-	-	-
TOTAL	-	4	-	20	20	7	51
ALTERNATIVE 3B							
Breezy Point	-	-	-	1	-	-	1
Highlands	-	-	-	-	-	-	-
Kips Bay	-	-	-	-	-	-	-
Eastchester Bay	-	-	-	-	-	-	-
Throgs Neck	-	-	-	-	-	-	-
Sands Point	-	-	-	-	-	-	-
Great Neck	-	-	-	-	-	-	-
Hutchinson River	-	-	-	-	-	-	-
Little Neck Bay	-	-	-	-	-	-	-
Rodman Neck	-	-	-	-	-	-	-
Port Washington	-	-	-	-	-	-	-
Roslyn Harbor	-	-	-	-	-	-	-
Hempstead Harbor	-	-	-	-	-	-	-

	Flip Up Barrier	Pedestrian Gate	Railroad Gate	Vehicle Gate	Tide Gate	Storm Surge Barrier	Grand Total
Bronx	-	-	-	9	-	-	9
Inwood	-	-	-	-	-	-	-
Sandy Hook Bay	-	-	-	-	-	-	-
Keyport - Cheesquake	-	-	-	-	-	-	-
Raritan River	-	-	-	-	-	-	-
South Staten Island	-	-	-	-	-	-	-
Great Kills	-	-	-	-	-	-	-
Harrison	-	-	-	-	-	-	-
Newark	-	-	-	-	-	-	-
Kearny Point	-	-	-	-	-	-	-
Elizabeth	-	-	-	-	-	-	-
Bergen Point	-	-	-	-	-	-	-
Hackensack-Jersey City	-	-	-	-	-	-	-
Port Richmond	-	-	-	-	-	-	-
Plandome	-	-	-	-	-	-	-
Little Bay	-	-	-	-	-	-	-
TOTAL	-	-	-	10	-	-	10
ALTERNATIVE 4							
Breezy Point	-	-	-	1	-	-	1
Highlands	-	-	-	-	-	-	-
Kips Bay	-	-	-	-	-	-	-
Eastchester Bay	-	-	-	-	-	-	-
Throgs Neck	-	-	-	-	-	-	-
Sands Point	-	-	-	-	-	-	-
Great Neck	-	-	-	-	-	-	-
Hutchinson River	-	-	-	-	-	-	-
Little Neck Bay	-	-	-	-	-	-	-
Rodman Neck	-	-	-	-	-	-	-
Port Washington	-	-	-	-	-	-	-
Roslyn Harbor	-	-	-	-	-	-	-
Hempstead Harbor	-	-	-	-	-	-	-
Bronx	-	-	-	-	-	-	-
Inwood	-	-	-	-	-	-	-
Sandy Hook Bay	-	-	-	-	-	-	-
Keyport - Cheesquake	-	-	-	-	-	-	-
Raritan River	-	-	-	-	-	-	-
South Staten Island	-	-	-	-	-	-	-
Great Kills	-	-	-	-	-	-	-
Harrison	-	-	-	-	-	-	-
Newark	-	-	-	1	-	-	1
Kearny Point	-	-	-	-	-	-	-
Elizabeth	-	-	-	12	1	-	13
Bergen Point	-	-	-	2	-	-	2
Hackensack-Jersey City	-	-	-	2	2	-	4
Port Richmond	-	-	-	33	-	-	33
Plandome	-	-	-	-	-	-	-
Little Bay	-	-	-	-	-	-	-
TOTAL	-	-	-	51	3	-	54

E.3 RESIDUAL RISK FEATURES

Table-E-13: Length in feet of Residual Risk Features (RRFs) by Type and Location – Alternative 2

	Low FW	Standard FW	High FW	Revet-ment with FW	Low Berm	Med. Berm	High Berm	Hybrid Berm	Shallow Bulk-head	Deep Bulk-head	Pedestrian Gate	Vehicle Gate	Road Raising	Road Ramp	Tide Gate	Nav-Gate	Grand Total
Arthur Kill	0	189	0	0	0	0	0	0	0	0	0	0	0	0	0	0	189
Atlantic Basin	5282	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5282
Bayonne Bridge	0	390	0	0	0	0	0	0	0	0	0	0	0	0	0	0	390
Bayswater Park	0	0	0	0	1463	0	0	0	0	0	0	0	0	0	0	0	1463
Bergen Pt SI	0	1284	0	0	0	0	0	0	0	0	0	0	0	0	149	0	1434
Breezy Point	0	0	0	0	0	7067	0	0	0	0	0	0	0	0	0	0	7067
Bridge Street Bridge	0	0	0	990	0	0	0	0	0	0	0	0	0	0	0	0	990
Broad Channel	0	0	0	0	3276	0	444	0	15248	1065	0	0	4440	46	0	0	24518
Canarsie	1759	0	0	913	0	0	0	0	0	0	0	0	0	0	0	0	2673
Caseys Creek	0	0	0	0	0	0	697	0	0	0	0	0	0	0	64	0	761
Chelsea	2380	0	0	0	0	0	0	0	0	2105	181	974	0	0	0	0	5640
Clay Street Bridge	0	1040	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1040
Coney Is Creek	0	0	0	0	0	0	0	0	0	4601	0	0	0	0	0	0	4601
Dock Bridge	94	0	0	804	0	0	0	0	0	0	0	0	0	0	0	0	897
Elizabeth River	0	0	1150	0	0	0	0	0	0	0	0	0	0	0	0	0	1150
Elizabethport	0	0	918	3032	0	0	0	0	0	0	0	0	0	0	0	0	3950
EssexCntyCorrFac	4547	1795	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6342
Flushing Creek	0	0	0	0	0	0	845	0	0	0	0	0	0	0	220	0	1065
Fort Hancock	0	0	0	1176	0	0	324	0	0	1606	0	44	0	0	0	0	3150
Gowanus Canal	0	0	0	0	0	0	0	0	0	1211	0	0	0	0	0	131	1342
Green Pt LI	0	0	0	0	0	0	0	0	0	2003	0	0	0	0	0	0	2003
Harrison Reach	681	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	681
Head of Bay Gate	0	0	1444	0	0	0	936	0	0	0	0	0	0	0	0	568	2949
Highlands	234	541	0	4293	0	165	0	679	1468	811	0	0	0	0	0	1059	9250
HudsonCntyCorrFac	1705	0	0	0	0	0	0	0	0	0	0	0	140	0	0	0	1845
Inwood Marina	0	832	0	0	996	0	0	0	769	0	0	30	0	0	0	0	2628
Jersey City	0	0	0	0	0	0	988	0	0	1522	0	0	0	0	0	0	2511
KearnyPoint	0	5160	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5160
Kips Bay	0	1598	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1598
Lenox Yard	0	0	0	0	0	0	0	0	0	329	0	0	0	0	0	0	329
Leonardo	42	0	0	0	0	0	0	0	0	1431	0	0	0	0	0	0	1473
Long Island City	0	0	0	0	0	0	0	0	0	3904	0	0	0	0	0	0	3904
Many Mind Creek	28	48	0	0	0	0	0	0	0	0	0	0	0	0	27	0	103
Mariners Harbor SI E	0	0	0	0	0	0	0	0	0	4107	0	0	0	0	0	0	4107
Mariners Harbor SI W	264	0	0	1892	0	0	0	0	0	631	0	0	0	0	0	0	2787

	Low FW	Standard FW	High FW	Revet-ment with FW	Low Berm	Med. Berm	High Berm	Hybrid Berm	Shallow Bulk-head	Deep Bulk-head	Pedestrian Gate	Vehicle Gate	Road Raising	Road Ramp	Tide Gate	Nav-Gate	Grand Total
Meadowlands Gate	0	230	0	0	0	3606	0	112	0	0	0	0	0	0	47	1427	5421
Morses Creek	0	0	1060	0	0	0	0	0	0	0	0	0	0	0	0	0	1060
Motts Basin N	662	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	662
Motts Basin S	0	1712	0	0	0	0	0	0	2008	0	0	52	0	0	0	0	3772
Newton Creek	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Norfolk Southern	0	353	0	2808	0	0	0	0	0	0	0	0	0	0	0	0	3161
North Arlington	0	0	0	1222	0	0	0	0	0	0	0	0	0	0	0	0	1222
Norton Basin	0	2398	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2398
Old Howard Beach	0	705	0	0	2080	0	211	0	0	0	0	0	0	0	0	0	2996
Old Howard Beach East	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	419	419
Old Howard Beach West	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	260	260
Passaic River	0	1258	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1258
Passaic Upriver	1779	390	0	0	507	0	0	0	0	0	0	123	0	0	0	0	2798
Red Hook	0	4144	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4144
Route 1 Bridge	0	1325	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1325
Roxbury	0	0	0	1114	749	1755	0	0	0	0	0	0	0	0	0	0	3618
S. Kearny-Passaic	0	2341	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2341
Sheepshead Bay	0	0	0	0	0	0	0	0	0	10571	0	0	0	0	0	0	10571
Shell - Passaic	0	879	0	0	0	0	0	0	0	0	0	0	0	0	0	0	879
South River	3339	0	0	1371	750	0	0	0	0	0	0	0	0	0	0	0	5460
South Slope	0	0	0	0	0	0	0	0	0	2301	0	0	0	0	0	0	2301
Tottenville	1376	0	0	761	0	0	0	0	0	449	0	0	0	0	0	0	2586
Tremley	0	0	511	0	0	0	0	0	0	0	0	0	0	0	19	0	530
UpperHudson	0	0	0	0	0	0	0	0	0	5576	0	0	0	0	0	0	5576
Wall Street	4906	0	0	0	0	0	0	0	0	0	0	105	0	0	0	0	5011
Whitehead	0	0	0	0	0	2735	0	0	0	0	0	0	0	0	0	0	2735
Yankee Stadium	0	0	0	0	0	0	0	0	0	2897	0	0	0	0	0	0	2897
TOTAL	29078	28612	5084	20375	9819	15329	4445	790	19494	47120	181	1329	4580	46	527	3866	190674

Table-E-14: Length in feet of Residual Risk Features (RRFs) by Type and Location – Alternative 3A

	Low FW	Standard FW	High FW	Revet-ment with FW	Low Berm	Med. Berm	High Berm	Hybrid Berm	Shallow Bulk-head	Deep Bulk-head	Pedestrian Gate	Vehicle Gate	Road Raising	Road Ramp	Tide Gate	Nav-Gate	Grand Total
Arthur Kill	0	189	0	0	0	0	0	0	0	0	0	0	0	0	0	0	189
Atlantic Basin	5282	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5282
Bayonne Bridge	0	390	0	0	0	0	0	0	0	0	0	0	0	0	0	0	390
Bayswater Park	0	0	0	0	1463	0	0	0	0	0	0	0	0	0	0	0	1463
Bergen Pt SI	0	1284	0	0	0	0	0	0	0	0	0	0	0	0	149	0	1434
Breezy Point	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bridge Street Bridge	0	0	0	990	0	0	0	0	0	0	0	0	0	0	0	0	990
Broad Channel	0	0	0	0	3276	0	444	0	15248	1065	0	0	4440	46	0	0	24518
Canarsie	1759	0	0	913	0	0	0	0	0	0	0	0	0	0	0	0	2673
Caseys Creek	0	0	0	0	0	0	697	0	0	0	0	0	0	0	64	0	761
Chelsea	2380	0	0	0	0	0	0	0	0	2105	181	974	0	0	0	0	5640
Clay Street Bridge	0	1040	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1040
Coney Is Creek	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dock Bridge	94	0	0	804	0	0	0	0	0	0	0	0	0	0	0	0	897
Elizabeth River	0	0	1150	0	0	0	0	0	0	0	0	0	0	0	0	0	1150
Elizabethport	0	0	918	3032	0	0	0	0	0	0	0	0	0	0	0	0	3950
EssexCntyCorrFac	4547	1795	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6342
Flushing Creek	0	0	0	0	0	0	845	0	0	0	0	0	0	0	220	0	1065
Fort Hancock	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gowanus Canal	0	0	0	0	0	0	0	0	0	1211	0	0	0	0	0	131	1342
Green Pt LI	0	0	0	0	0	0	0	0	0	2003	0	0	0	0	0	0	2003
Harrison Reach	681	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	681
Head of Bay Gate	0	0	1444	0	0	0	936	0	0	0	0	0	0	0	0	568	2949
Highlands	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HudsonCntyCorrFac	1705	0	0	0	0	0	0	0	0	0	0	0	140	0	0	0	1845
Inwood Marina	0	832	0	0	996	0	0	0	769	0	0	30	0	0	0	0	2628
Jersey City	0	0	0	0	0	0	988	0	0	1522	0	0	0	0	0	0	2511
KearnyPoint	0	5160	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5160
Kips Bay	0	1598	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1598
Lenox Yard	0	0	0	0	0	0	0	0	0	329	0	0	0	0	0	0	329
Leonardo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Long Island City	0	0	0	0	0	0	0	0	0	3904	0	0	0	0	0	0	3904
Many Mind Creek	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mariners Harbor SI E	0	0	0	0	0	0	0	0	0	4107	0	0	0	0	0	0	4107
Mariners Harbor SI W	264	0	0	1892	0	0	0	0	0	631	0	0	0	0	0	0	2787
Meadowlands Gate	0	230	0	0	0	3606	0	112	0	0	0	0	0	0	47	1427	5421
Morses Creek	0	0	1060	0	0	0	0	0	0	0	0	0	0	0	0	0	1060

	Low FW	Standard FW	High FW	Revet-ment with FW	Low Berm	Med. Berm	High Berm	Hybrid Berm	Shallow Bulk-head	Deep Bulk-head	Pedestrian Gate	Vehicle Gate	Road Raising	Road Ramp	Tide Gate	Nav-Gate	Grand Total
Motts Basin N	662	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	662
Motts Basin S	0	1712	0	0	0	0	0	0	2008	0	0	52	0	0	0	0	3772
Newton Creek	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Norfolk Southern	0	353	0	2808	0	0	0	0	0	0	0	0	0	0	0	0	3161
North Arlington	0	0	0	1222	0	0	0	0	0	0	0	0	0	0	0	0	1222
Norton Basin	0	2398	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2398
Old Howard Beach	0	705	0	0	2080	0	211	0	0	0	0	0	0	0	0	0	2996
Old Howard Beach East	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	419	419
Old Howard Beach West	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	260	260
Passaic River	0	1258	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1258
Passaic Upriver	1779	390	0	0	507	0	0	0	0	0	0	123	0	0	0	0	2798
Red Hook	0	4144	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4144
Route 1 Bridge	0	1325	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1325
Roxbury	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S. Kearny-Passaic	0	2341	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2341
Sheepshead Bay	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Shell - Passaic	0	879	0	0	0	0	0	0	0	0	0	0	0	0	0	0	879
South River	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
South Slope	0	0	0	0	0	0	0	0	0	2301	0	0	0	0	0	0	2301
Tottenville	1376	0	0	761	0	0	0	0	0	449	0	0	0	0	0	0	2586
Tremley	0	0	511	0	0	0	0	0	0	0	0	0	0	0	19	0	530
UpperHudson	0	0	0	0	0	0	0	0	0	5576	0	0	0	0	0	0	5576
Wall Street	4906	0	0	0	0	0	0	0	0	0	0	105	0	0	0	0	5011
Whitehead	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Yankee Stadium	0	0	0	0	0	0	0	0	0	2897	0	0	0	0	0	0	2897
TOTAL	25435	28023	5084	12421	8320	3606	4121	112	18025	28100	181	1285	4580	46	500	2806	142646

Table-E-15: Length in feet of Residual Risk Features (RRFs) by Type and Location – Alternative 3B

	Low FW	Standard FW	High FW	Revet-ment with FW	Low Berm	Med. Berm	High Berm	Hybrid Berm	Shallow Bulk-head	Deep Bulk-head	Pedestrian Gate	Vehicle Gate	Road Raising	Road Ramp	Tide Gate	Nav-Gate	Grand Total
Arthur Kill	0	189	0	0	0	0	0	0	0	0	0	0	0	0	0	0	189
Atlantic Basin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bayonne Bridge	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bayswater Park	0	0	0	0	1463	0	0	0	0	0	0	0	0	0	0	0	1463
Bergen Pt SI	0	1284	0	0	0	0	0	0	0	0	0	0	0	0	149	0	1434
Breezy Point	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bridge Street Bridge	0	0	0	990	0	0	0	0	0	0	0	0	0	0	0	0	990
Broad Channel	0	0	0	0	3276	0	444	0	15248	1065	0	0	4440	46	0	0	24518
Canarsie	1759	0	0	913	0	0	0	0	0	0	0	0	0	0	0	0	2673
Caseys Creek	0	0	0	0	0	0	697	0	0	0	0	0	0	0	64	0	761
Chelsea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Clay Street Bridge	0	1040	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1040
Coney Is Creek	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dock Bridge	94	0	0	804	0	0	0	0	0	0	0	0	0	0	0	0	897
Elizabeth River	0	0	1150	0	0	0	0	0	0	0	0	0	0	0	0	0	1150
Elizabethport	0	0	918	3032	0	0	0	0	0	0	0	0	0	0	0	0	3950
EssexCntyCorrFac	4547	1795	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6342
Flushing Creek	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fort Hancock	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gowanus Canal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Green Pt LI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Harrison Reach	681	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	681
Head of Bay Gate	0	0	1444	0	0	0	936	0	0	0	0	0	0	0	0	568	2949
Highlands	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HudsonCntyCorrFac	1705	0	0	0	0	0	0	0	0	0	0	0	140	0	0	0	1845
Inwood Marina	0	832	0	0	996	0	0	0	769	0	0	30	0	0	0	0	2628
Jersey City	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
KearnyPoint	0	5160	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5160
Kips Bay	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lenox Yard	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Leonardo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Long Island City	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Many Mind Creek	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mariners Harbor SI E	0	0	0	0	0	0	0	0	0	4107	0	0	0	0	0	0	4107
Mariners Harbor SI W	264	0	0	1892	0	0	0	0	0	631	0	0	0	0	0	0	2787
Meadowlands Gate	0	230	0	0	0	3606	0	112	0	0	0	0	0	0	47	1427	5421
Morses Creek	0	0	1060	0	0	0	0	0	0	0	0	0	0	0	0	0	1060

	Low FW	Standard FW	High FW	Revet-ment with FW	Low Berm	Med. Berm	High Berm	Hybrid Berm	Shallow Bulk-head	Deep Bulk-head	Pedestrian Gate	Vehicle Gate	Road Raising	Road Ramp	Tide Gate	Nav-Gate	Grand Total
Motts Basin N	662	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	662
Motts Basin S	0	1712	0	0	0	0	0	0	2008	0	0	52	0	0	0	0	3772
Newton Creek	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Norfolk Southern	0	353	0	2808	0	0	0	0	0	0	0	0	0	0	0	0	3161
North Arlington	0	0	0	1222	0	0	0	0	0	0	0	0	0	0	0	0	1222
Norton Basin	0	2398	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2398
Old Howard Beach	0	705	0	0	2080	0	211	0	0	0	0	0	0	0	0	0	2996
Old Howard Beach East	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	419	419
Old Howard Beach West	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	260	260
Passaic River	0	1258	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1258
Passaic Upriver	1779	390	0	0	507	0	0	0	0	0	0	123	0	0	0	0	2798
Red Hook	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Route 1 Bridge	0	1325	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1325
Roxbury	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S. Kearny-Passaic	0	2341	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2341
Sheepshead Bay	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Shell - Passaic	0	879	0	0	0	0	0	0	0	0	0	0	0	0	0	0	879
South River	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
South Slope	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tottenville	1376	0	0	761	0	0	0	0	0	449	0	0	0	0	0	0	2586
Tremley	0	0	511	0	0	0	0	0	0	0	0	0	0	0	19	0	530
UpperHudson	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wall Street	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Whitehead	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Yankee Stadium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	12868	21890	5084	12421	8320	3606	2288	112	18025	6253	0	206	4580	46	279	2675	98653

Table-E-16: Length in feet of Residual Risk Features (RRFs) by Type and Location – Alternative 4

	Low FW	Standard FW	High FW	Revet-ment with FW	Low Berm	Med. Berm	High Berm	Hybrid Berm	Shallow Bulk-head	Deep Bulk-head	Pedestrian Gate	Vehicle Gate	Road Raising	Road Ramp	Tide Gate	Nav-Gate	Grand Total
Arthur Kill	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Atlantic Basin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bayonne Bridge	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bayswater Park	0	0	0	0	1463	0	0	0	0	0	0	0	0	0	0	0	1463
Bergen Pt SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Breezy Point	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bridge Street Bridge	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Broad Channel	0	0	0	0	3276	0	444	0	15248	1065	0	0	4440	46	0	0	24518
Canarsie	1759	0	0	913	0	0	0	0	0	0	0	0	0	0	0	0	2673
Caseys Creek	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chelsea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Clay Street Bridge	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coney Is Creek	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dock Bridge	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Elizabeth River	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Elizabethport	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EssexCntyCorrFac	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Flushing Creek	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fort Hancock	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gowanus Canal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Green Pt LI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Harrison Reach	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Head of Bay Gate	0	0	1444	0	0	0	936	0	0	0	0	0	0	0	0	568	2949
Highlands	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HudsonCntyCorrFac	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Inwood Marina	0	832	0	0	996	0	0	0	769	0	0	30	0	0	0	0	2628
Jersey City	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
KearnyPoint	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kips Bay	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lenox Yard	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Leonardo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Long Island City	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Many Mind Creek	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mariners Harbor SI E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mariners Harbor SI W	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Meadowlands Gate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Morses Creek	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	Low FW	Standard FW	High FW	Revet-ment with FW	Low Berm	Med. Berm	High Berm	Hybrid Berm	Shallow Bulk-head	Deep Bulk-head	Pedestrian Gate	Vehicle Gate	Road Raising	Road Ramp	Tide Gate	Nav-Gate	Grand Total
Motts Basin N	662	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	662
Motts Basin S	0	1712	0	0	0	0	0	0	2008	0	0	52	0	0	0	0	3772
Newton Creek	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Norfolk Southern	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
North Arlington	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Norton Basin	0	2398	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2398
Old Howard Beach	0	705	0	0	2080	0	211	0	0	0	0	0	0	0	0	0	2996
Old Howard Beach East	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	419	419
Old Howard Beach West	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	260	260
Passaic River	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Passaic Upriver	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Red Hook	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Route 1 Bridge	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Roxbury	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S. Kearny-Passaic	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sheepshead Bay	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Shell - Passaic	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
South River	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
South Slope	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tottenville	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tremley	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
UpperHudson	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wall Street	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Whitehead	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Yankee Stadium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	2422	5647	1444	913	7814	0	1591	0	18025	1065	0	83	4440	46	0	1248	44738

Table-E-17: Residual Risk Features (RRF) count by Type and Location for Alternatives 2-4

	Flip Up Barrier	Pedestrian Gate	Railroad Gate	Vehicle Gate	Tide Gate	Storm Surge Barrier	Grand Total
ALTERNATIVE 2							
Arthur Kill	-	-	-	-	-	-	-
Atlantic Basin	-	-	-	-	-	-	-
Bayonne Bridge	-	-	-	-	-	-	-
Bayswater Park	-	-	-	-	-	-	-
Bergen Pt SI	-	-	1	-	-	1	2
Breezy Point	-	-	-	-	-	-	-
Bridge Street Bridge	-	-	-	-	-	-	-
Broad Channel	-	-	-	2	-	-	2
Canarsie	-	-	-	-	-	-	-
Caseys Creek	-	-	1	-	-	1	2
Chelsea	9	11	-	-	-	-	20
Clay Street Bridge	-	-	-	-	-	-	-
Coney Is Creek	-	-	-	-	-	-	-
Dock Bridge	-	-	-	-	-	-	-
Elizabeth River	-	-	-	-	-	-	-
Elizabethport	-	-	-	-	-	-	-
EssexCntyCorrFac	-	-	-	-	-	-	-
Flushing Creek	-	-	1	-	-	1	2
Fort Hancock	-	1	-	-	-	-	1
Gowanus Canal	-	-	-	-	1	-	1
Green Pt LI	-	-	-	-	-	-	-
Harrison Reach	-	-	-	-	-	-	-
Head of Bay Gate	-	-	-	-	1	-	1
Highlands	-	-	-	-	1	-	1
HudsonCntyCorrFac	-	-	-	-	-	-	-
Inwood Marina	-	1	-	-	-	-	1
Jersey City	-	-	-	-	-	-	-
KearnyPoint	-	-	-	-	-	-	-
Kips Bay	-	-	-	-	-	-	-
Lenox Yard	-	-	-	-	-	-	-
Leonardo	-	-	-	-	-	-	-
Long Island City	-	-	-	-	-	-	-
Many Mind Creek	-	-	1	-	-	1	2
Mariners Harbor SI E	-	-	-	-	-	-	-
Mariners Harbor SI W	-	-	-	-	-	-	-
Meadowlands Gate	-	-	1	-	1	1	3
Morses Creek	-	-	-	-	-	-	-
Motts Basin N	-	-	-	-	-	-	-
Motts Basin S	-	1	-	-	-	-	1
Newton Creek	-	-	-	-	-	-	-
Norfolk Southern	-	-	-	-	-	-	-
North Arlington	-	-	-	-	-	-	-
Norton Basin	-	-	-	-	-	-	-
Old Howard Beach	-	-	-	-	-	-	-
Old Howard Beach East	-	-	-	-	1	-	1
Old Howard Beach West	-	-	-	-	1	-	1
Passaic River	-	-	-	-	-	-	-
Passaic Upriver	-	2	-	-	-	-	2
Red Hook	-	-	-	-	-	-	-
Route 1 Bridge	-	-	-	-	-	-	-
Roxbury	-	-	-	-	-	-	-
S. Kearny-Passaic	-	-	-	-	-	-	-
Sheepshead Bay	-	-	-	-	-	-	-
Shell - Passaic	-	-	-	-	-	-	-
South River	-	-	-	-	-	-	-
South Slope	-	-	-	-	-	-	-
Tottenville	-	-	-	-	-	-	-
Tremley	-	-	1	-	-	1	2
UpperHudson	-	-	-	-	-	-	-
Wall Street	-	1	-	-	-	-	1
Whitehead	-	-	-	-	-	-	-
Yankee Stadium	-	-	-	-	-	-	-
TOTAL	9	17	6	2	6	6	46
ALTERNATIVE 3A							
Arthur Kill	-	-	-	-	-	-	-
Atlantic Basin	-	-	-	-	-	-	-
Bayonne Bridge	-	-	-	-	-	-	-
Bayswater Park	-	-	-	-	-	-	-
Bergen Pt SI	-	-	1	-	-	1	2
Breezy Point	-	-	-	-	-	-	-
Bridge Street Bridge	-	-	-	-	-	-	-
Broad Channel	-	-	-	2	-	-	2
Canarsie	-	-	-	-	-	-	-
Caseys Creek	-	-	1	-	-	1	2
Chelsea	9	11	-	-	-	-	20

	Flip Up Barrier	Pedestrian Gate	Railroad Gate	Vehicle Gate	Tide Gate	Storm Surge Barrier	Grand Total
Clay Street Bridge	-	-	-	-	-	-	-
Coney Is Creek	-	-	-	-	-	-	-
Dock Bridge	-	-	-	-	-	-	-
Elizabeth River	-	-	-	-	-	-	-
Elizabethport	-	-	-	-	-	-	-
EssexCntyCorrFac	-	-	-	-	-	-	-
Flushing Creek	-	-	1	-	-	1	2
Fort Hancock	-	-	-	-	-	-	-
Gowanus Canal	-	-	-	-	1	-	1
Green Pt LI	-	-	-	-	-	-	-
Harrison Reach	-	-	-	-	-	-	-
Head of Bay Gate	-	-	-	-	1	-	1
Highlands	-	-	-	-	-	-	-
HudsonCntyCorrFac	-	-	-	-	-	-	-
Inwood Marina	-	1	-	-	-	-	1
Jersey City	-	-	-	-	-	-	-
KearnyPoint	-	-	-	-	-	-	-
Kips Bay	-	-	-	-	-	-	-
Lenox Yard	-	-	-	-	-	-	-
Leonardo	-	-	-	-	-	-	-
Long Island City	-	-	-	-	-	-	-
Many Mind Creek	-	-	-	-	-	-	-
Mariners Harbor SI E	-	-	-	-	-	-	-
Mariners Harbor SI W	-	-	-	-	-	-	-
Meadowlands Gate	-	-	1	-	1	1	3
Morses Creek	-	-	-	-	-	-	-
Motts Basin N	-	-	-	-	-	-	-
Motts Basin S	-	1	-	-	-	-	1
Newton Creek	-	-	-	-	-	-	-
Norfolk Southern	-	-	-	-	-	-	-
North Arlington	-	-	-	-	-	-	-
Norton Basin	-	-	-	-	-	-	-
Old Howard Beach	-	-	-	-	-	-	-
Old Howard Beach East	-	-	-	-	1	-	1
Old Howard Beach West	-	-	-	-	1	-	1
Passaic River	-	-	-	-	-	-	-
Passaic Upriver	-	2	-	-	-	-	2
Red Hook	-	-	-	-	-	-	-
Route 1 Bridge	-	-	-	-	-	-	-
Roxbury	-	-	-	-	-	-	-
S. Kearny-Passaic	-	-	-	-	-	-	-
Sheepshead Bay	-	-	-	-	-	-	-
Shell - Passaic	-	-	-	-	-	-	-
South River	-	-	-	-	-	-	-
South Slope	-	-	-	-	-	-	-
Tottenville	-	-	-	-	-	-	-
Tremley	-	-	1	-	-	1	2
UpperHudson	-	-	-	-	-	-	-
Wall Street	-	1	-	-	-	-	1
Whitehead	-	-	-	-	-	-	-
Yankee Stadium	-	-	-	-	-	-	-
TOTAL	9	16	5	2	5	5	42
ALTERNATIVE 3B							
Arthur Kill	-	-	-	-	-	-	-
Atlantic Basin	-	-	-	-	-	-	-
Bayonne Bridge	-	-	-	-	-	-	-
Bayswater Park	-	-	-	-	-	-	-
Bergen Pt SI	-	-	1	-	-	1	2
Breezy Point	-	-	-	-	-	-	-
Bridge Street Bridge	-	-	-	-	-	-	-
Broad Channel	-	-	-	2	-	-	2
Canarsie	-	-	-	-	-	-	-
Caseys Creek	-	-	1	-	-	1	2
Chelsea	-	-	-	-	-	-	-
Clay Street Bridge	-	-	-	-	-	-	-
Coney Is Creek	-	-	-	-	-	-	-
Dock Bridge	-	-	-	-	-	-	-
Elizabeth River	-	-	-	-	-	-	-
Elizabethport	-	-	-	-	-	-	-
EssexCntyCorrFac	-	-	-	-	-	-	-
Flushing Creek	-	-	-	-	-	-	-
Fort Hancock	-	-	-	-	-	-	-
Gowanus Canal	-	-	-	-	-	-	-
Green Pt LI	-	-	-	-	-	-	-
Harrison Reach	-	-	-	-	-	-	-
Head of Bay Gate	-	-	-	-	1	-	1
Highlands	-	-	-	-	-	-	-

	Flip Up Barrier	Pedestrian Gate	Railroad Gate	Vehicle Gate	Tide Gate	Storm Surge Barrier	Grand Total
HudsonCntyCorrFac	-	-	-	-	-	-	-
Inwood Marina	-	1	-	-	-	-	1
Jersey City	-	-	-	-	-	-	-
KearnyPoint	-	-	-	-	-	-	-
Kips Bay	-	-	-	-	-	-	-
Lenox Yard	-	-	-	-	-	-	-
Leonardo	-	-	-	-	-	-	-
Long Island City	-	-	-	-	-	-	-
Many Mind Creek	-	-	-	-	-	-	-
Mariners Harbor SI E	-	-	-	-	-	-	-
Mariners Harbor SI W	-	-	-	-	-	-	-
Meadowlands Gate	-	-	1	-	1	1	3
Morses Creek	-	-	-	-	-	-	-
Motts Basin N	-	-	-	-	-	-	-
Motts Basin S	-	1	-	-	-	-	1
Newton Creek	-	-	-	-	-	-	-
Norfolk Southern	-	-	-	-	-	-	-
North Arlington	-	-	-	-	-	-	-
Norton Basin	-	-	-	-	-	-	-
Old Howard Beach	-	-	-	-	-	-	-
Old Howard Beach East	-	-	-	-	1	-	1
Old Howard Beach West	-	-	-	-	1	-	1
Passaic River	-	-	-	-	-	-	-
Passaic Upriver	-	2	-	-	-	-	2
Red Hook	-	-	-	-	-	-	-
Route 1 Bridge	-	-	-	-	-	-	-
Roxbury	-	-	-	-	-	-	-
S. Kearny-Passaic	-	-	-	-	-	-	-
Sheepshead Bay	-	-	-	-	-	-	-
Shell - Passaic	-	-	-	-	-	-	-
South River	-	-	-	-	-	-	-
South Slope	-	-	-	-	-	-	-
Tottenville	-	-	-	-	-	-	-
Tremley	-	-	1	-	-	1	2
UpperHudson	-	-	-	-	-	-	-
Wall Street	-	-	-	-	-	-	-
Whitehead	-	-	-	-	-	-	-
Yankee Stadium	-	-	-	-	-	-	-
TOTAL	-	4	4	2	4	4	18
ALTERNATIVE 4							
Arthur Kill	-	-	-	-	-	-	-
Atlantic Basin	-	-	-	-	-	-	-
Bayonne Bridge	-	-	-	-	-	-	-
Bayswater Park	-	-	-	-	-	-	-
Bergen Pt SI	-	-	-	-	-	-	-
Breezy Point	-	-	-	-	-	-	-
Bridge Street Bridge	-	-	-	-	-	-	-
Broad Channel	-	-	-	2	-	-	2
Canarsie	-	-	-	-	-	-	-
Caseys Creek	-	-	-	-	-	-	-
Chelsea	-	-	-	-	-	-	-
Clay Street Bridge	-	-	-	-	-	-	-
Coney Is Creek	-	-	-	-	-	-	-
Dock Bridge	-	-	-	-	-	-	-
Elizabeth River	-	-	-	-	-	-	-
Elizabethport	-	-	-	-	-	-	-
EssexCntyCorrFac	-	-	-	-	-	-	-
Flushing Creek	-	-	-	-	-	-	-
Fort Hancock	-	-	-	-	-	-	-
Gowanus Canal	-	-	-	-	-	-	-
Green Pt LI	-	-	-	-	-	-	-
Harrison Reach	-	-	-	-	-	-	-
Head of Bay Gate	-	-	-	-	1	-	1
Highlands	-	-	-	-	-	-	-
HudsonCntyCorrFac	-	-	-	-	-	-	-
Inwood Marina	-	1	-	-	-	-	1
Jersey City	-	-	-	-	-	-	-
KearnyPoint	-	-	-	-	-	-	-
Kips Bay	-	-	-	-	-	-	-
Lenox Yard	-	-	-	-	-	-	-
Leonardo	-	-	-	-	-	-	-
Long Island City	-	-	-	-	-	-	-
Many Mind Creek	-	-	-	-	-	-	-
Mariners Harbor SI E	-	-	-	-	-	-	-
Mariners Harbor SI W	-	-	-	-	-	-	-
Meadowlands Gate	-	-	-	-	-	-	-
Morses Creek	-	-	-	-	-	-	-

	Flip Up Barrier	Pedestrian Gate	Railroad Gate	Vehicle Gate	Tide Gate	Storm Surge Barrier	Grand Total
Motts Basin N	-	-	-	-	-	-	-
Motts Basin S	-	1	-	-	-	-	1
Newton Creek	-	-	-	-	-	-	-
Norfolk Southern	-	-	-	-	-	-	-
North Arlington	-	-	-	-	-	-	-
Norton Basin	-	-	-	-	-	-	-
Old Howard Beach	-	-	-	-	-	-	-
Old Howard Beach East	-	-	-	-	1	-	1
Old Howard Beach West	-	-	-	-	1	-	1
Passaic River	-	-	-	-	-	-	-
Passaic Upriver	-	-	-	-	-	-	-
Red Hook	-	-	-	-	-	-	-
Route 1 Bridge	-	-	-	-	-	-	-
Roxbury	-	-	-	-	-	-	-
S. Kearny-Passaic	-	-	-	-	-	-	-
Sheepshead Bay	-	-	-	-	-	-	-
Shell - Passaic	-	-	-	-	-	-	-
South River	-	-	-	-	-	-	-
South Slope	-	-	-	-	-	-	-
Tottenville	-	-	-	-	-	-	-
Tremley	-	-	-	-	-	-	-
UpperHudson	-	-	-	-	-	-	-
Wall Street	-	-	-	-	-	-	-
Whitehead	-	-	-	-	-	-	-
Yankee Stadium	-	-	-	-	-	-	-
TOTAL	-	2	-	2	3	-	7



**US Army Corps
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New York District

Shore Based Measures Sub-Appendix

Annex F – SBM and RRF Quantity Take-Offs

DRAFT

New York – New Jersey Harbor and Tributaries Coastal Storm Risk Management Feasibility Study

Annex B1.F

September 2022

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 - A.1 Material Take-Offs for SBMs 4
 - A.2 Material Take-Offs for RRFs 5

A. Quantity Take-Offs

Measure quantities for Shore Based Measures (SBMs) and Risk Reduction Features¹ (RRFs) are presented in this annex. Feature types for SBMs and Induced Flooding mitigation Features² (IFF) are identical, thus, measure quantities for IFFs are the same as for the SBMs. Quantities are generally provided in linear foot, however, for gates and pre-fabricated items such as flip-up barriers, operable floodgates and tide gates, the total quantity per each SBM/IFF/RRF feature was provided instead. This annex includes the following information in order:

- Material Take-Offs for SBMs
- Material Take-Offs for RRFs

¹ Formerly also referred to as residual risk feature.

² Formerly also referred to as induced flooding feature.

A.1 Material Take-Offs for SBMs

Title: Quantities Per Linear Foot for Cost Estimate
 Contract No.: W912DS-18-D-0006
 Task Order No.: W912DS-19F0111

Discipline: Civil Engineering
 Prepared By: Bryan Troast
 Sheet: 1 of 5
 Date: 2/14/2020

Project Title: New York/New Jersey Harbor & Tributaries CSRM Study
 Consultant Name: Moffatt & Nichol
 Consultant Contact: M. Kluijver
 Revision: 1

Checked By: I.Kwong
 Date: 2/28/2020

XL Floodwall		
Item	Quantity per linear foot	Unit
Reinforced Concrete for Flood Wall and Splash Aprons	4.70	CY
PZ-27 Sheetpile Wall	0.43	TN
HP 14x102 Piles (86.44' Long)	24.70	LF
Excavation	5.59	CY
Repair Disturbed Pavement	0.11	SY
Additional Appurtenances: The items below are outside of the core construction quantities but should still be considered in the cost estimate. Ladders/Stairs with handrail to provide access to flood side and aid inspection Transitions between feature types Utility relocation, drainage features, aesthetic features, real estate, right-of-way, easement, environmental mitigation		

Large Floodwall		
Item	Quantity per linear foot	Unit
Reinforced Concrete for Flood Wall and Splash Aprons	3.56	CY
PZ-27 Sheetpile Wall	0.34	TN
HP 14x89 Piles (84.33' Long)	19.84	LF
Excavation	4.07	CY
Repair Disturbed Pavement	0.11	SY
Additional Appurtenances: The items below are outside of the core construction quantities but should still be considered in the cost estimate. Ladders/Stairs with handrail to provide access to flood side and aid inspection Transitions between feature types Utility relocation, drainage features, aesthetic features, real estate, right-of-way, easement, environmental mitigation		

Medium Floodwall		
Item	Quantity per linear foot	Unit
Reinforced Concrete for Flood Wall and Splash Aprons	3.00	CY
PZ-27 Sheetpile Wall	0.27	TN
HP 14x89 Piles (89' Long)	17.80	LF
Excavation	3.15	CY
Repair Disturbed Pavement	0.11	SY
Additional Appurtenances: The items below are outside of the core construction quantities but should still be considered in the cost estimate. Ladders/Stairs with handrail to provide access to flood side and aid inspection Transitions between feature types Utility relocation, drainage features, aesthetic features, real estate, right-of-way, easement, environmental mitigation		

Title: Quantities Per Linear Foot for Cost Estimate
 Contract No.: W912DS-18-D-0006 Discipline: Civil Engineering Sheet: 2 of 5
 Task Order No.: W912DS-19F0111 Prepared By: Bryan Troast Date: 2/14/2020

Project Title: New York/New Jersey Harbor & Tributaries CSRM Study Checked By: I.Kwong Date: 2/28/2020
 Consultant Name: Moffatt & Nichol
 Consultant Contact: M. Kluijver
 Revision: 1

Large Levee		
Item	Quantity per linear foot	Unit
Impervious Core	14.11	CY
Fill Dirt	16.74	CY
Berm Excavation	8.19	CY
Drainage Ditch Excavation	0.45	CY
Grass Cover with Matting	11.89	SY
Additional Appurtenances: The items below are outside of the core construction quantities but should still be considered in the cost estimate. Patrol/Inspection Roads Access Ramps Transitions between feature types Utility relocation, drainage features, aesthetic features, real estate, right-of-way, easement, environmental mitigation		

Medium Levee		
Item	Quantity per linear foot	Unit
Impervious Core	6.70	CY
Fill Dirt	6.37	CY
Berm Excavation	5.04	CY
Drainage Ditch Excavation	0.45	CY
Grass Cover with Matting	7.89	SY
Additional Appurtenances: The items below are outside of the core construction quantities but should still be considered in the cost estimate. Patrol/Inspection Roads Access Ramps Transitions between feature types Utility relocation, drainage features, aesthetic features, real estate, right-of-way, easement, environmental mitigation		

Title: Quantities Per Linear Foot for Cost Estimate
 Contract No.: W912DS-18-D-0006 Discipline: Civil Engineering Sheet: 3 of 5
 Task Order No.: W912DS-19F0111 Prepared By: Bryan Troast Date: 2/14/2020

Project Title: New York/New Jersey Harbor & Tributaries CSRM Study Checked By: I.Kwong Date: 2/28/2020
 Consultant Name: Moffatt & Nichol
 Consultant Contact: M. Kluijver
 Revision: 1

Elevated Promenade		
Item	Quantity per linear foot	Unit
Sand Fill	23.61	CY
Reinforced Concrete	1.64	CY
Riprap	1.65	TN
Bedding Stone	1.60	TN
Steel Flat Sheet Piles PS 27.5	2.25	TN
Geotextile	2.11	SY
Additional Appurtenances: The items below are outside of the core construction quantities but should still be considered in the cost estimate. Access Ramps Benches Emergency Phones AEDs Bike Racks Bollards Concrete Markings (Striping for Pedestrians / Bikes) Signage Lighting Conduit (to power lighting) Transitions between feature types Utility relocation, drainage features, aesthetic features, real estate, right-of-way, easement, environmental mitigation		

Reinforced Dune with Partial Dune Cover - Urban		
Item	Quantity per linear foot	Unit
Bedding Stone	9.67	TN
Armor Stone W-50	12.39	TN
Splash Apron Stone	4.19	TN
Reinforced Concrete Pile Cap	0.60	CY
FCZ 51 Sheetpile Wall	0.63	TN
Geotextile Fabric	7.56	SY
Planting Area	13.11	SY
Sand Fill	40.85	CY
Excavation	6.96	CY
Additional Appurtenances: The items below are outside of the core construction quantities but should still be considered in the cost estimate: Stairs and ramps with handrail Dune Fence to protect plantings Transitions between feature types Utility relocation, drainage features, aesthetic features, real estate, right-of-way, easement, environmental mitigation		

Reinforced Dune with Natural Dune Cover - Natural		
Item	Quantity per linear foot	Unit
Bedding Stone	10.00	TN
Armor Stone W-50	12.39	TN
Splash Apron Stone	5.80	TN
Reinforced Concrete Pile Cap	0.36	CY
FCZ-51 Sheetpile Wall	0.63	TN
Geotextile Fabric	9.00	SY
Planting Area	22.22	SY
Sand Fill	55.89	CY
Excavation	16.93	CY
Additional Appurtenances: The items below are outside of the core construction quantities but should still be considered in the cost estimate: Stairs and ramps with handrail Dune Fence to protect plantings Transitions between feature types Utility relocation, drainage features, aesthetic features, real estate, right-of-way, easement, environmental mitigation		

Title: Quantities Per Linear Foot for Cost Estimate
 Contract No.: W912DS-18-D-0006 Discipline: Civil Engineering Sheet: 4 of 5
 Task Order No.: W912DS-19F0111 Prepared By: Bryan Troast Date: 2/14/2020

Project Title: New York/New Jersey Harbor & Tributaries CSRM Study Checked By: I.Kwong Date: 2/28/2020
 Consultant Name: Moffatt & Nichol
 Consultant Contact: M. Kluijver
 Revision: 1

Seawall		
Item	Quantity per linear foot	Unit
Reinforced Concrete	7.30	CY
Armor Stone D50 = 2.3'	22.44	TN
Excavation	22.96	CY
PZ-27 Sheetpile Wall	0.57	TN
HP 14x117 Piles (95')	24.86	LF
Geotextile	8.00	SY
Underlayer Stone D50 = 1.1'	9.48	TN
Additional Appurtenances: The items below are outside of the core construction quantities but should still be considered in the cost estimate. Ladders/Stairs with handrail to provide access to flood side and aid inspection Transitions between feature types Utility relocation, drainage features, aesthetic features, real estate, right-of-way, easement, environmental mitigation		

Floodwall With Park Integration		
Item	Quantity per linear foot	Unit
Reinforced Concrete	4.52	CY
Fill Dirt	15.67	CY
Excavation	4.15	CY
PZ-27 Sheetpile Wall	0.35	TN
HP 14x102 Piles (70' long)	20.00	LF
Grass Cover With Matting	11.89	SY
Excavation	5.00	CY
Repair Disturbed Pavement	0.11	SY
Additional Appurtenances: The items below are outside of the core construction quantities but should still be considered in the cost estimate. Benches Picnic Tables Lighting Landscaping Stairs and ramps with handrail Transitions between feature types Utility relocation, drainage features, aesthetic features, real estate, right-of-way, easement, environmental mitigation		

Title: Quantities Per Linear Foot for Cost Estimate
 Contract No.: W912DS-18-D-0006 Discipline: Civil Engineering Sheet: 5 of 5
 Task Order No.: W912DS-19F0111 Prepared By: Bryan Troast Date: 2/14/2020

Project Title: New York/New Jersey Harbor & Tributaries CSRM Study Checked By: I.Kwong Date: 2/28/2020
 Consultant Name: Moffatt & Nichol
 Consultant Contact: M. Kluijver
 Revision: 1

Flip-up Barrier		
Item	Quantity	Unit
Flip-up Barrier (Super-structure)*	NA	NA
Reinforced Concrete for Gate Foundation and Splash Aprons	3.02	CY
PZ-27 Sheetpile Wall	0.43	TN
HP 14x102 Piles (86.44' Long)	24.70	LF
Excavation	5.59	CY
Repair Disturbed Pavement	0.11	SY

Additional Appurtenances: The items below are outside of the core construction quantities but should still be considered in the cost estimate.

Exclusions per Vendor

Transitions/ additional structural supports due to change in directions or obstructions

Transitions between feature types

Utility relocation, drainage features, aesthetic features, real estate, right-of-way, easement, environmental mitigation

*Note: The Flip-up barrier length was provided. Commensurate with the level of analysis for this feasibility study and nature of the project, material quantities for the superstructure per linear foot has not been obtained for this passive automatic flood barrier as it will be highly site dependent. A quote from the Vendor is provided. In addition, the foundation quantity per linear foot is provided.

Pedestrian, Vehicular and Railroad Gates		
Item	Quantity	Unit
Operable Floodgates (Super-structure)*	1.00	Each
Reinforced Concrete for Gate Foundation and Splash Aprons	2.44	CY
PZ-27 Sheetpile Wall	0.59	TN
HP 14x89 Piles (84.33' Long)	19.84	LF
Excavation	4.07	CY
Repair Disturbed Pavement	0.11	SY

Additional Appurtenances: The items below are outside of the core construction quantities but should still be considered in the cost estimate.

Transitions between feature types

Utility relocation, drainage features, aesthetic features, real estate, right-of-way, easement, environmental mitigation

*Note: Deployable floodgate super-structure (roller or swing gate) quantities are on a per each basis. The deployable flood gates include pedestrian gates, railroad gates and vehicle gates. The total quantity/number per each SBM alignment is provided. In addition, the foundation quantity per linear foot is provided. Commensurate with the level of analysis for this feasibility study and nature of the project, material quantities for the super-structure per linear foot has not been obtained for this passive automatic flood barrier as it will be highly site dependent.

Tide Gates		
Item	Quantity*	Unit
Reinforced Concrete	14.49	CY
PZ-27 Sheetpile Wall	0.41	TN
H-Piles (HP 14x89, 75 ft long)	134.00	LF
Grate (4'x2'x7")	0.29	EA
Slide Gates	0.29	EA

Additional Appurtenances: The items below are outside of the core construction quantities but should still be considered in the cost estimate.

Access Ramps

Emergency Phones

Signage

Lighting

Conduit (to power lighting)

Gate Actuator

Mechanical parts

Security fence and rails

Transitions between feature types

Utility relocation, drainage features, aesthetic features, real estate, right-of-way, easement, environmental mitigation

*Note: Tide gates quantities are on a per linear foot basis. Commensurate with the level of analysis for this feasibility study and nature of the project, material quantities for the tide gate per linear foot has been obtained for a tide gate with a length of 75 feet, which is an average design tide gate length for the project.

A.2 Material Take-Offs for RRFs

Title:	Quantities Per Linear Foot for Cost Estimate	Discipline:	Civil Engineering	Sheet:	1 of 7
Contract No.:	W912DR-20-D-0016: Through USACE NAB Contract, Delivery Order	Prepared By:	Ivy Kwong	Date:	5/25/2022
Task Order No.:	TO3	Checked By:	Sean Jessup	Date:	5/27/2022
Project Title:	New York/New Jersey Harbor & Tributaries Study (HATS) TO3				
Consultant Name:	Moffatt & Nichol				
Consultant Contact:	M. Kluijver				
Revision:	3				

High Floodwall						
Item					Quantity per linear foot	Unit
Concrete Flood Wall					2.81	CY
Steel Sheetpile					0.34	tons
Pile					0.36	tons
Fill					5.11	CY
Excavation					3.41	CY
Repair Disturbed Pavement					0.11	SY
Additional Appurtenances: The items below are outside of the core construction quantities but should still be considered in the cost estimate.						
Ladders/Stairs with handrail to provide access to flood side and aid inspection						
Transitions between feature types						
Utility relocation, drainage features, aesthetic features, real estate, right-of-way, easement, environmental mitigation						

Standard Floodwall						
Item					Quantity per linear foot	Unit
Concrete Flood Wall					1.48	CY
Steel Sheetpile					0.27	tons
Piles					0.22	tons
Fill					2.69	CY
Excavation					2.06	CY
Repair Disturbed Pavement					0.11	SY
Additional Appurtenances: The items below are outside of the core construction quantities but should still be considered in the cost estimate.						
Ladders/Stairs with handrail to provide access to flood side and aid inspection						
Transitions between feature types						
Utility relocation, drainage features, aesthetic features, real estate, right-of-way, easement, environmental mitigation						

Title:	Quantities Per Linear Foot for Cost Estimate		
Contract No.:	W912DR-20-D-0016: Through USACE NAB Contract,	Discipline:	Civil Engineering
Task Order No.:	TO3	Prepared By:	Ivy Kwong
		Sheet:	2 of 7
		Date:	5/25/2022
Project Title:	New York/New Jersey Harbor & Tributaries Study		
Consultant Name:	(HATS) TO3	Checked By:	Sean Jessup
Consultant Contact:	Moffatt & Nichol	Date:	5/27/2022
Revision:	M. Kluijver		
	3		

Low Floodwall				
Item			Quantity per linear foot	Unit
Concrete Flood Wall			0.83	CY
Steel Sheetpile			0.18	tons
Piles			0.14	tons
Fill			1.75	CY
Excavation			1.27	CY
Repair Disturbed Pavement			0.11	SY
<p>Additional Appurtenances: The items below are outside of the core construction quantities but should still be considered in the cost estimate.</p> <p>Ladders/Stairs with handrail to provide access to flood side and aid inspection</p> <p>Transitions between feature types</p> <p>Utility relocation, drainage features, aesthetic features, real estate, right-of-way, easement, environmental mitigation</p>				

High Berm				
Item			Quantity per linear foot	Unit
Impervious Core			4.63	CY
Berm Soil			30.40	CY
Excavation - Berm and Core			4.19	CY
Excavation - Drainage Ditch			0.44	CY
Grass Cover with Matting			6.64	SY
<p>Additional Appurtenances: The items below are outside of the core construction quantities but should still be considered in the cost estimate.</p> <p>Patrol/Inspection Roads</p> <p>Access Ramps</p> <p>Transitions between feature types</p> <p>Utility relocation, drainage features, aesthetic features, real estate, right-of-way, easement, environmental mitigation</p>				

Title:	Quantities Per Linear Foot for Cost Estimate		
Contract No.:	W912DR-20-D-0016: Through USACE NAB Contract,	Discipline:	Civil Engineering
Task Order No.:	TO3	Prepared By:	Ivy Kwong
		Sheet:	3 of 7
		Date:	5/25/2022
Project Title:	New York/New Jersey Harbor & Tributaries Study		
Consultant Name:	(HATS) TO3	Checked By:	Sean Jessup
Consultant Contact:	Moffatt & Nichol	Date:	5/27/2022
Revision:	M. Kluijver		
	3		

Medium Berm				
Item			Quantity per linear foot	Unit
Impervious Core			2.22	CY
Berm Soil			11.00	CY
Excavation - Berm and Core			2.26	CY
Excavation - Drainage Ditch			0.37	CY
Grass Cover with Matting			5.33	SY
<p>Additional Appurtenances: The items below are outside of the core construction quantities but should still be considered in the cost estimate.</p> <p>Patrol/Inspection Roads</p> <p>Access Ramps</p> <p>Transitions between feature types</p> <p>Utility relocation, drainage features, aesthetic features, real estate, right-of-way, easement, environmental mitigation</p>				

Low Berm				
Item			Quantity per linear foot	Unit
Impervious Core			1.30	CY
Berm Soil			7.69	CY
Excavation - Berm and Core			1.96	CY
Excavation - Drainage Ditch			0.44	CY
Grass Cover with Matting			3.06	SY
<p>Additional Appurtenances: The items below are outside of the core construction quantities but should still be considered in the cost estimate.</p> <p>Patrol/Inspection Roads</p> <p>Access Ramps</p> <p>Transitions between feature types</p> <p>Utility relocation, drainage features, aesthetic features, real estate, right-of-way, easement, environmental mitigation</p>				

Title: Quantities Per Linear Foot for Cost Estimate
 Contract No.: W912DR-20-D-0016: Through USACE NAB Contract, Discipline: Civil Engineering Sheet: 4 of 7
 Task Order No.: TO3 Prepared By: Ivy Kwong Date: 5/25/2022
 Project Title: New York/New Jersey Harbor & Tributaries Study Checked By: Sean Jessup Date: 5/27/2022
 Consultant Name: (HATS) TO3
 Consultant Contact: M. Kluijver
 Revision: 3

Hybrid Berm				Quantity per linear foot	Unit
Sheetpile Wall				0.19	Ton
Berm Soil				64.46	CY
Excavation - Berm				0.58	CY
Excavation - Drainage Ditch				0.44	CY
Grass Cover with Matting				3.27	SY
Geotextile				0.94	SY
Riprap				0.45	CY
Concrete				0.13	CY
<p>Additional Appurtenances: The items below are outside of the core construction quantities but should still be considered in the cost estimate.</p> <p>Patrol/Inspection Roads Access Ramps Transitions between feature types Utility relocation, drainage features, aesthetic features, real estate, right-of-way, easement, environmental mitigation</p>					

Revetment with Floodwall				Quantity per linear foot	Unit
Concrete Cap Wall				0.70	CY
Steel Sheetpile				0.26	tons
Repair Disturbed Pavement				0.56	SY
Armor Stone				10.38	TON
Bedding Stone				3.22	TON
Total Excavation				3.72	CY
Geotextile				5.00	SY
<p>Additional Appurtenances: The items below are outside of the core construction quantities but should still be considered in the cost estimate:</p> <p>Stairs and ramps with handrail Dune Fence to protect plantings Transitions between feature types Utility relocation, drainage features, aesthetic features, real estate, right-of-way, easement, environmental mitigation</p>					

Title: Quantities Per Linear Foot for Cost Estimate
 Contract No.: W912DR-20-D-0016: Through USACE NAB Contract,
 Task Order No.: TO3
 Project Title: New York/New Jersey Harbor & Tributaries Study
 Consultant Name: (HATS) TO3
 Consultant Contact: Moffatt & Nichol
 Revision: M. Kluijver
 3

Discipline: Civil Engineering Sheet: 5 of 7
 Prepared By: Ivy Kwong Date: 5/25/2022
 Checked By: Sean Jessup Date: 5/27/2022

Deep Bulkhead						
Item					Quantity per linear foot	Unit
Concrete cap					0.43	CY
Steel Sheetpile					1.05	TON
Fill					1.76	CY
Splash pad					0.19	CY
Repair Disturbed Pavement					0.11	SY
Additional Appurtenances: The items below are outside of the core construction quantities but should still be considered in the cost estimate. Ladders/Stairs with handrail to provide access to flood side and aid inspection Transitions between feature types Utility relocation, drainage features, aesthetic features, real estate, right-of-way, easement, environmental mitigation						

Shallow Bulkhead						
Item					Quantity per linear foot	Unit
Concrete cap					0.24	CY
Steel Sheetpile					0.65	tons
Fill					0.64	CY
Splash pad					0.19	CY
Repair Disturbed Pavement					0.11	SY
Additional Appurtenances: The items below are outside of the core construction quantities but should still be considered in the cost estimate. Ladders/Stairs with handrail to provide access to flood side and aid inspection Transitions between feature types Utility relocation, drainage features, aesthetic features, real estate, right-of-way, easement, environmental mitigation						

Title: Quantities Per Linear Foot for Cost Estimate
 Contract No.: W912DR-20-D-0016: Through USACE NAB Contract, Discipline: Civil Engineering Sheet: 6 of 7
 Task Order No.: TO3 Prepared By: Ivy Kwong Date: 5/25/2022
 Project Title: New York/New Jersey Harbor & Tributaries Study Checked By: Sean Jessup Date: 5/27/2022
 Consultant Name: (HATS) TO3
 Consultant Contact: M. Kluijver
 Revision: 3

Pedestrian and Vehicular Gates			
Item			Quantity* Unit
Operable Floodgates (Super-structure)*			1.00 Each
Concrete			1.2 CY
Sheet Pile Cutoff wall (PZ27)			0.4 ton
H-Piles (HP 14 x 73)			0.5 ton
Fill			1 CY
Cut/Excavation			2.1 CY
Repair Disturbed Pavement			0.11 SY
Additional Appurtenances: The items below are outside of the core construction quantities but should still be considered in the cost estimate. Transitions between feature types Utility relocation, drainage features, aesthetic features, real estate, right-of-way, easement, environmental mitigation			

*Note: Deployable floodgate super-structure (roller or swing gate) quantities are on a per each basis. The deployable flood gates include pedestrian gates and vehicle gates. The total quantity/number per each RRF alignment is provided. In addition, the foundation quantity per linear foot is provided. Commensurate with the level of analysis for this feasibility study and nature of the project, material quantities for the super-structure per linear foot has not been obtained for this passive automatic flood barrier as it will be highly site dependent.

Tide Gates			
Item			Quantity* Unit
Reinforced Concrete			11.00 CY
PZ-27 Sheetpile Wall			0.41 TN
H-Piles (HP 14x89, 75 ft long)			134.00 LF
Gate (4'x2'x7")			0.29 EA
Slide Gates			0.29 EA
Additional Appurtenances: The items below are outside of the core construction quantities but should still be considered in the cost estimate. Access Ramps Emergency Phones Signage Lighting Conduit (to power lighting) Gate Actuator Mechanical parts Security fence and rails Transitions between feature types Utility relocation, drainage features, aesthetic features, real estate, right-of-way, easement, environmental mitigation			

*Note: Tide gates quantities are on a per linear foot basis. Commensurate with the level of analysis for this feasibility study and nature of the project, material quantities for the tide gate per linear foot has been obtained for a tide gate with a length of 75 feet, which is an average design tide gate length for the project.

Title: Quantities Per Linear Foot for Cost Estimate
 Contract No.: W912DR-20-D-0016: Through USACE NAB Contract, Discipline: Civil Engineering Sheet: 7 of 7
 Task Order No.: TO3 Prepared By: Ivy Kwong Date: 5/25/2022
 Project Title: New York/New Jersey Harbor & Tributaries Study Checked By: Sean Jessup Date: 5/27/2022
 Consultant Name: (HATS) TO3
 Consultant Contact: M. Kluijver
 Revision: 3

Road Ramp			
Item		Quantity*	Unit
Fill		151.03	CY
Sheetpile Wall		6.32	Ton
Excavation		10.74	CY
Pavement, Concrete, and Sub Base removal		118.69	CY
Bedding Stone		62.96	CY
Hand Rail		170.00	ft
Concrete		41.36	CY
Pavement 7" thickness		44.07	CY
Geotextile		519.44	SY
Preformed Detectable Warning Surface		9.44	SY
Inlaid Pavement Markings		170.00	LF
Additional Appurtenances: The items below are outside of the core construction quantities but should still be considered in the cost estimate. Transitions between feature types Utility relocation, drainage features, aesthetic features, real estate, right-of-way, easement, environmental mitigation			

Road Raising			
Item		Quantity*	Unit
Fill		9.89	CY
Stormwater Pipe 30"		1.00	LF
Excavation		9.48	CY
Pavement, Concrete, and Sub Base removal		1.37	CY
Bedding Stone		1.08	CY
Water Main 6"		1.00	LF
Sewer Line 10"		1.00	LF
Concrete		1.16	CY
Pavement 7" thickness		0.69	CY
Geotextile		5.37	SY
Piles		0.33	Ea.
Preformed Detectable Warning Surface		0.11	SY
Inlaid Pavement Markings		2.00	LF
Additional Appurtenances: The items below are outside of the core construction quantities but should still be considered in the cost estimate. Transitions between feature types Utility relocation, drainage features, aesthetic features, real estate, right-of-way, easement, environmental mitigation Driveways will need to be transitioned to new road elevations.			