Navigation Stakeholder Engagement Report

NY/NJ Harbor and Tributaries Study

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Revision	Date	Status	Comments	Prepared	Reviewed	Approved
A	20200424	Draft	For client review	EAL	LAW	RDS
B	20220825	Draft	For client review	EAL	LAW	LAW

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1. Introduction

Forward: This report was primarily drafted in April 2020 with minor updates in 2022. The recommendations provided in this report were used to guide additional pre-TSP work that was completed in 2022, and therefore several the recommendations in this report have been partially carried out.

The Baird team was awarded delivery order W912DS19F0111 under contract W912DS18D0006. The Delivery Order (DO) involves engineering, analysis, and documentation to support the feasibility study / development of the tentatively selected plan (TSP) to advance the conceptual layout of storm surge barriers (SSBs) and shore-based methods (SBMs) to reduce flood risk in parts of New York and New Jersey (see Figure 1.1 below). The scope is entitled the New York/ New Jersey Harbor & Tributaries Study (HATS) and generally includes revised layouts, feasibility level design, and preparation of cost estimates for various coastal storm risk management measures to help identify and document the Tentatively Selected Plan.

The goal of the DO is to advance the pre-TSP conceptual design of structural flood risk features to reduce the uncertainty in the current cost estimates as detailed in the Interim Report (Interim Report) Cost Appendix, with the objective of achieving a Class 4 (Class 5 for some cases) cost estimate per USACE ER 1110-2-1302.

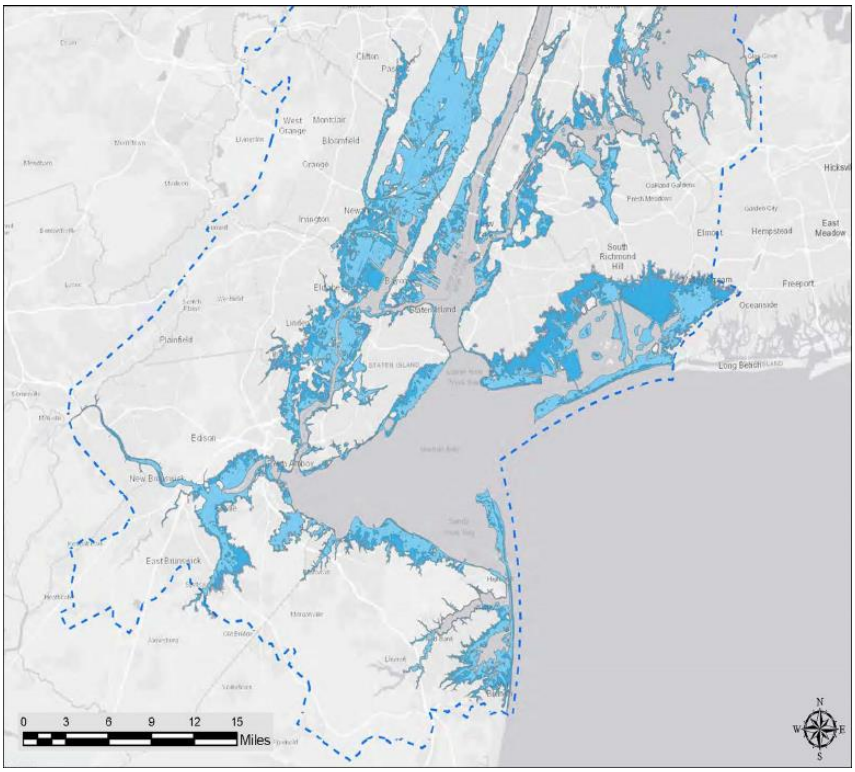


Figure 1.1: Without Project Flood Extents

The scope included the following navigation related assessments:

- The preparation of preliminary desktop navigation assessments of the SSB to determine channel sizing and alignment requirements. Desktop assessments are needed to better define baseline conditions (fleet, frequency, vessel patterns, etc.) and evaluate, at a high level, potential impacts.

- To obtain the input of commercial vessel pilots (both Sandy Hook and Docking pilots) and complete pilot interviews in coordination with other maritime interests (e.g., USCG, Port Authority, etc.).

Following a review of the desktop assessment of baseline vessel conditions and subsequent channel sizing and alignment completed in the Interim Engineering Report dated February 2019 (Interim Report), it was determined that while additional data gathering and analysis could be undertaken, it was likely of significantly lower value than obtaining input from navigation stakeholders. In addition, it was noted that any additional channel alignment work completed in this phase would likely be subject to significant rework until the locations of the SSB were generally frozen. As such, the focus of the navigation assessment was changed to stakeholder engagement.

It was also determined that, given the timeframe associated with the stakeholder engagement exercise, any substantive recommended changes that result to the SSB alignments would not be incorporated in this phase of the study.

The remainder of this document presents the background and results of the stakeholder engagement exercise.

2. Introduction to the Alternatives

HATS includes a series of flood protection alternatives consisting of SSBs, which cross open water and SBM, which run along the shore. Many of the SSBs have integrated navigation gates to allow commercial and recreational navigation to continue after the SSBs are constructed. Figure 2.1 below illustrations the location of the various SSBs that are included in the HATS alternatives. This study is focused on a subset of the alternatives as described below:

- Alternative 2 includes SSBs running from Sandy Hook to Breezy Point and an SSB at Throgs Neck. This alternative, shown in Figure 2.2 below, has four navigation gates. Three gates, including Sandy Hook, Ambrose, and Rockaway, are located within the Sandy Hook to Breezy Point SSB, and a single gate is located within the Throgs Neck SSB. This alternative protects the vast majority of the NY/NJ Harbor System.
- Alternative 3A includes SSBs at Verrazano Narrows, Arthur Kill, and Throgs neck with a single commercial navigation gate within each SSB. The Verrazano Narrows SSB also incorporates a dedicated gate for recreational traffic on the west side the primary commercial gate. Alternative 3A provides protection to critical port and terminal infrastructure along the Arthur Kill, Upper New York Bay, and Newark Bay, as well as protection to mixed use areas along the Hudson, East, Passaic, and Hackensack River banks. The alternative is depicted in Figure 2.3.
- Alternative 3B includes SSBs at Kill Van Kull and Arthur Kill with a single commercial navigation gate within each SSB. Alternative 3B provides protection to critical port and terminal infrastructure along the Arthur Kill and Newark Bay, as well as protection to mixed use areas along the Passaic and Hackensack River banks. The alternative is depicted in Figure 2.4.
- Alternative 4 includes SSBs at Jamaica Bay and Hackensack. This alternative, shown in Figure 2.5, has three navigation gates; two gates located within the Jamaica Bay SSB and a single gate located within the Hackensack SSB. Alternative 4 protects largely residential areas in Jamaica Bay and along the banks of the Hackensack River.

Figure 2.1: Location of proposed SSB (Interim Report)

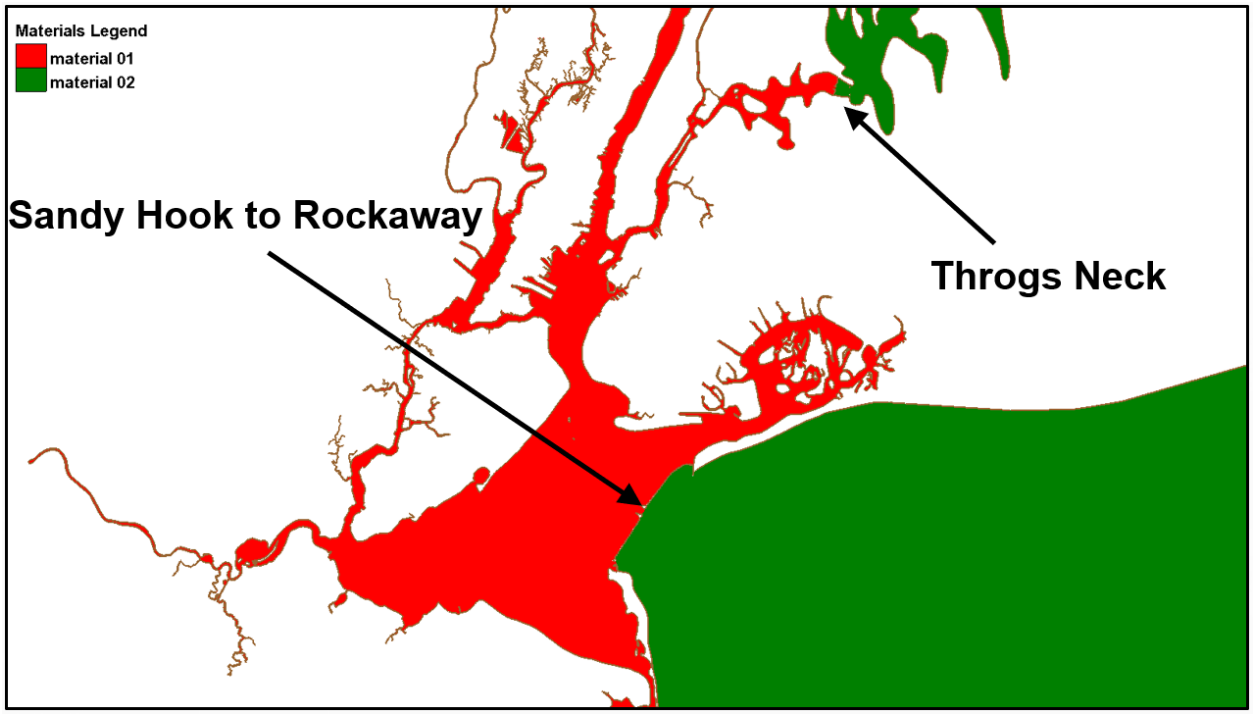


Figure 2.2: Alternative 2

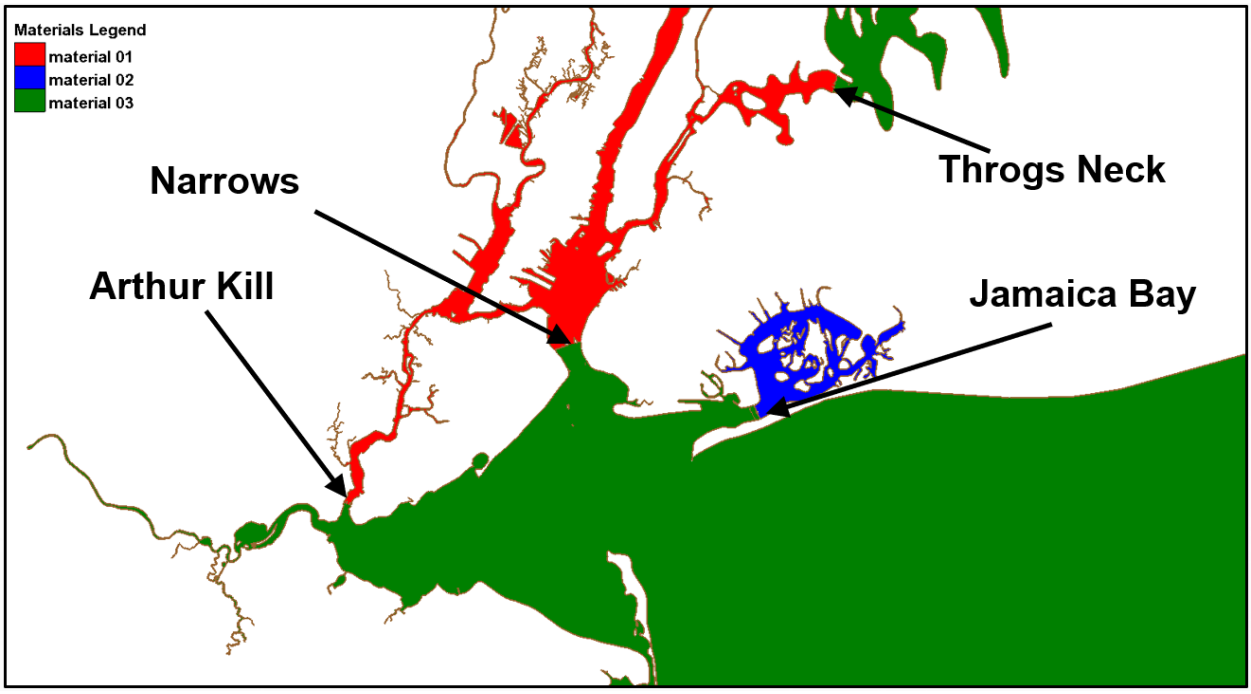


Figure 2.3: Alternative 3A

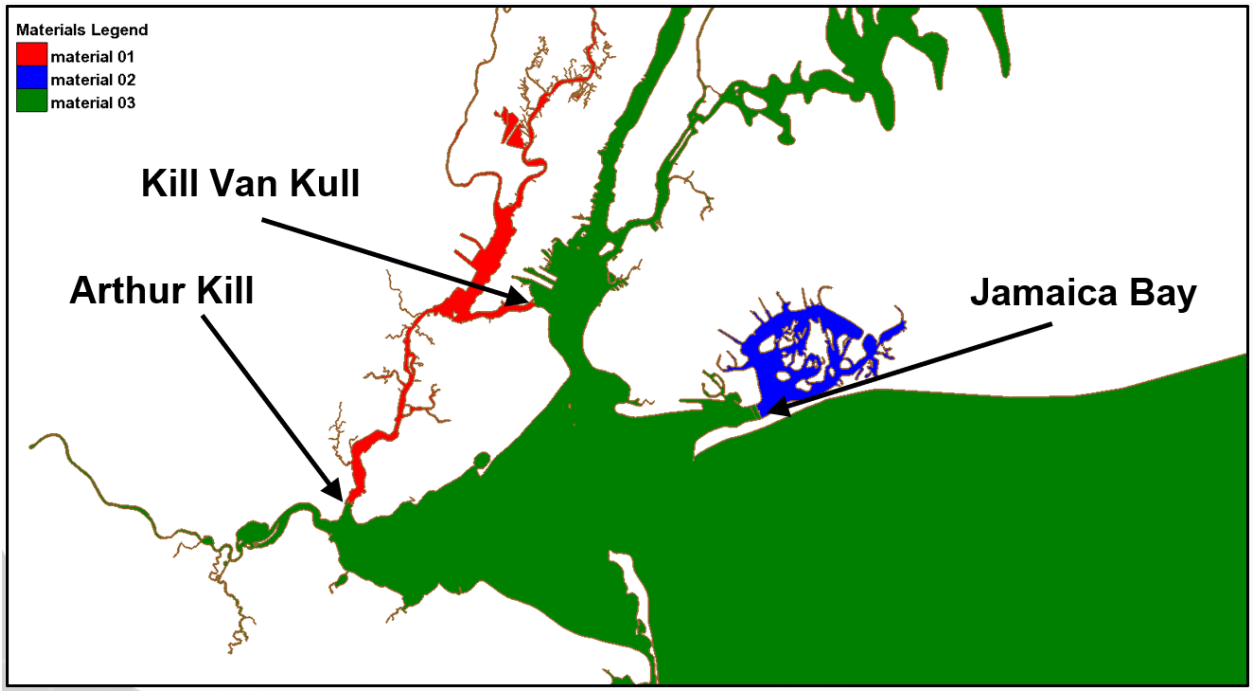


Figure 2.4: Alternative 3B

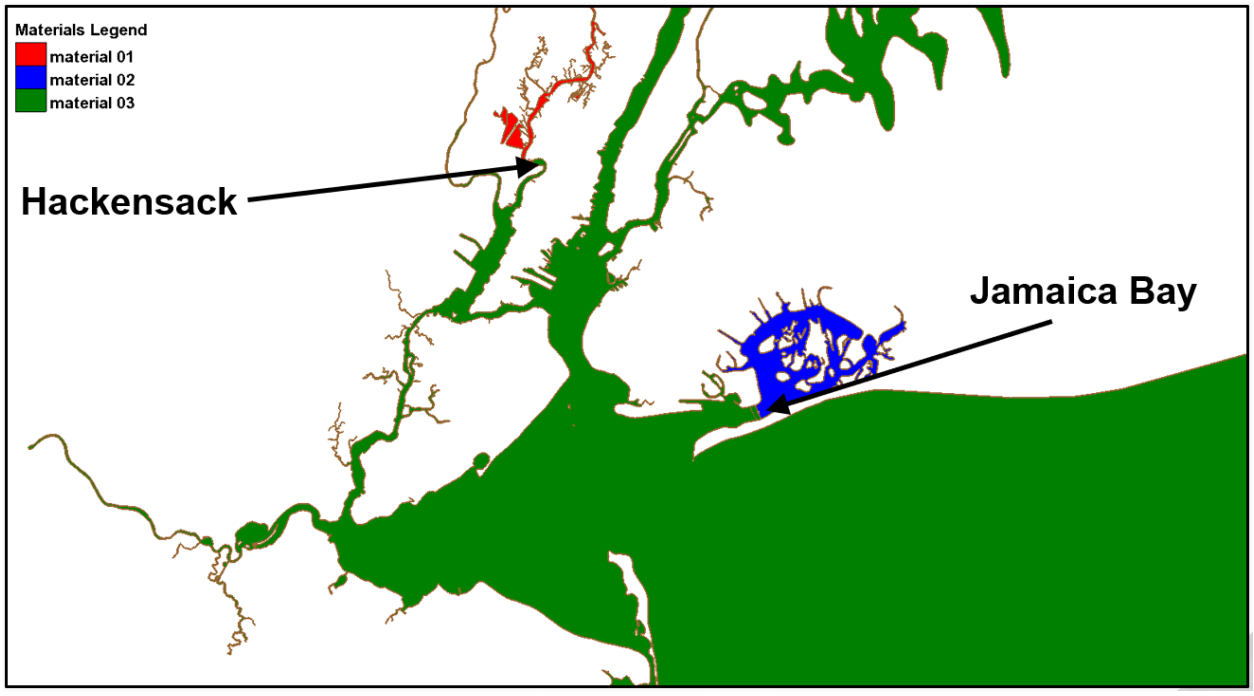


Figure 2.5: Alternative 4

3. Summary of Previous Work

The Interim Report included the following work on the navigational elements of HATS:

- An AIS assessment covering two years of data at various SSB locations to determine the overall volume of traffic crossing the proposed SSB alignments as well as a statistical breakdown of vessel length and beam to define design vessels.
- Channel width calculations following the approach outlined by the World Association for Waterborne Transport Infrastructure (PIANC, 2014) in the Working Group 121 report "Harbour Approach Channels Design Guidelines". Calculations utilized the design vessels produced from the AIS analysis.

The prior work generally resulted in proposed channel width and depths through the navigation gates as shown in Table 3.1 below.

Table 3.1: Interim Report Navigation Features

Navigable Pass	Design Ship Beam	Proposed Channel Width at Gate Location	Minimum Proposed Sill Depth	Air Clearance
Sandy Hook	48 m	800 ft	-37 ft	No bridges
Ambrose	59 m (21k TEU)	1000-1500 ft*	-55 ft	No bridges
Rockaway	11 m	200 ft*	-22 ft	No bridges
Verrazano Narrows Primary	59 m (21k TEU)	1000-1400 ft*	-55 ft	228 ft
VN Secondary	11 m	200 ft	-42 ft	228 ft
Kill Van Kull	59 m (21k TEU)	800 ft*	-52 ft	228 ft
Arthur Kill	45 m	600 ft	-35 ft	143 ft
Throgs Neck	31 m	450 ft*	-37 ft	142 ft
Hackensack River	N/A**	100 ft*	-23 ft	102 ft
Jamaica Bay	N/A**	200 ft*	-22 ft	152 ft
Newtown Creek	N/A**	170 ft	-23 ft	125 ft
Gowanus Canal	N/A**	90 ft	-22 ft	No bridges
Sheepshead Bay	N/A**	100 ft	-6 ft	No bridges

*Authorized channel is wider

** Not available in the Interim Report

4. Stakeholder Engagement

The stakeholder engagement exercise consisted of four navigation stakeholder meetings to discuss the navigation aspects of HATS. The meeting dates and general agendas are summarized below.

- November 6, 2019: a general meeting with the NY/NJ Harbor Operations Steering Committee[1] to introduce the project and set a path forward.
- November 20, 2019: a general meeting with the full Harbor Operations membership to introduce the project and establish a sub-committee to look at HATS in detail.
- December 12, 2019: a dedicated meeting with sub-committee members to discuss commercial navigation issues for the Sandy Hook, Ambrose, Breezy Point, Verrazano Narrows, Kill van Kull, and Arthur Kill SSBs.
- February 25, 2020: a dedicated meeting with sub-committee members to discuss recreational and commercial navigation issues for the Jamaica Bay, Hackensack, and Throgs Neck SSBs. It is noted that this meeting coincided with the public shut-down of the HATS process as well as the early onset of COVID-19, and as such, participation by the recreational community was limited to a single representative.

The general purpose of the stakeholder engagement was to identify potential fatal flaws with respect to the SSB concepts developed during the Interim Engineering Report as they related to navigation only. Participants were reminded of the current stage of the feasibility study, 5% design with the intent of producing Class IV Opinions of Probable Construction Cost, and the need to focus on high level feasibility rather than design details.

At the start of the November meetings, the HATS project was presented at a high level with a description of the four alternatives being considered and the general components comprising a SSB. A short question and answer session followed each presentation. As the meetings progressed into December and February, additional details were added to the discussion with the aid of a detailed GIS environment encompassing the study area that included the following elements:

- Background aerial imagery
- Proposed SSB alignments
- Bathymetry
- Major NOAA navigational features
- Peak spatial currents at flood and ebb tide at each SSB location
- Spatial AIS vessel track data separated into vessel classes including (commercial, tanker, recreational, passenger)

Representative figures from the GIS environment may be found in Appendix A attached to this report. Each of the SSBs was discussed in detail with the representatives from both the commercial and recreational navigation community, as well as the Coast Guard.

[1] The Maritime Association of the Port of New York – New Jersey – Harbor Safety, Navigation, and Operations Committee https://nymaritime.org/harbor-safety-navigation-and-operations/

5. Summary of Stakeholder Comments

The key points raised by the participants in the stakeholder engagement are summarized below. Detailed notes for each of the meetings, along with lists of attendees, may be found in Appendix B of this report.

- While stakeholders did recommend significant adjustments to SSB locations and dimensions, fatal flaws with respect to navigation feasibility were not identified.
- Alternative 2 (Sandy Hook to Breezy Point) is the preferred alternative from a commercial navigation perspective, as it has the least impact on commercial navigation.
- Alternative 2 (Sandy Hook to Breezy Point) is the most restrictive alternative from a recreational traffic perspective, as it forces recreational traffic into commercial channels to exit the harbor, whereas the current condition allows for recreational vessels to exit the harbor utilizing many possible routes.
- No significant preference was identified by either commercial or recreational stakeholders regarding the remainder of the alternatives.
- In general, the widths and depths of the proposed navigation gates were considered adequate for this phase.
- Stakeholders recommended that the location of the Sandy Hook SSB be moved east towards the 2-2A buoys for the following reasons:
    - The area just off the point is subject to consistent shoaling, and it was suggested that the SSB may be oriented to limit this shoaling.
    - The present position of the Sandy Hook gate will be in direct view of inbound tankers lining up for the west Sandy Hook approach, thus impairing their view.
    - Currents at the existing location can be opposing either side of the gate.
    - See Figure 5.1 below for adjustments recommended by the participants.
- Stakeholders recommended that the Verrazano SSB be moved south of the Verrazano Narrows Bridge for the following reasons:
    - The location in the Interim Engineering Report intersects the primary anchorage area for the NY harbor making the anchorage generally unusable. The existing anchorage area is heavily utilized for making up barges and for various vessel safety procedures.
    - During flood tides, vessels would need to navigate through the gates at significant speed (at least 10 knots), and navigation representatives questioned their ability to properly slow down prior to making the turn into the KVK.
    - Navigation representatives also noted that due to the speed required to sail through the gates, they would need to “commit themselves through the gates”, with no ability to emergency stop before the gates and little space to emergency stop after the gates.
    - See Figure 5.2 below for adjustments recommended by the participants.
- Stakeholders recommended that the Kill Van Kull SSB be moved approximately 600’ to the east and widened out for the following reasons:
    - The location in the Interim Engineering Report is in a highly utilized area or meeting point, especially during slack tides. Barges in the area limit their movements off berth to current velocities of less than 1 to 2 knots, which occur around slack tides. Barge operations are intermixed with ocean going vessels at the proposed location.
    - Moving the structure would avoid the meeting point and position the gate structure on a straight section of channel rather than on a turn.
    - See Figure 5.3 below for adjustments recommended by the participants.

- Stakeholders recommended that the Jamaica Bay SSB gate be better aligned with the Gil Hodges bridge abutments and that a minimum 0.5 mile spacing be added between the gates and the Gil Hodges bridge for the following reasons:
  - Vessels will be set when going through the gates and will need the appropriate time to correct and line up to go through the oncoming bridge abutments. The recommended distance was based upon an assumed speed of 2-3 knots (barge traffic) resulting in 10 min between the gate and the bridge.
  - See Figure 5.4 below for adjustments recommended by the participants.
- Stakeholders recommended that the Throgs Neck SSB location be moved north or that the navigation gate be widened to 1,000 ft for the following reasons:
  - Barge tows are typically made up immediately west of the planned SSB. The tows typically consist of stone barges with a 3x2 configuration. These tows are operated with less maneuverable tugs.
  - Given the proximity to the barge makeup area to the proposed SSB, width of the barge tows, and the lack of maneuverability of the tugs it will be difficult for the tows to move into position to pass through the SSB gate.
  - See Figure 5.5 below for adjustments recommended by the participants.
- It was the preference of the recreational community to have two gates, one on each side of the main navigation gate, at each SSB location where considerable recreation traffic exists (Verrazano, Throgs Neck, Sandy Hook to Breezy Point). However, it was recognized that this may not be possible within the project's financial constraints. Modifying one auxiliary gate on each side of the main navigation gate at each SSB location for recreational vessels to sail through should be investigated.
- The vertical elevation of the lift gates will likely create a significant visual obstruction as it relates to navigation. Recreational traffic, barges, and a significant portion of ocean-going traffic will need to rely on instrumentation to see what traffic exists ahead. Stakeholders strongly recommended gates that rotate in the water rather than lift vertically to minimize the visual obstruction impact. See Figure 5.6 and Figure 5.7 below illustrating a navigator's perspective from the water.
- Stakeholders are concerned that the criteria for closing the gates will become less stringent over time with the gates being closed for only minor flooding events in the future. Thus, gate operations may have a more frequent and significant impact on commercial traffic in the future when compared to the current operational vison.
- Stakeholders are concerned with the overall reliability of the system as any delay upon reopening will be significant negative impact to the navigation industry.
- Stakeholders made clear that detailed planning to incorporate continued operation of vessels during the long SSB construction phases would be critical and that temporary channels completely bypassing around the SSBs during would likely not be possible in width restricted channels such as Kill Van Kull and Arthur Kill.

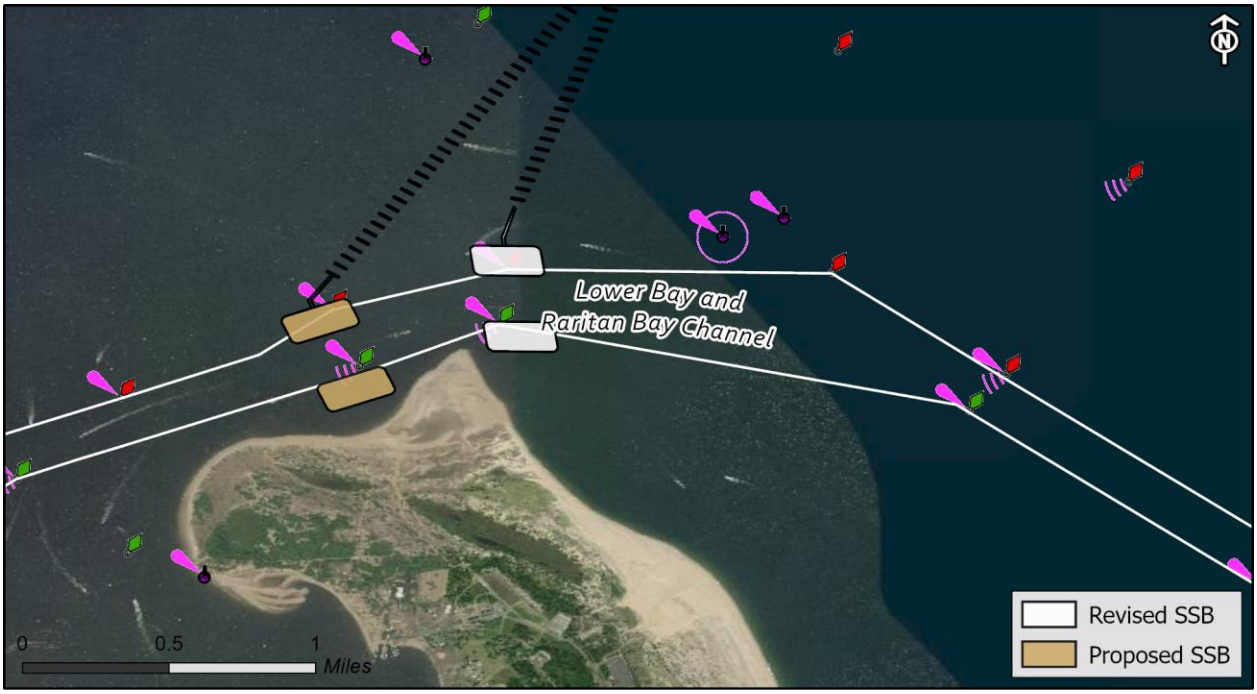


Figure 5.1: Sandy Hook SSB Adjustment Recommended by Participants

Figure 5.2: Verrazano SSB Adjustment Recommended by Participants

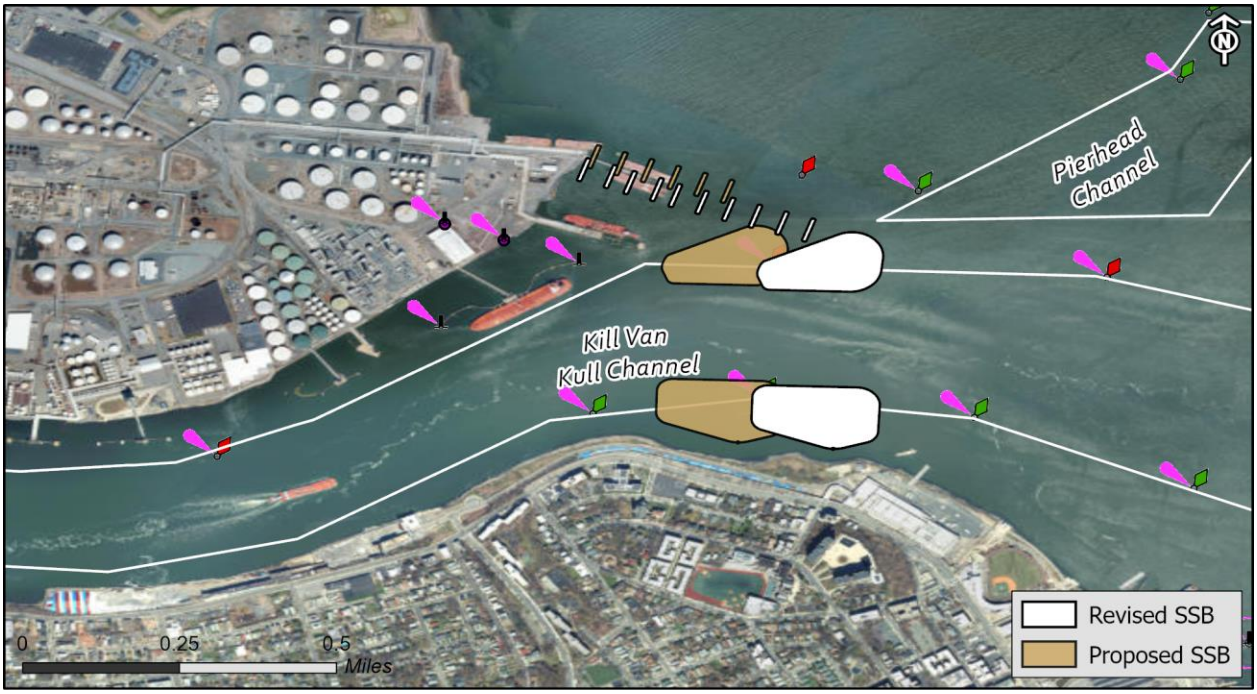


Figure 5.3: Kill Van Kull SSB Adjustment Recommended by Participants

Figure 5.4: Jamaica Bay SSB Adjustment Recommended by Participants

Figure 5.5: Throgs Neck SSB Adjustment Recommended by Participants

Figure 5.6: Existing View Looking South a Verrazano Narrows Bridge

Figure 5.7: View Looking South a Verrazano Narrows Bridge with SSB in Place

6. Discussion and Recommendations

Each of the high-level recommendations from the stakeholder engagement summarized in Section 5 warrants further investigation prior to PED.

In prioritizing future navigation work, the focus should remain on overall feasibility and establishing accurate overall costs of the SSBs. The portions of the navigation study that will most influence feasibility and cost include:

- Locating the SSBs, which can have substantial impacts on cost due to length, depth, and geotechnical conditions associated with alternative locations as well as landside restrictions and existing conditions.
- Finalizing the major navigation components that need to be included in each SSB, focusing on the number of recreational gates needed for each SSB and the visual impact of the auxiliary gates.
- The overall width and depth of each navigation gate, which is influenced by the location of the SSBs and the existing and future traffic that the gates will be planned for.

The following are the recommended priorities developed from the study:

1. While the stakeholder engagement exercise did not identify fatal flaws with the alternatives, it did expose the need for a location study with respect to the SSBs as such a study has not been completed. It is recommended that the location study be completed prior to PED, incorporating stakeholder engagement as well as current considerations of underground utilities, landside tie-ins and restrictions, bathymetry, geotechnical information, sedimentation data, anchorage areas, navigation risk, future project plans, and costs. It is noted that any adjustments to the location of the SSBs has significant impacts with respect to not only the SSBs but also shore-based measures.

2. The visual obstruction created by the axillary gates was brought up repeatedly by the commercial and recreational community as a significant safety hazard. While not part of this study, it is likely the overall visual obstruction of the auxiliary gates, outside of navigation concerns, will also be brought up by other stakeholder groups in the future. Given that an alternative auxiliary gate concept represents numerous challenges and potentially significant additional cost, it is recommended that a trade-off study be conducted amongst the various axillary gate alternatives that exist including multi-leaf vertical lift gates, horizontally stored lift gates, and lift gates which rotate into place prior to PED.

3. Investigation into the cost of incorporating dual recreational gates at the locations was requested by the recreational community. A tradeoff between full recreational gates and modified auxiliary gates should be conducted prior to PED.

4. Addition investigation prior to PED into the recommended width of the commercial gates including:
    - AIS data analysis to better understand overall vessel routing (trip analysis) and the frequency of vessel meeting, passing, and overtaking.
    - Trends for future vessel traffic, including vessel size and frequency.
    - Note, the two preceding analyses would be used to establish design vessels as well as the need for one-way versus two-way traffic.
    - Navigation simulations to refine the channel width from desktop PIANC calculations.

5. While the input from the commercial navigation community was excellent, experience dictates that the opinions resulting from stakeholder engagement should always be verified by data to the extent practical, as presentation of data often alters opinions. Several potential future verifications prior to PED follow:

- Desktop navigation simulation of transits through the Verrazano Narrows location in the Interim Engineering Report to support the difficulty of emergency stops prior to the gates and slowing prior to entering the KVK.
- Additional AIS data analysis of the extent of barge makeup operations in near Throgs Neck at the Verrazano anchorage as well as the general usage of the Verrazano anchorage.
- Additional AIS data analysis of vessel currently transiting Gil Hodges bridge to determine the extent of set that occurs and the speed of vessels in that reach. Additional coordination with transportation authorities on design for Gil Hodges bridge replacement.
- The creation of multiple perspective views from the water showing what a navigator might experience with the SSB in place.
- As noted, participation by recreational stakeholders has been limited to date. In addition, there was no participation by the commercial fishing interests. As these two stakeholder groups can have significant impact on projects, it is recommended that additional stakeholder engagement meetings be conducted to engage the opinions of these groups. It is noted that additional traffic research outside of AIS data including past and present studies and VMS data is recommended to better capture the impact of recreational and fishing traffic, which is often not represented well by AIS data. A focus would be on locations historically having little traffic, such as the Hackensack River or locations where AIS data may not well represent traffic.

6. The definition of operational conditions to open and close the gates appears as though it may be a contentious issue requiring the input from multiple authorities, interests, and states. It is recommended that the discussion commence prior to PED as it may require a multi-year effort.

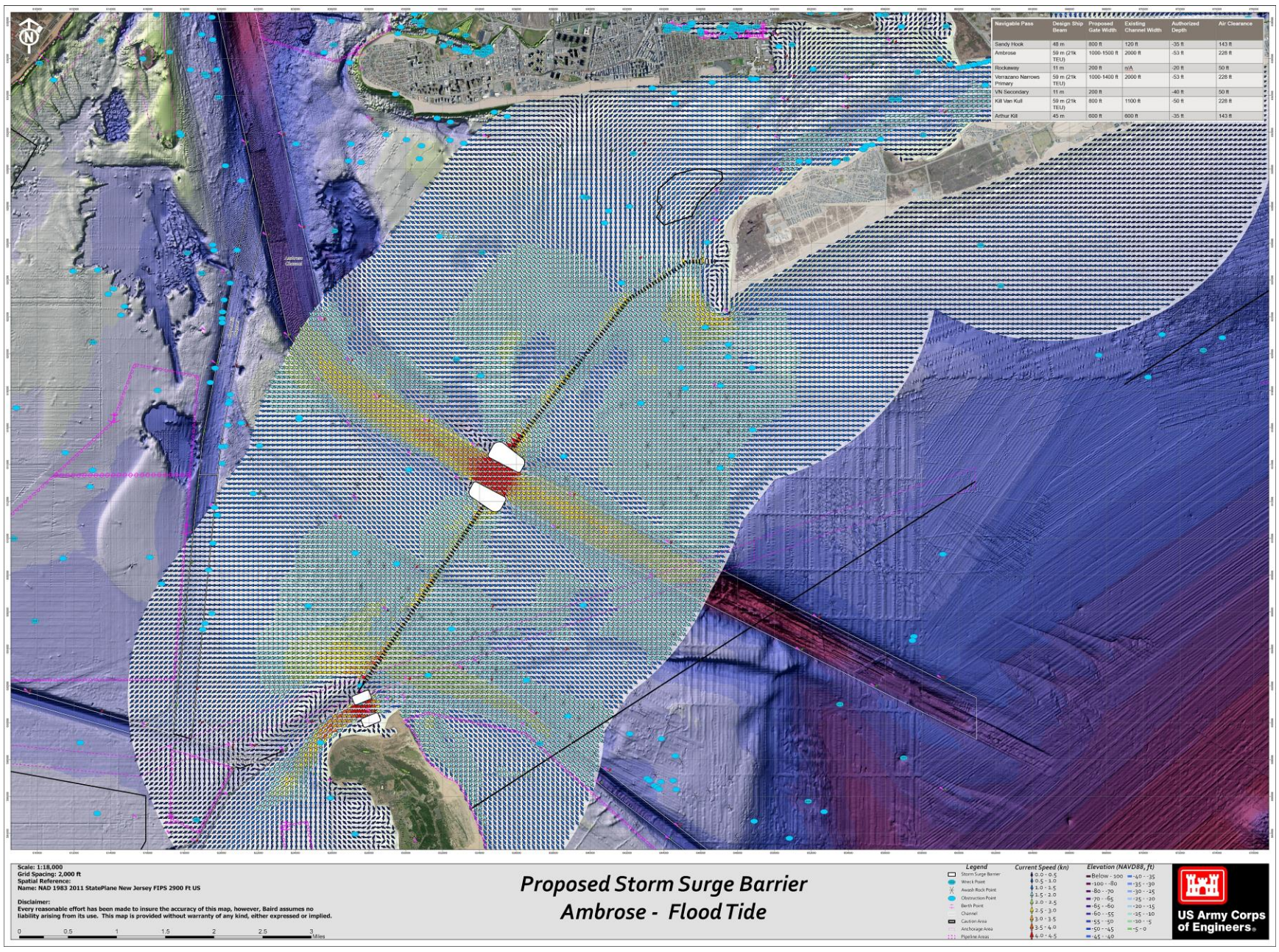
7. The additional assessments identified in the Interim Engineering Report are also recommended prior to PED, including:
   - Vessel wait areas, queuing, and wait times
   - Cross-traffic conditions
   - Barrier positioning and fairway lengths for maneuvering
   - Currents, cross currents, wind, tides, surge, weather, night, visibility, and other environmental considerations for vessel passage
   - Requirements for vessel traffic service, including advisory / control / restrictions on navigation
   - Requirements for Aids-to-Navigation, guide structures, and protective structures
   - Navigation evaluations, including pilot and navigation industry input, and real-time simulations to assess, amongst others:
     - Flow and cross-current considerations
     - Gate approach and departure
     - Passing vessel assessments

7. References

(2014) PIANC. MarCom WG 121: Harbour Approach Channels - Design Guidelines.

(2019). W.F. Baird & Associates Ltd. Interim Engineering Report. February 2019.

Appendix A Relevant Stakeholder Engagement Maps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Sandy Hook | 48 m | 800 ft | 120 ft | -35 ft | 143 ft
Ambrose | 59 m (21k TEU) | 1000-1500 ft | 2000 ft | -53 ft | 228 ft
Rockaway | 11 m | 200 ft | n/A | -20 ft | 50 ft
Verrazano Narrows Primary | 59 m (21k TEU) | 1000-1400 ft | 2000 ft | -53 ft | 228 ft
VN Secondary | 11 m | 200 ft | | -40 ft | 50 ft
Kill Van Kull | 59 m (21k TEU) | 800 ft | 1100 ft | -50 ft | 228 ft
Arthur Kill | 45 m | 600 ft | 600 ft | -35 ft | 143 ft
Scale: 1:18,000
Grid Spacing: 2,000 ft
Spatial Reference:
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Disclaimer:
Every reasonable effort has been made to insure the accuracy of this map, however, Baird assumes no liability arising from its use. This map is provided without warranty of any kind, either expressed or implied.
0 0.5 1 1.5 2 2.5 3 Miles
Proposed Storm Surge Barrier
Ambrose - Flood Tide
Legend
Storm Surge Barrier
Wreck Point
Awash Rock Point
Obstruction Point
Berth Point
Channel
Caution Area
Anchorage Area
Pipeline Areas
Current Speed (kn)
0.0 - 0.5
0.5 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0 - 2.5
2.5 - 3.0
3.0 - 3.5
3.5 - 4.0
4.0 - 4.5
Elevation (NAVD88, ft)
Below - 100
-100 - -80
-80 - -70
-70 - -65
-65 - -60
-60 - -55
-55 - -50
-50 - -45
-45 - -40
-40 - -35
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-30 - -25
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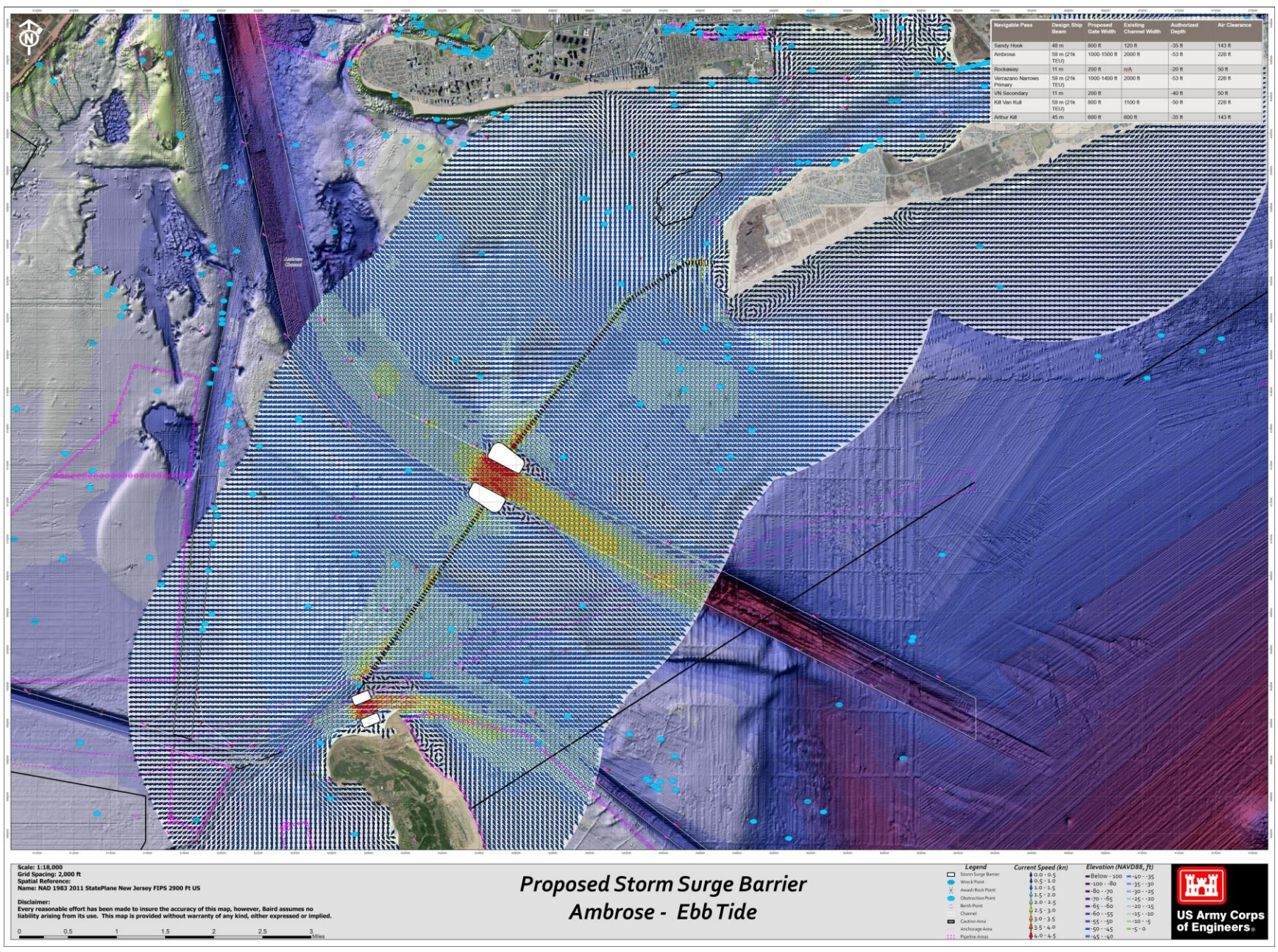
-15 - -10
-10 - -5
-5 - 0
US Army Corps of Engineers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Grid Spacing: 2,000 ft
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Ambrose - Ebb Tide
Legend
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Wreck Point
Awash Rock Point
Obstruction Point
Berth Point
Channel
Caution Area
Anchorage Area
Pipeline Areas
Current Speed (kn)
0.0 - 0.5
0.5 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0 - 2.5
2.5 - 3.0
3.0 - 3.5
3.5 - 4.0
4.0 - 4.5
Elevation (NAVD88, ft)
Below - 100
-100 - -80
-80 - -70
-70 - -65
-65 - -60
-60 - -55
-55 - -50
-50 - -45
-45 - -40
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-25 - -20
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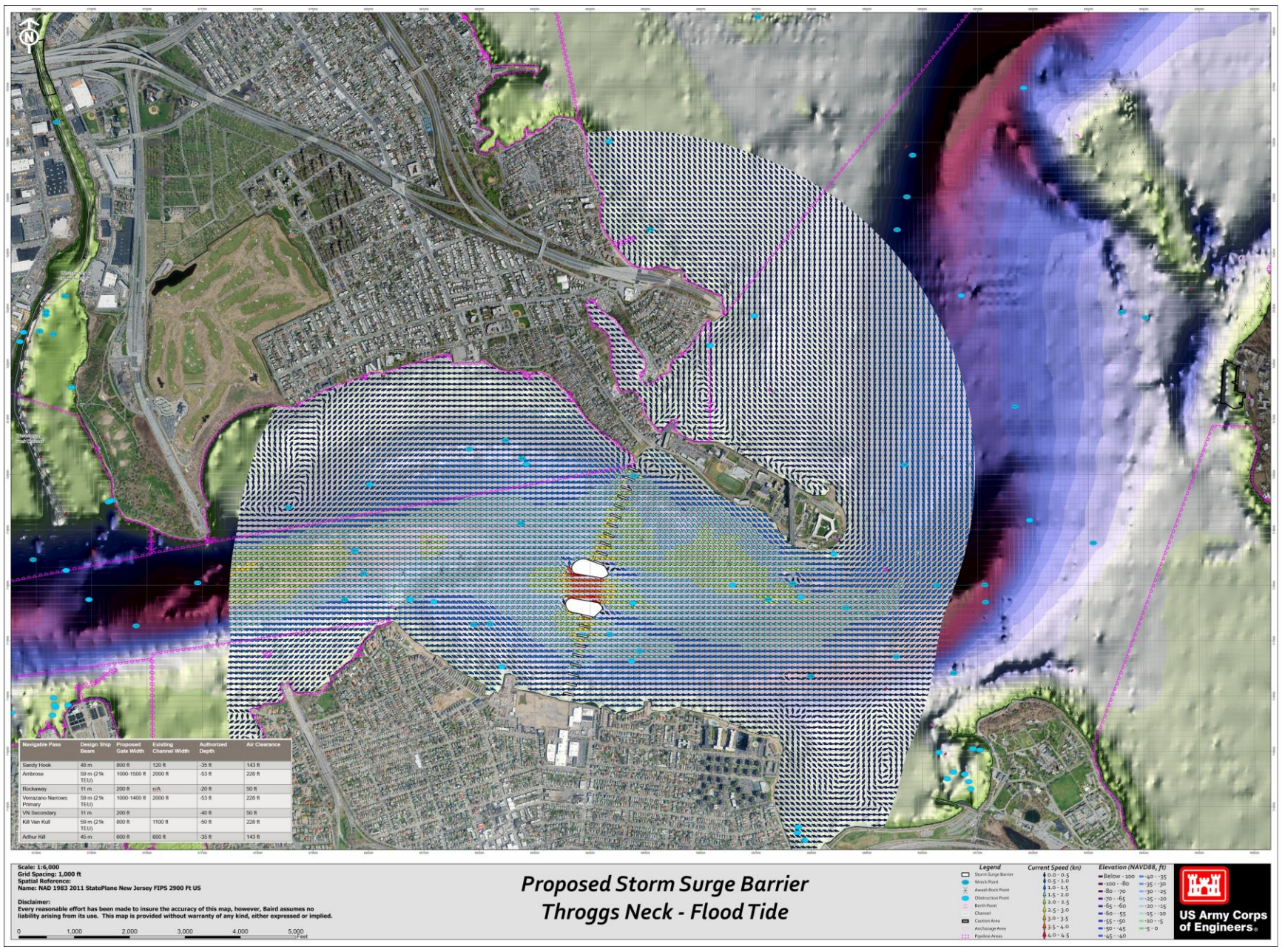
-10 - -5
-5 - 0
US Army Corps of Engineers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Grid Spacing: 1,000 ft
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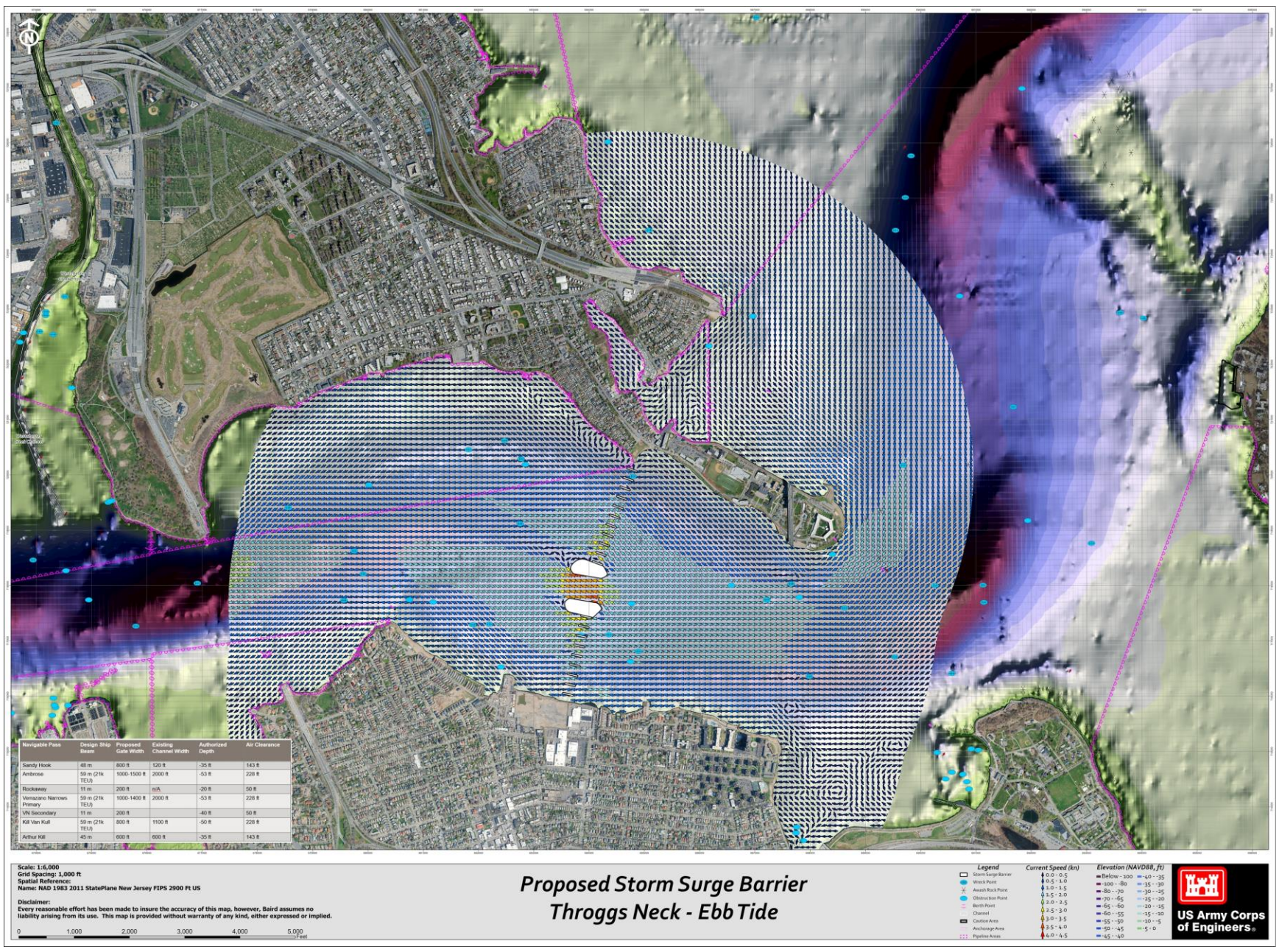
Disclaimer:
Every reasonable effort has been made to insure the accuracy of this map, however, Baird assumes no liability arising from its use. This map is provided without warranty of any kind, either expressed or implied.
0 1,000 2,000 3,000 4,000 5,000 Feet
Proposed Storm Surge Barrier
Throggs Neck - Flood Tide
Legend
Storm Surge Barrier
Wreck Point
Awash Rock Point
Obstruction Point
Berth Point
Channel
Caution Area
Anchorage Area
Pipeline Areas
Current Speed (kn)
0.0 - 0.5
0.5 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0 - 2.5
2.5 - 3.0
3.0 - 3.5
3.5 - 4.0
4.0 - 4.5
Elevation (NAVD88, ft)
Below -100
-100 - -80
-80 - -70
-70 - -65
-65 - -60
-60 - -55
-55 - -50
-50 - -45
-45 - -40
-40 - -35
-35 - -30
-30 - -25
-25 - -20
-20 - -15
-15 - -10
-10 - -5
-5 - 0
US Army Corps of Engineers


Navigable Pass | Design Ship Beam | Proposed Gate Width | Existing Channel Width | Authorized Depth | Air Clearance
Sandy Hook | 48 m | 800 ft | 120 ft | -35 ft | 143 ft
Ambrose | 59 m (21k TEU) | 1000-1500 ft | 2000 ft | -53 ft | 228 ft
Rockaway | 11 m | 200 ft | n/A | -20 ft | 50 ft
Verrazano Narrows Primary | 59 m (21k TEU) | 1000-1400 ft | 2000 ft | -53 ft | 228 ft
VN Secondary | 11 m | 200 ft | | -40 ft | 50 ft
Kill Van Kull | 59 m (21k TEU) | 800 ft | 1100 ft | -50 ft | 228 ft
Arthur Kill | 45 m | 600 ft | 600 ft | -35 ft | 143 ft
Scale: 1:6,000
Grid Spacing: 1,000 ft
Spatial Reference:
Name: NAD 1983 2011 StatePlane New Jersey FIPS 2900 Ft US
Disclaimer:
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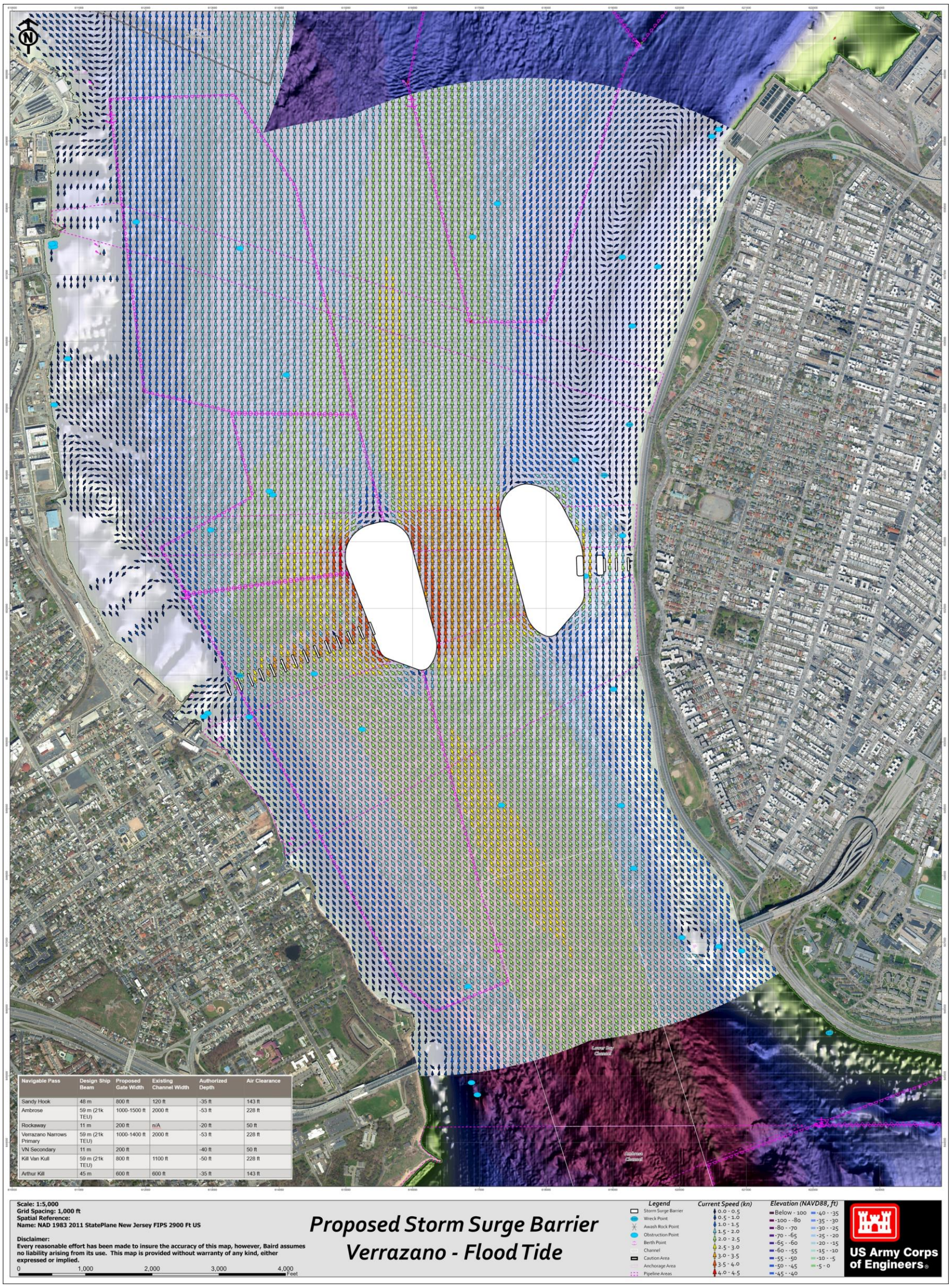
0 1,000 2,000 3,000 4,000 5,000 Feet
Proposed Storm Surge Barrier
Throggs Neck - Ebb Tide
Legend
Storm Surge Barrier
Wreck Point
Awash Rock Point
Obstruction Point
Berth Point
Channel
Caution Area
Anchorage Area
Pipeline Areas
Current Speed (kn)
0.0 - 0.5
0.5 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0 - 2.5
2.5 - 3.0
3.0 - 3.5
3.5 - 4.0
4.0 - 4.5
Elevation (NAVD88, ft)
Below -100
-100 - -80
-80 - -70
-70 - -65
-65 - -60
-60 - -55
-55 - -50
-50 - -45
-45 - -40
-40 - -35
-35 - -30
-30 - -25
-25 - -20
-20 - -15
-15 - -10
-10 - -5
-5 - 0
US Army Corps of Engineers


Navigable Pass | Design Ship Beam | Proposed Gate Width | Existing Channel Width | Authorized Depth | Air Clearance
Sandy Hook | 48 m | 800 ft | 120 ft | -35 ft | 143 ft
Ambrose | 59 m (21k TEU) | 1000-1500 ft | 2000 ft | -53 ft | 228 ft
Rockaway | 11 m | 200 ft | n/A | -20 ft | 50 ft
Verrazano Narrows Primary | 59 m (21k TEU) | 1000-1400 ft | 2000 ft | -53 ft | 228 ft
VN Secondary | 11 m | 200 ft | | -40 ft | 50 ft
Kill Van Kull | 59 m (21k TEU) | 800 ft | 1100 ft | -50 ft | 228 ft
Arthur Kill | 45 m | 600 ft | 600 ft | -35 ft | 143 ft
Lower Bay Channel
Ambrose Channel
Scale: 1:5,000
Grid Spacing: 1,000 ft
Spatial Reference:
Name: NAD 1983 2011 StatePlane New Jersey FIPS 2900 Ft US
Disclaimer:
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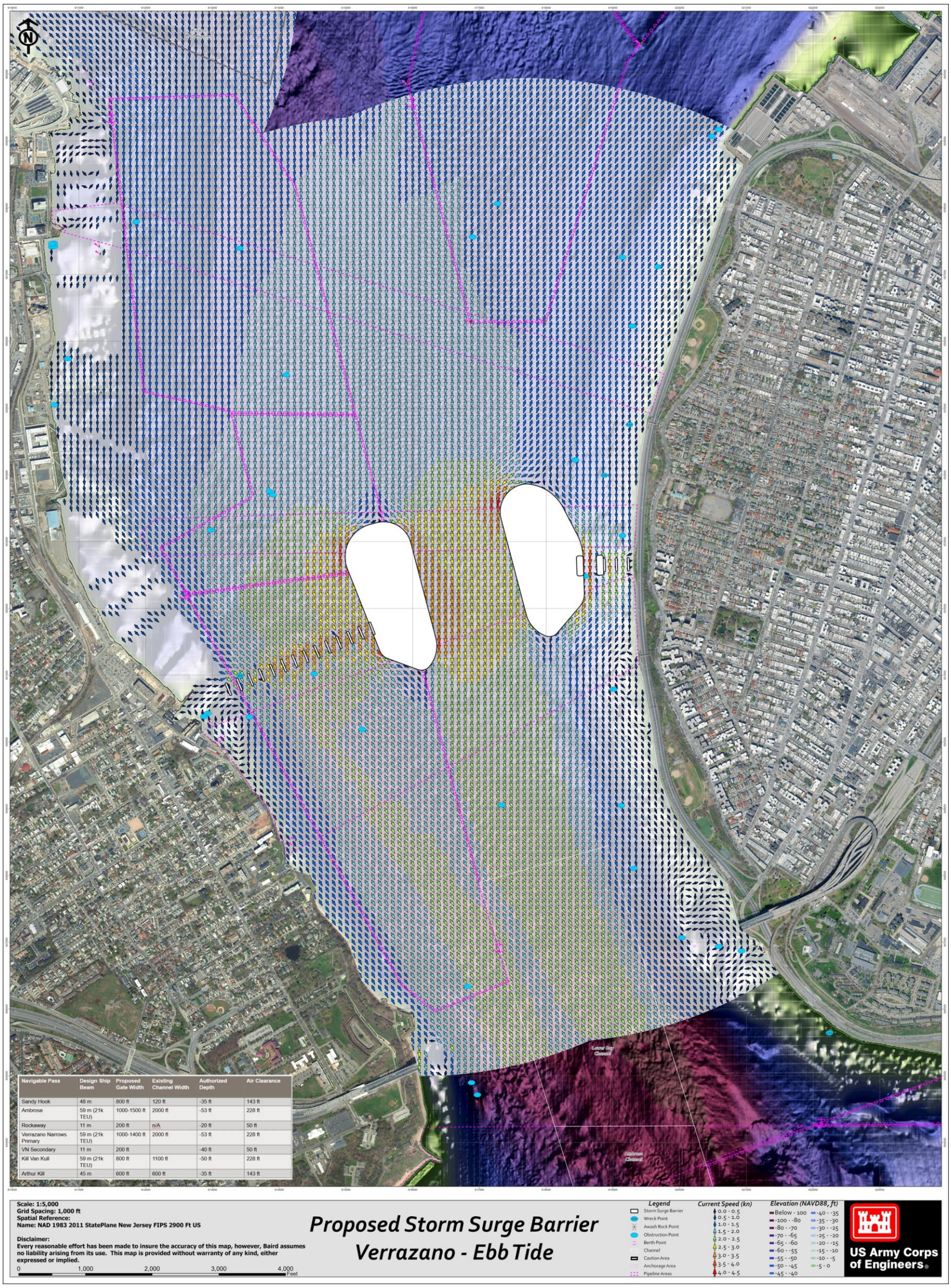
0 1,000 2,000 3,000 4,000 Feet
Proposed Storm Surge Barrier
Verrazano - Flood Tide
Legend
Storm Surge Barrier
Wreck Point
Awash Rock Point
Obstruction Point
Berth Point
Channel
Caution Area
Anchorage Area
Pipeline Areas
Current Speed (kn)
0.0 - 0.5
0.5 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0 - 2.5
2.5 - 3.0
3.0 - 3.5
3.5 - 4.0
4.0 - 4.5
Elevation (NAVD88, ft)
Below - 100
-100 - -80
-80 - -70
-70 - -65
-65 - -60
-60 - -55
-55 - -50
-50 - -45
-45 - -40
-40 - -35
-35 - -30
-30 - -25
-25 - -20
-20 - -15
-15 - -10
-10 - -5
-5 - 0
US Army Corps of Engineers


Navigable Pass | Design Ship Beam | Proposed Gate Width | Existing Channel Width | Authorized Depth | Air Clearance
Sandy Hook | 48 m | 800 ft | 120 ft | -35 ft | 143 ft
Ambrose | 59 m (21k TEU) | 1000-1500 ft | 2000 ft | -53 ft | 228 ft
Rockaway | 11 m | 200 ft | n/A | -20 ft | 50 ft
Verrazano Narrows Primary | 59 m (21k TEU) | 1000-1400 ft | 2000 ft | -53 ft | 228 ft
VN Secondary | 11 m | 200 ft | | -40 ft | 50 ft
Kill Van Kull | 59 m (21k TEU) | 800 ft | 1100 ft | -50 ft | 228 ft
Arthur Kill | 45 m | 600 ft | 600 ft | -35 ft | 143 ft
Lower Bay Channel
Ambrose Channel
Scale: 1:5,000
Grid Spacing: 1,000 ft
Spatial Reference:
Name: NAD 1983 2011 StatePlane New Jersey FIPS 2900 Ft US
Disclaimer:
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0 1,000 2,000 3,000 4,000 Feet
Proposed Storm Surge Barrier
Verrazano - Ebb Tide
Legend
Storm Surge Barrier
Wreck Point
Awash Rock Point
Obstruction Point
Berth Point
Channel
Caution Area
Anchorage Area
Pipeline Areas
Current Speed (kn)
0.0 - 0.5
0.5 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0 - 2.5
2.5 - 3.0
3.0 - 3.5
3.5 - 4.0
4.0 - 4.5
Elevation (NAVD88, ft)
Below - 100
-100 - -80
-80 - -70
-70 - -65
-65 - -60
-60 - -55
-55 - -50
-50 - -45
-45 - -40
-40 - -35
-35 - -30
-30 - -25
-25 - -20
-20 - -15
-15 - -10
-10 - -5
-5 - 0
US Army Corps of Engineers


Navigable Pass | Design Ship Beam | Proposed Gate Width | Existing Channel Width | Authorized Depth | Air Clearance
Sandy Hook | 48 m | 800 ft | 120 ft | -35 ft | 143 ft
Ambrose | 59 m (21k TEU) | 1000-1500 ft | 2000 ft | -53 ft | 228 ft
Rockaway | 11 m | 200 ft | n/A | -20 ft | 50 ft
Verrazano Narrows Primary | 59 m (21k TEU) | 1000-1400 ft | 2000 ft | -53 ft | 228 ft
VN Secondary | 11 m | 200 ft | | -40 ft | 50 ft
Kill Van Kull | 59 m (21k TEU) | 800 ft | 1100 ft | -50 ft | 228 ft
Arthur Kill | 45 m | 600 ft | 600 ft | -35 ft | 143 ft
Raritan Bay and Arthur Kil Channel
Scale: 1:4,000
Grid Spacing: 1,000 ft
Spatial Reference:
Name: NAD 1983 2011 StatePlane New Jersey FIPS 2900 Ft US
Disclaimer:
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0 1,000 2,000 3,000 Feet
Proposed Storm Surge Barrier
Arthur Kill - Flood Tide
Legend
Storm Surge Barrier
Wreck Point
Awash Rock Point
Obstruction Point
Berth Point
Channel
Caution Area
Anchorage Area
Pipeline Areas
Current Speed (kn)
0.0 - 0.5
0.5 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0 - 2.5
2.5 - 3.0
3.0 - 3.5
3.5 - 4.0
4.0 - 4.5
Elevation (NAVD88, ft)
Below - 100
-100 - -80
-80 - -70
-70 - -65
-65 - -60
-60 - -55
-55 - -50
-50 - -45
-45 - -40
-40 - -35
-35 - -30
-30 - -25
-25 - -20
-20 - -15
-15 - -10
-10 - -5
-5 - 0
US Army Corps of Engineers®


Navigable Pass | Design Ship Beam | Proposed Gate Width | Existing Channel Width | Authorized Depth | Air Clearance
Sandy Hook | 48 m | 800 ft | 120 ft | -35 ft | 143 ft
Ambrose | 59 m (21k TEU) | 1000-1500 ft | 2000 ft | -53 ft | 228 ft
Rockaway | 11 m | 200 ft | n/A | -20 ft | 50 ft
Verrazano Narrows Primary | 59 m (21k TEU) | 1000-1400 ft | 2000 ft | -53 ft | 228 ft
VN Secondary | 11 m | 200 ft | | -40 ft | 50 ft
Kill Van Kull | 59 m (21k TEU) | 800 ft | 1100 ft | -50 ft | 228 ft
Arthur Kill | 45 m | 600 ft | 600 ft | -35 ft | 143 ft
Raritan Bay and Arthur Kill Channel
Scale: 1:4,000
Grid Spacing: 1,000 ft
Spatial Reference:
Name: NAD 1983 2011 StatePlane New Jersey FIPS 2900 Ft US
Disclaimer:
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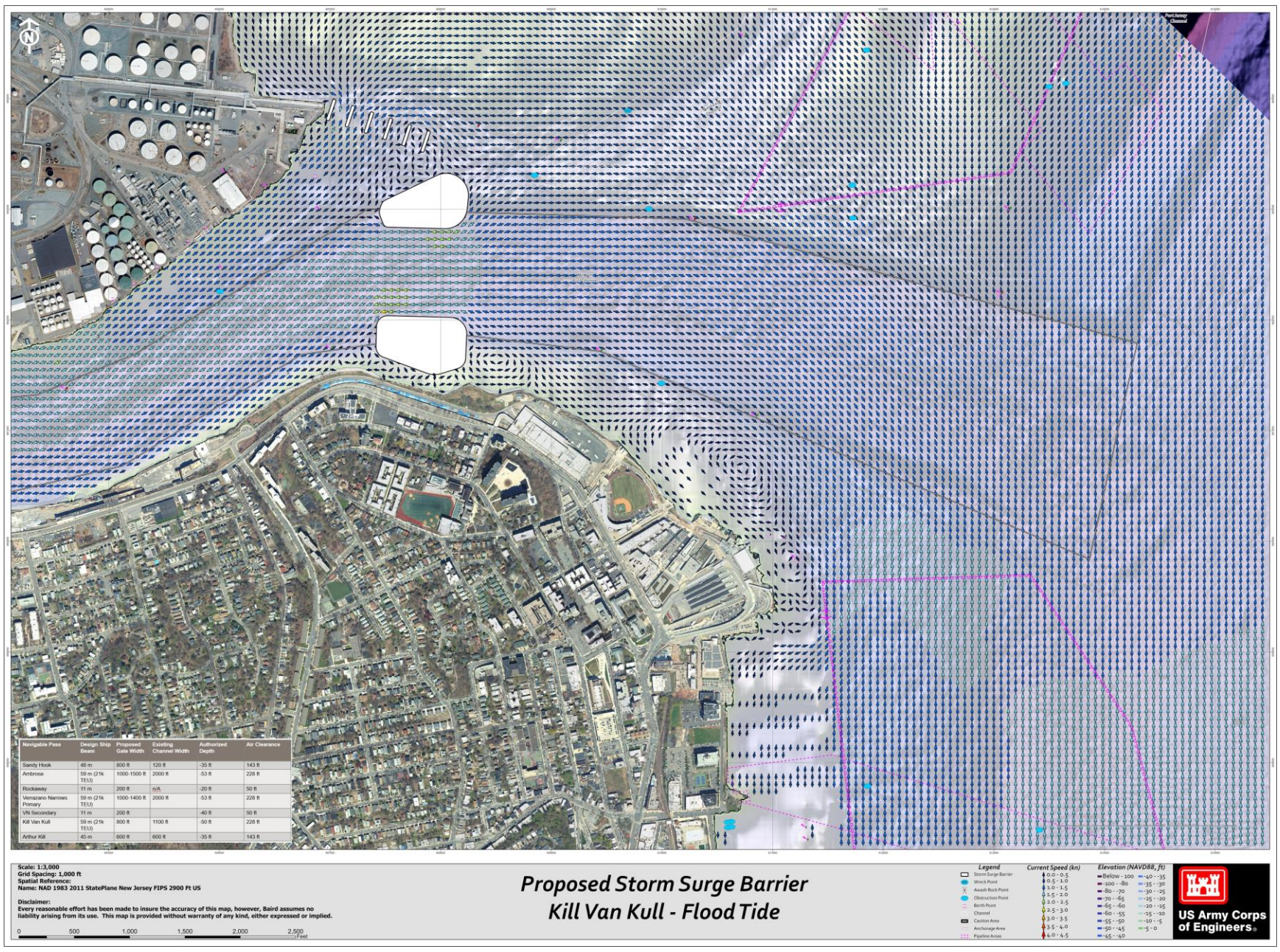
0 1,000 2,000 3,000 Feet
Proposed Storm Surge Barrier
Arthur Kill - Ebb Tide
Legend
Storm Surge Barrier
Wreck Point
Awash Rock Point
Obstruction Point
Berth Point
Channel
Caution Area
Anchorage Area
Pipeline Areas
Current Speed (kn)
0.0 - 0.5
0.5 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0 - 2.5
2.5 - 3.0
3.0 - 3.5
3.5 - 4.0
4.0 - 4.5
Elevation (NAVD88, ft)
Below - 100
-100 - -80
-80 - -70
-70 - -65
-65 - -60
-60 - -55
-55 - -50
-50 - -45
-45 - -40
-40 - -35
-35 - -30
-30 - -25
-25 - -20
-20 - -15
-15 - -10
-10 - -5
-5 - 0
US Army Corps of Engineers®


Navigable Pass | Design Ship Beam | Proposed Gate Width | Existing Channel Width | Authorized Depth | Air Clearance
Sandy Hook | 48 m | 800 ft | 120 ft | -35 ft | 143 ft
Ambrose | 59 m (21k TEU) | 1000-1500 ft | 2000 ft | -53 ft | 228 ft
Rockaway | 11 m | 200 ft | n/A | -20 ft | 50 ft
Verrazano Narrows Primary | 59 m (21k TEU) | 1000-1400 ft | 2000 ft | -53 ft | 228 ft
VN Secondary | 11 m | 200 ft | | -40 ft | 50 ft
Kill Van Kull | 59 m (21k TEU) | 800 ft | 1100 ft | -50 ft | 228 ft
Arthur Kill | 45 m | 600 ft | 600 ft | -35 ft | 143 ft
Scale: 1:3,000
Grid Spacing: 1,000 ft
Spatial Reference:
Name: NAD 1983 2011 StatePlane New Jersey FIPS 2900 Ft US
Disclaimer:
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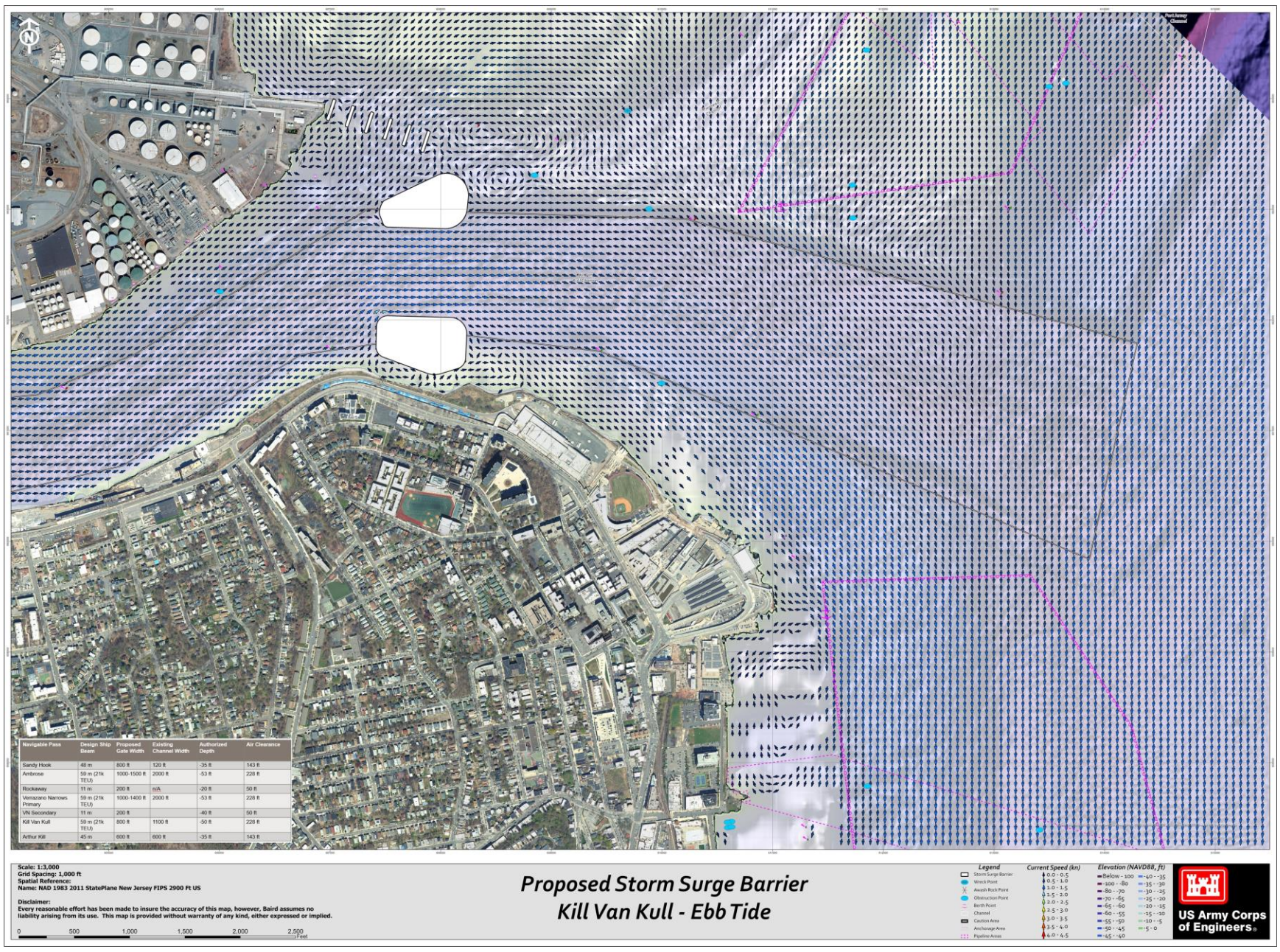
0 500 1,000 1,500 2,000 2,500 Feet
Proposed Storm Surge Barrier
Kill Van Kull - Flood Tide
Legend
Storm Surge Barrier
Wreck Point
Awash Rock Point
Obstruction Point
Berth Point
Channel
Caution Area
Anchorage Area
Pipeline Areas
Current Speed (kn)
0.0 - 0.5
0.5 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0 - 2.5
2.5 - 3.0
3.0 - 3.5
3.5 - 4.0
4.0 - 4.5
Elevation (NAVD88, ft)
Below -100
-100 - -80
-80 - -70
-70 - -65
-65 - -60
-60 - -55
-55 - -50
-50 - -45
-45 - -40
-40 - -35
-35 - -30
-30 - -25
-25 - -20
-20 - -15
-15 - -10
-10 - -5
-5 - 0
US Army Corps of Engineers


Navigable Pass | Design Ship Beam | Proposed Gate Width | Existing Channel Width | Authorized Depth | Air Clearance
Sandy Hook | 48 m | 800 ft | 120 ft | -35 ft | 143 ft
Ambrose | 59 m (21k TEU) | 1000-1500 ft | 2000 ft | -53 ft | 228 ft
Rockaway | 11 m | 200 ft | n/A | -20 ft | 50 ft
Verrazano Narrows Primary | 59 m (21k TEU) | 1000-1400 ft | 2000 ft | -53 ft | 228 ft
VN Secondary | 11 m | 200 ft | | -40 ft | 50 ft
Kill Van Kull | 59 m (21k TEU) | 800 ft | 1100 ft | -50 ft | 228 ft
Arthur Kill | 45 m | 600 ft | 600 ft | -35 ft | 143 ft
Scale: 1:3,000
Grid Spacing: 1,000 ft
Spatial Reference:
Name: NAD 1983 2011 StatePlane New Jersey FIPS 2900 Ft US
Disclaimer:
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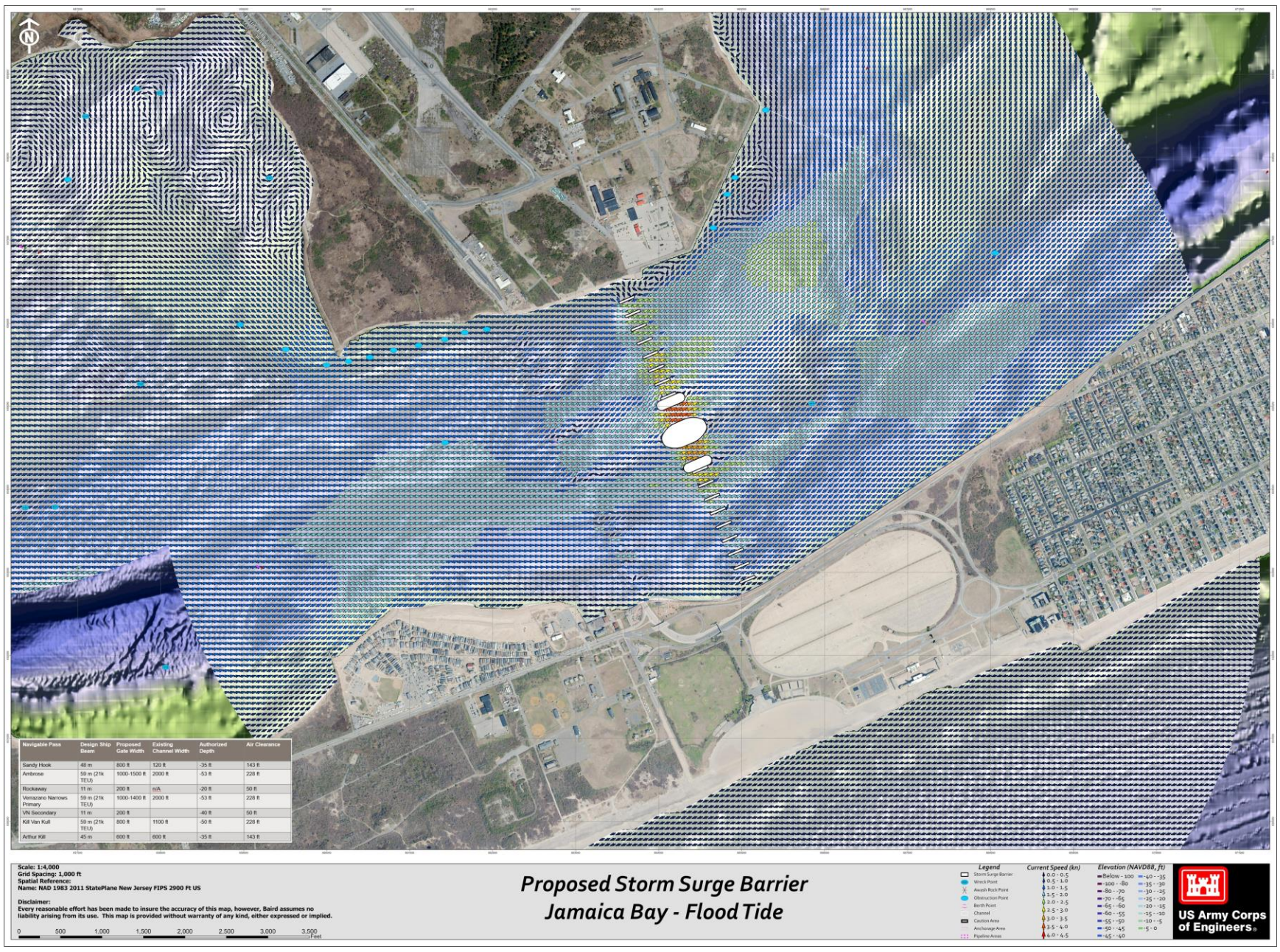
0 500 1,000 1,500 2,000 2,500 Feet
Proposed Storm Surge Barrier
Kill Van Kull - Ebb Tide
Legend
Storm Surge Barrier
Wreck Point
Awash Rock Point
Obstruction Point
Berth Point
Channel
Caution Area
Anchorage Area
Pipeline Areas
Current Speed (kn)
0.0 - 0.5
0.5 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0 - 2.5
2.5 - 3.0
3.0 - 3.5
3.5 - 4.0
4.0 - 4.5
Elevation (NAVD88, ft)
Below -100
-100 - -80
-80 - -70
-70 - -65
-65 - -60
-60 - -55
-55 - -50
-50 - -45
-45 - -40
-40 - -35
-35 - -30
-30 - -25
-25 - -20
-20 - -15
-15 - -10
-10 - -5
-5 - 0
US Army Corps of Engineers


Navigable Pass | Design Ship Beam | Proposed Gate Width | Existing Channel Width | Authorized Depth | Air Clearance
Sandy Hook | 48 m | 800 ft | 120 ft | -35 ft | 143 ft
Ambrose | 59 m (21k TEU) | 1000-1500 ft | 2000 ft | -53 ft | 228 ft
Rockaway | 11 m | 200 ft | n/A | -20 ft | 50 ft
Verrazano Narrows Primary | 59 m (21k TEU) | 1000-1400 ft | 2000 ft | -53 ft | 228 ft
VN Secondary | 11 m | 200 ft | | -40 ft | 50 ft
Kill Van Kull | 59 m (21k TEU) | 800 ft | 1100 ft | -50 ft | 228 ft
Arthur Kill | 45 m | 600 ft | 600 ft | -35 ft | 143 ft
Scale: 1:4,000
Grid Spacing: 1,000 ft
Spatial Reference:
Name: NAD 1983 2011 StatePlane New Jersey FIPS 2900 Ft US
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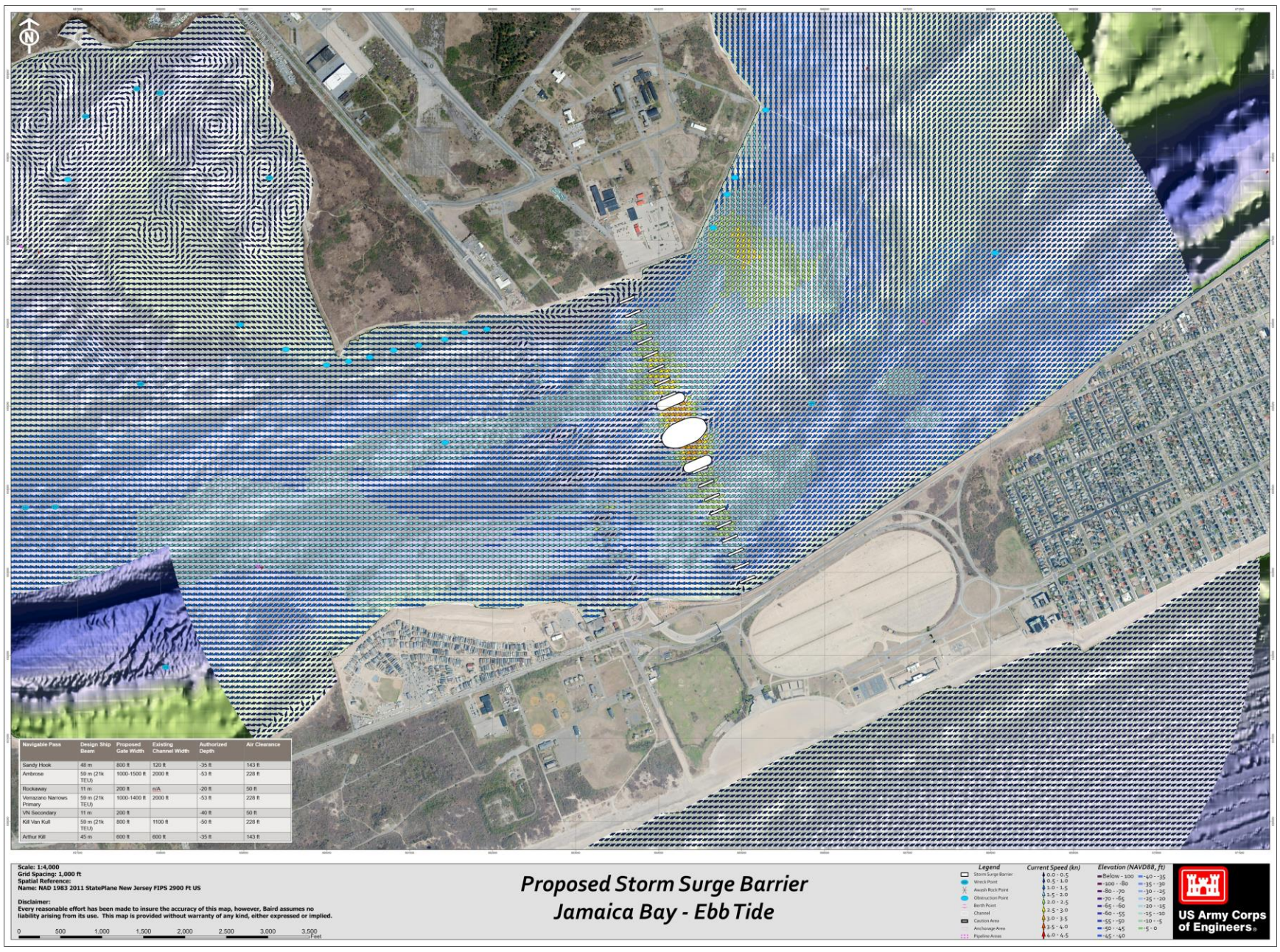
0 500 1,000 1,500 2,000 2,500 3,000 3,500 Feet
Proposed Storm Surge Barrier
Jamaica Bay - Flood Tide
Legend
Storm Surge Barrier
Wreck Point
Awash Rock Point
Obstruction Point
Berth Point
Channel
Caution Area
Anchorage Area
Pipeline Areas
Current Speed (kn)
0.0 - 0.5
0.5 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0 - 2.5
2.5 - 3.0
3.0 - 3.5
3.5 - 4.0
4.0 - 4.5
Elevation (NAVD88, ft)
Below -100
-100 - -80
-80 - -70
-70 - -65
-65 - -60
-60 - -55
-55 - -50
-50 - -45
-45 - -40
-40 - -35
-35 - -30
-30 - -25
-25 - -20
-20 - -15
-15 - -10
-10 - -5
-5 - 0
US Army Corps of Engineers


Navigable Pass | Design Ship Beam | Proposed Gate Width | Existing Channel Width | Authorized Depth | Air Clearance
Sandy Hook | 48 m | 800 ft | 120 ft | -35 ft | 143 ft
Ambrose | 59 m (21k TEU) | 1000-1500 ft | 2000 ft | -53 ft | 228 ft
Rockaway | 11 m | 200 ft | n/A | -20 ft | 50 ft
Verrazano Narrows Primary | 59 m (21k TEU) | 1000-1400 ft | 2000 ft | -53 ft | 228 ft
VN Secondary | 11 m | 200 ft | | -40 ft | 50 ft
Kill Van Kull | 59 m (21k TEU) | 800 ft | 1100 ft | -50 ft | 228 ft
Arthur Kill | 45 m | 600 ft | 600 ft | -35 ft | 143 ft
Scale: 1:4,000
Grid Spacing: 1,000 ft
Spatial Reference:
Name: NAD 1983 2011 StatePlane New Jersey FIPS 2900 Ft US
Disclaimer:
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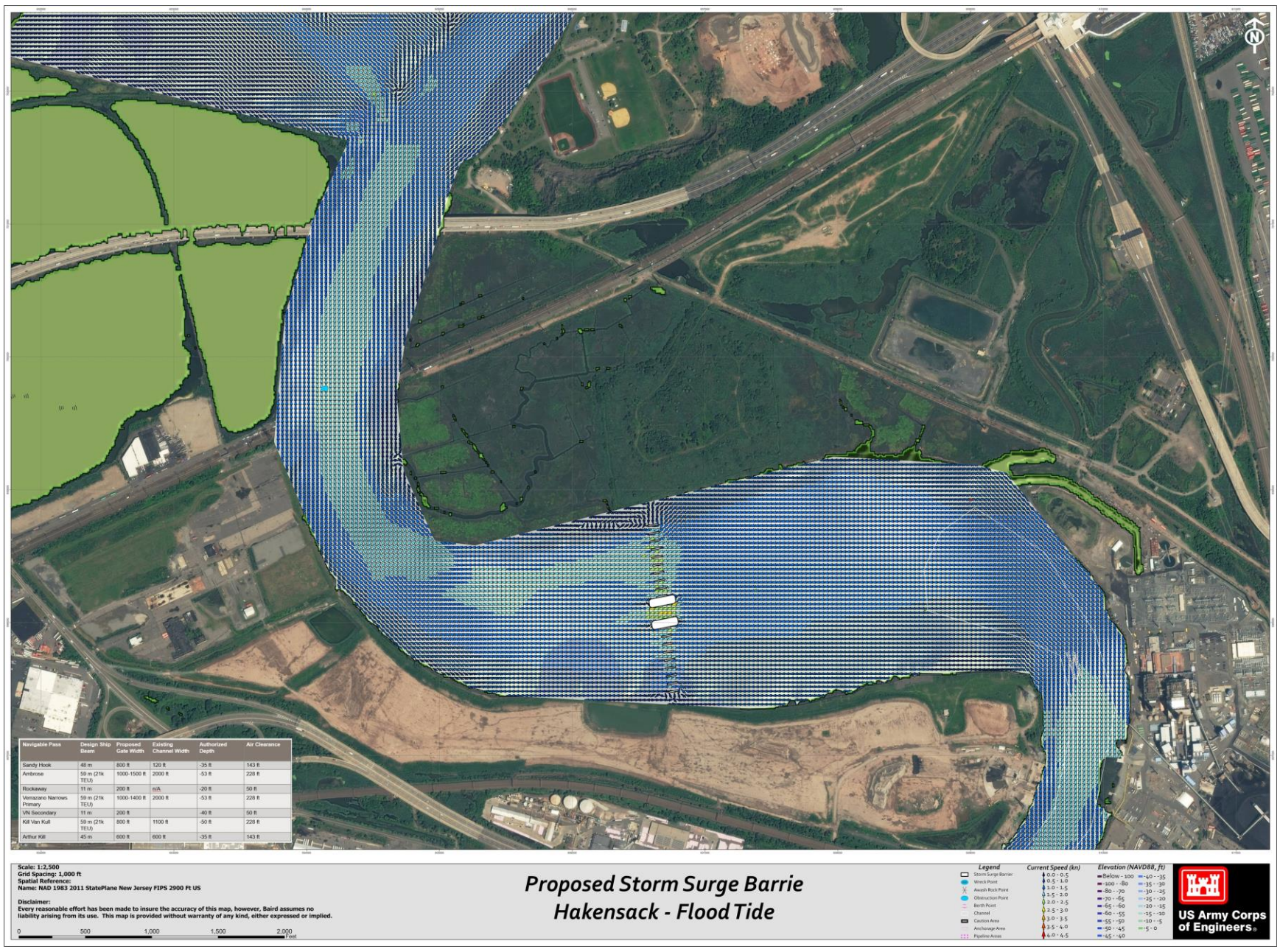
0 500 1,000 1,500 2,000 2,500 3,000 3,500 Feet
Proposed Storm Surge Barrier
Jamaica Bay - Ebb Tide
Legend
Storm Surge Barrier
Wreck Point
Awash Rock Point
Obstruction Point
Berth Point
Channel
Caution Area
Anchorage Area
Pipeline Areas
Current Speed (kn)
0.0 - 0.5
0.5 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0 - 2.5
2.5 - 3.0
3.0 - 3.5
3.5 - 4.0
4.0 - 4.5
Elevation (NAVD88, ft)
Below -100
-100 - -80
-80 - -70
-70 - -65
-65 - -60
-60 - -55
-55 - -50
-50 - -45
-45 - -40
-40 - -35
-35 - -30
-30 - -25
-25 - -20
-20 - -15
-15 - -10
-10 - -5
-5 - 0
US Army Corps of Engineers


Navigable Pass | Design Ship Beam | Proposed Gate Width | Existing Channel Width | Authorized Depth | Air Clearance
Sandy Hook | 48 m | 800 ft | 120 ft | -35 ft | 143 ft
Ambrose | 59 m (21k TEU) | 1000-1500 ft | 2000 ft | -53 ft | 228 ft
Rockaway | 11 m | 200 ft | n/A | -20 ft | 50 ft
Verrazano Narrows Primary | 59 m (21k TEU) | 1000-1400 ft | 2000 ft | -53 ft | 228 ft
VN Secondary | 11 m | 200 ft | | -40 ft | 50 ft
Kill Van Kull | 59 m (21k TEU) | 800 ft | 1100 ft | -50 ft | 228 ft
Arthur Kill | 45 m | 600 ft | 600 ft | -35 ft | 143 ft
Scale: 1:2,500
Grid Spacing: 1,000 ft
Spatial Reference:
Name: NAD 1983 2011 StatePlane New Jersey FIPS 2900 Ft US
Disclaimer:
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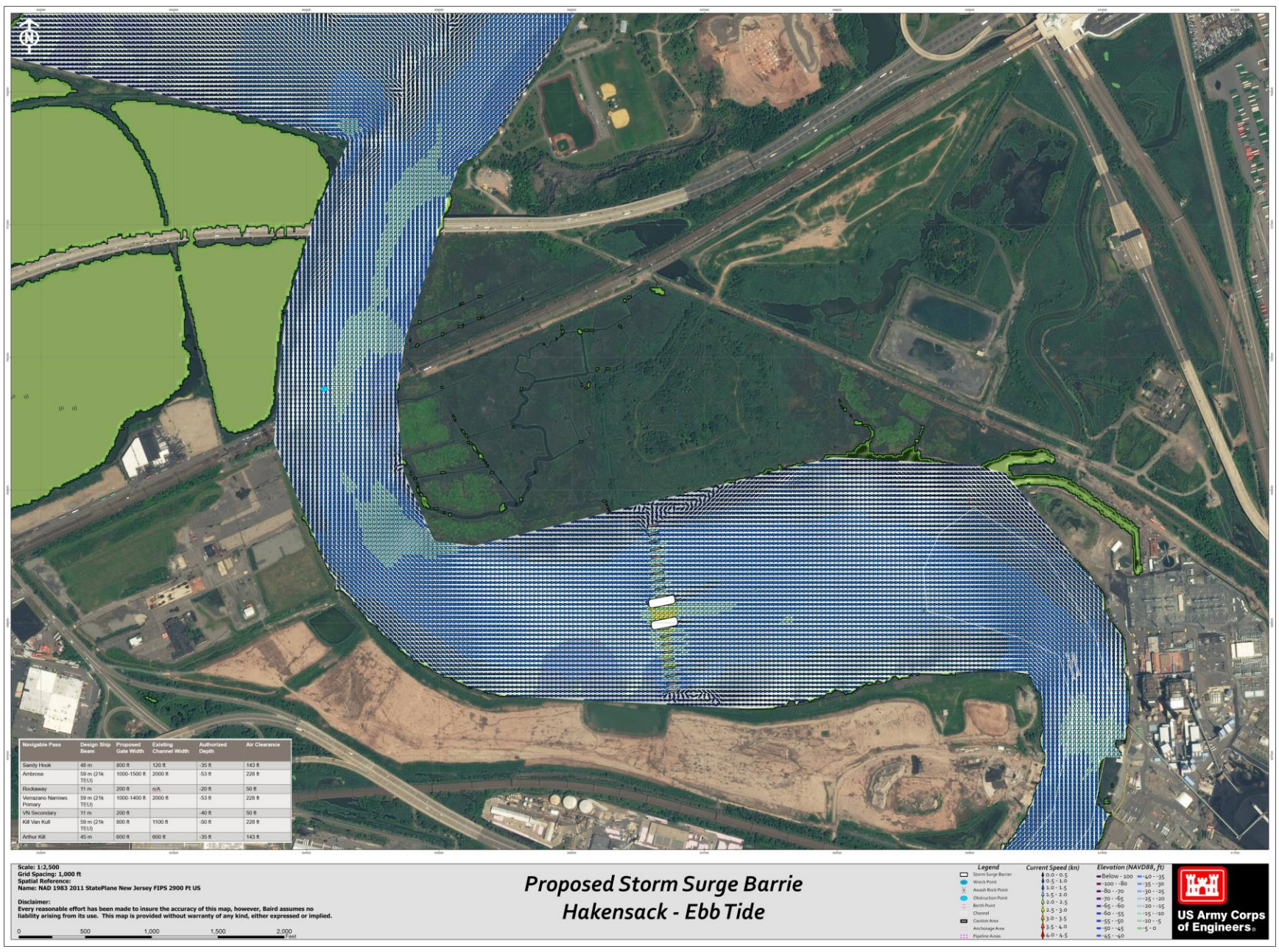
0 500 1,000 1,500 2,000 Feet
Proposed Storm Surge Barrie
Hakensack - Flood Tide
Legend
Storm Surge Barrier
Wreck Point
Awash Rock Point
Obstruction Point
Berth Point
Channel
Caution Area
Anchorage Area
Pipeline Areas
Current Speed (kn)
0.0 - 0.5
0.5 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0 - 2.5
2.5 - 3.0
3.0 - 3.5
3.5 - 4.0
4.0 - 4.5
Elevation (NAVD88, ft)
Below -100
-100 - -80
-80 - -70
-70 - -65
-65 - -60
-60 - -55
-55 - -50
-50 - -45
-45 - -40
-40 - -35
-35 - -30
-30 - -25
-25 - -20
-20 - -15
-15 - -10
-10 - -5
-5 - 0
US Army Corps of Engineers


Navigable Pass | Design Ship Beam | Proposed Gate Width | Existing Channel Width | Authorized Depth | Air Clearance
Sandy Hook | 48 m | 800 ft | 120 ft | -35 ft | 143 ft
Ambrose | 59 m (21k TEU) | 1000-1500 ft | 2000 ft | -53 ft | 228 ft
Rockaway | 11 m | 200 ft | n/A | -20 ft | 50 ft
Verrazano Narrows Primary | 59 m (21k TEU) | 1000-1400 ft | 2000 ft | -53 ft | 228 ft
VN Secondary | 11 m | 200 ft | | -40 ft | 50 ft
Kill Van Kull | 59 m (21k TEU) | 800 ft | 1100 ft | -50 ft | 228 ft
Arthur Kill | 45 m | 600 ft | 600 ft | -35 ft | 143 ft
Scale: 1:2,500
Grid Spacing: 1,000 ft
Spatial Reference:
Name: NAD 1983 2011 StatePlane New Jersey FIPS 2900 Ft US
Disclaimer:
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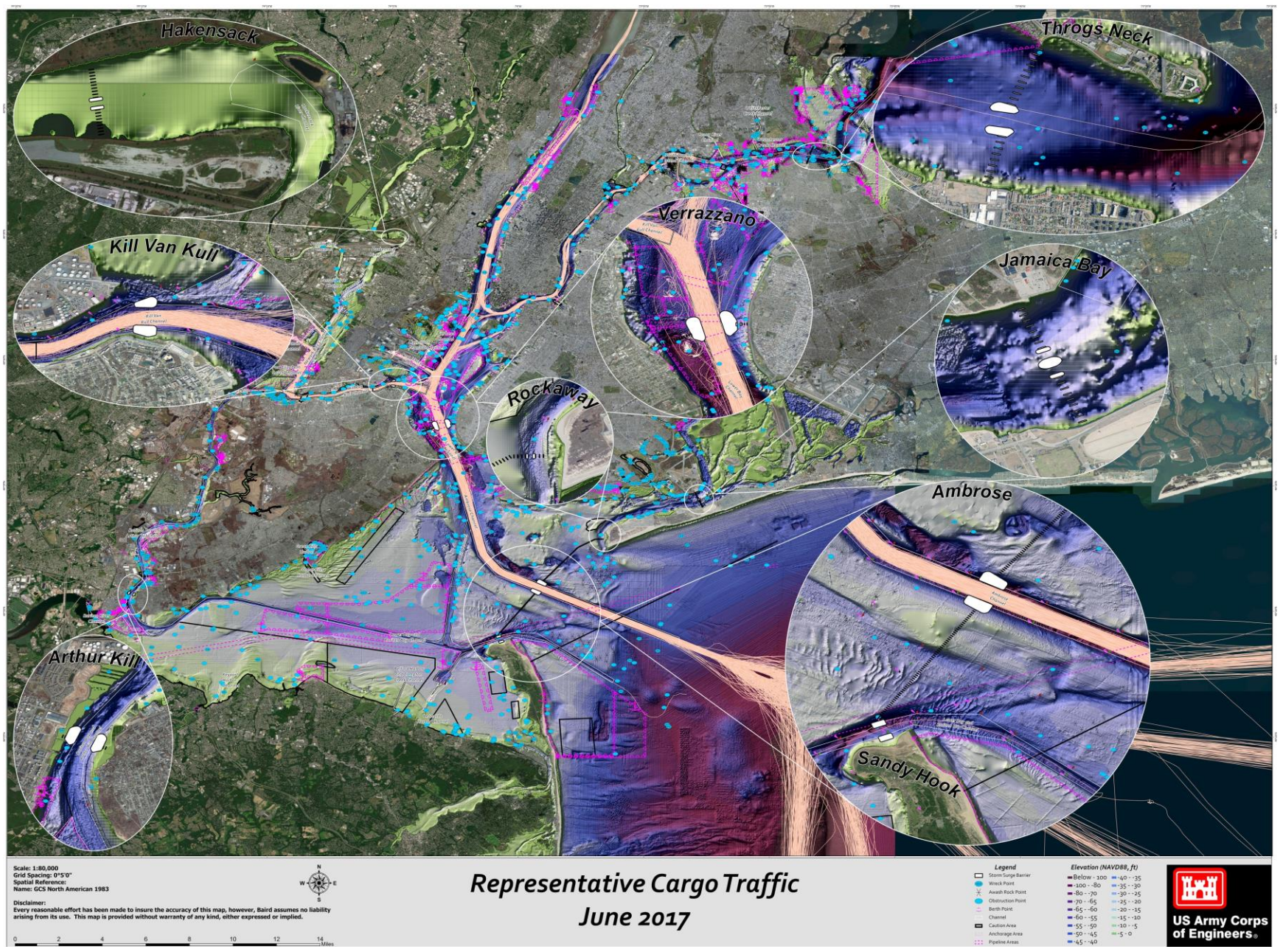
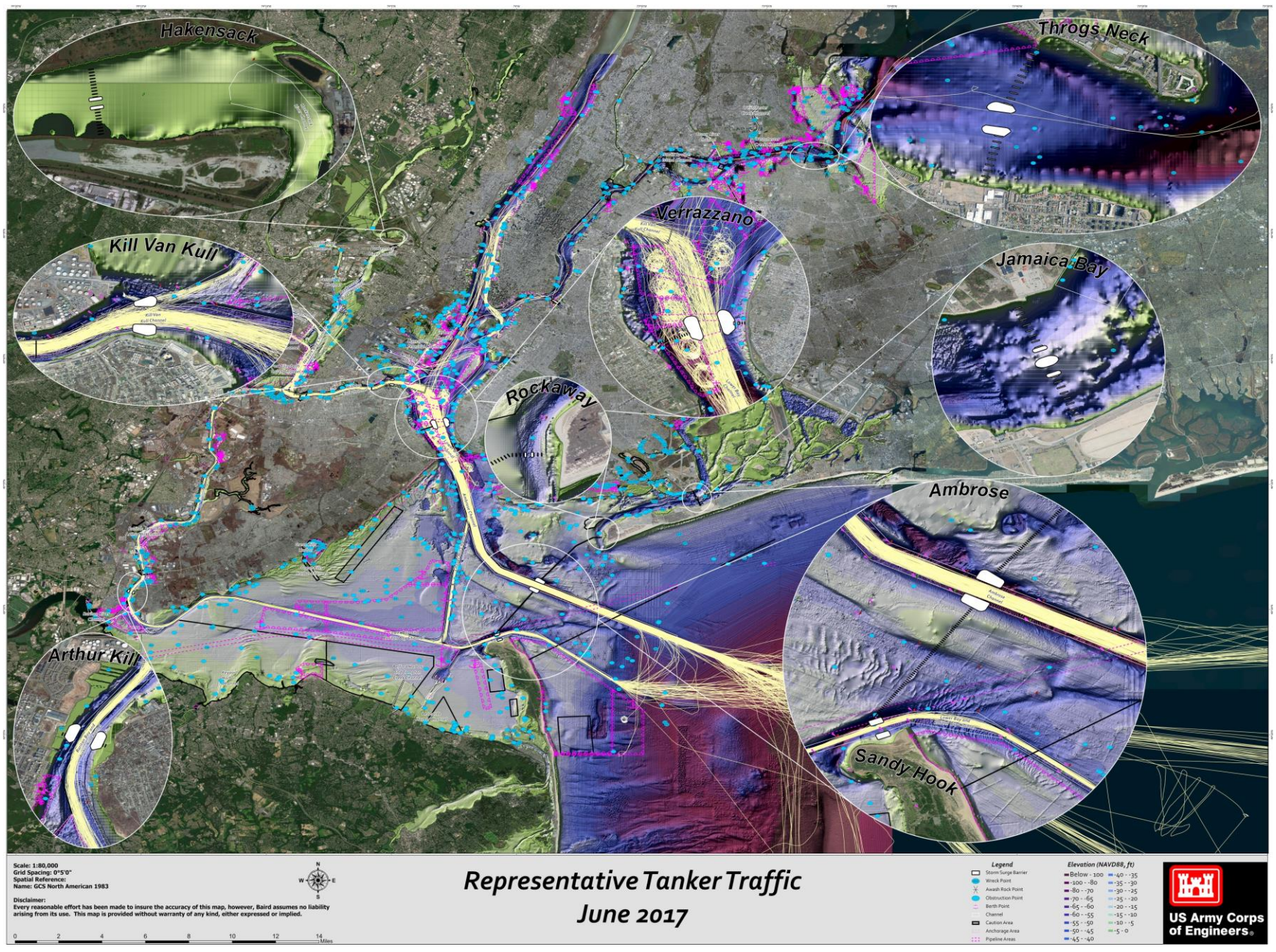
0 500 1,000 1,500 2,000 Feet
Proposed Storm Surge Barrie
Hakensack - Ebb Tide
Legend
Storm Surge Barrier
Wreck Point
Awash Rock Point
Obstruction Point
Berth Point
Channel
Caution Area
Anchorage Area
Pipeline Areas
Current Speed (kn)
0.0 - 0.5
0.5 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0 - 2.5
2.5 - 3.0
3.0 - 3.5
3.5 - 4.0
4.0 - 4.5
Elevation (NAVD88, ft)
Below -100
-100 - -80
-80 - -70
-70 - -65
-65 - -60
-60 - -55
-55 - -50
-50 - -45
-45 - -40
-40 - -35
-35 - -30
-30 - -25
-25 - -20
-20 - -15
-15 - -10
-10 - -5
-5 - 0
US Army Corps of Engineers


Hakensack
Throgs Neck
Kill Van Kull
Verrazzano
Jamaica Bay
Rockaway
Ambrose
Arthur Kill
Sandy Hook
Scale: 1:80,000
Grid Spacing: 0°5'0"
Spatial Reference:
Name: GCS North American 1983
Disclaimer:
Every reasonable effort has been made to insure the accuracy of this map, however, Baird assumes no liability arising from its use. This map is provided without warranty of any kind, either expressed or implied.
0 2 4 6 8 10 12 14 Miles
N W E S
Representative Cargo Traffic
June 2017
Legend
Storm Surge Barrier
Wreck Point
Awash Rock Point
Obstruction Point
Berth Point
Channel
Caution Area
Anchorage Area
Pipeline Areas
Elevation (NAVD88, ft)
Below - 100
-100 - -80
-80 - -70
-70 - -65
-65 - -60
-60 - -55
-55 - -50
-50 - -45
-45 - -40
-40 - -35
-35 - -30
-30 - -25
-25 - -20
-20 - -15
-15 - -10
-10 - -5
-5 - 0
US Army Corps of Engineers®


Hakensack
Throgs Neck
Kill Van Kull
Verrazzano
Jamaica Bay
Rockaway
Ambrose
Arthur Kill
Sandy Hook
Scale: 1:80,000
Grid Spacing: 0°5'0"
Spatial Reference:
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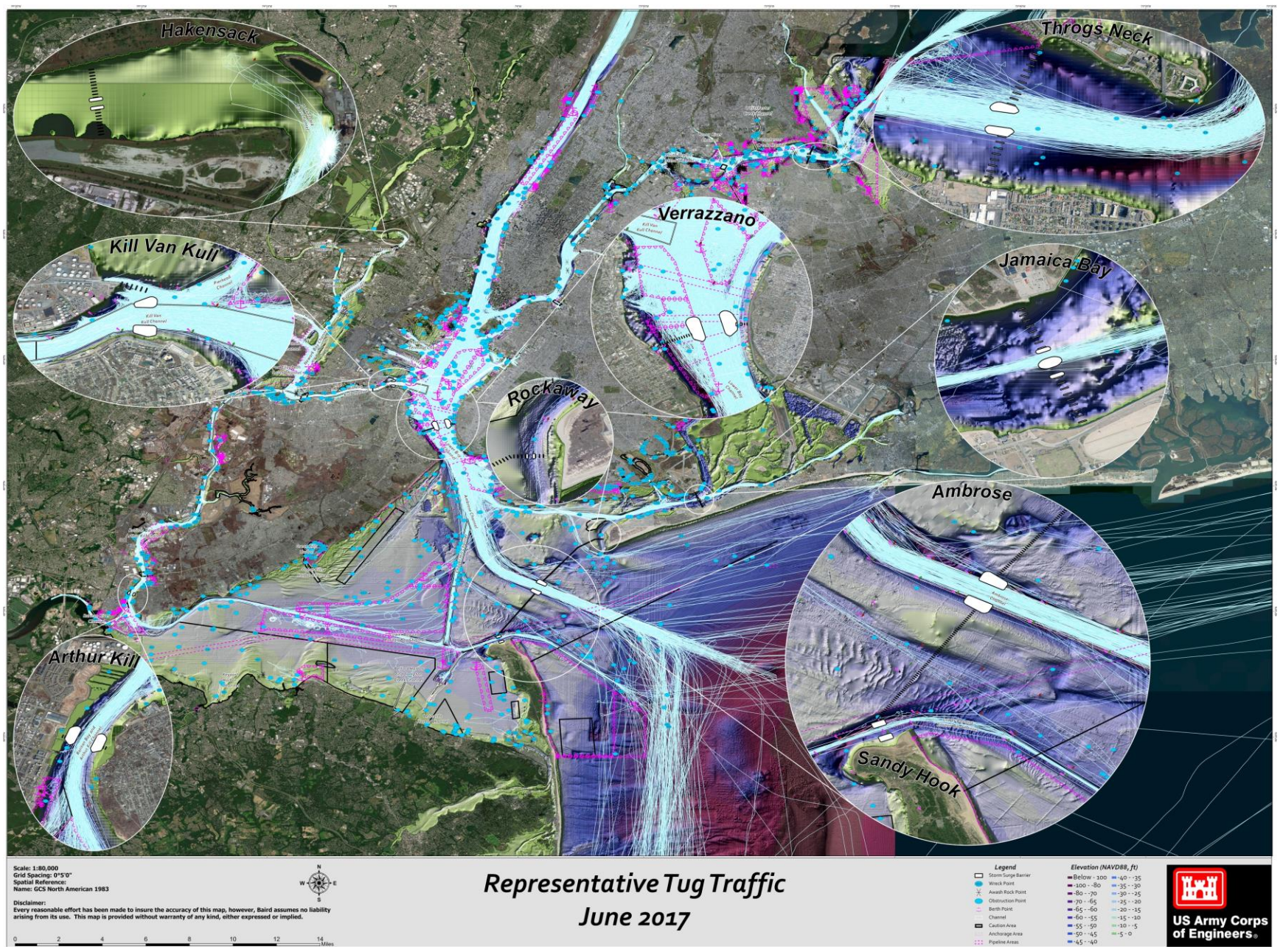
0 2 4 6 8 10 12 14 Miles
N W E S
Representative Tanker Traffic
June 2017
Legend
Storm Surge Barrier
Wreck Point
Awash Rock Point
Obstruction Point
Berth Point
Channel
Caution Area
Anchorage Area
Pipeline Areas
Elevation (NAVD88, ft)
Below - 100
-100 - -80
-80 - -70
-70 - -65
-65 - -60
-60 - -55
-55 - -50
-50 - -45
-45 - -40
-40 - -35
-35 - -30
-30 - -25
-25 - -20
-20 - -15
-15 - -10
-10 - -5
-5 - 0
US Army Corps of Engineers®


Hakensack
Throgs Neck
Verrazzano
Kill Van Kull
Jamaica Bay
Rockaway
Ambrose
Arthur Kill
Sandy Hook
Scale: 1:80,000
Grid Spacing: 0°5'0"
Spatial Reference:
Name: GCS North American 1983
Disclaimer:
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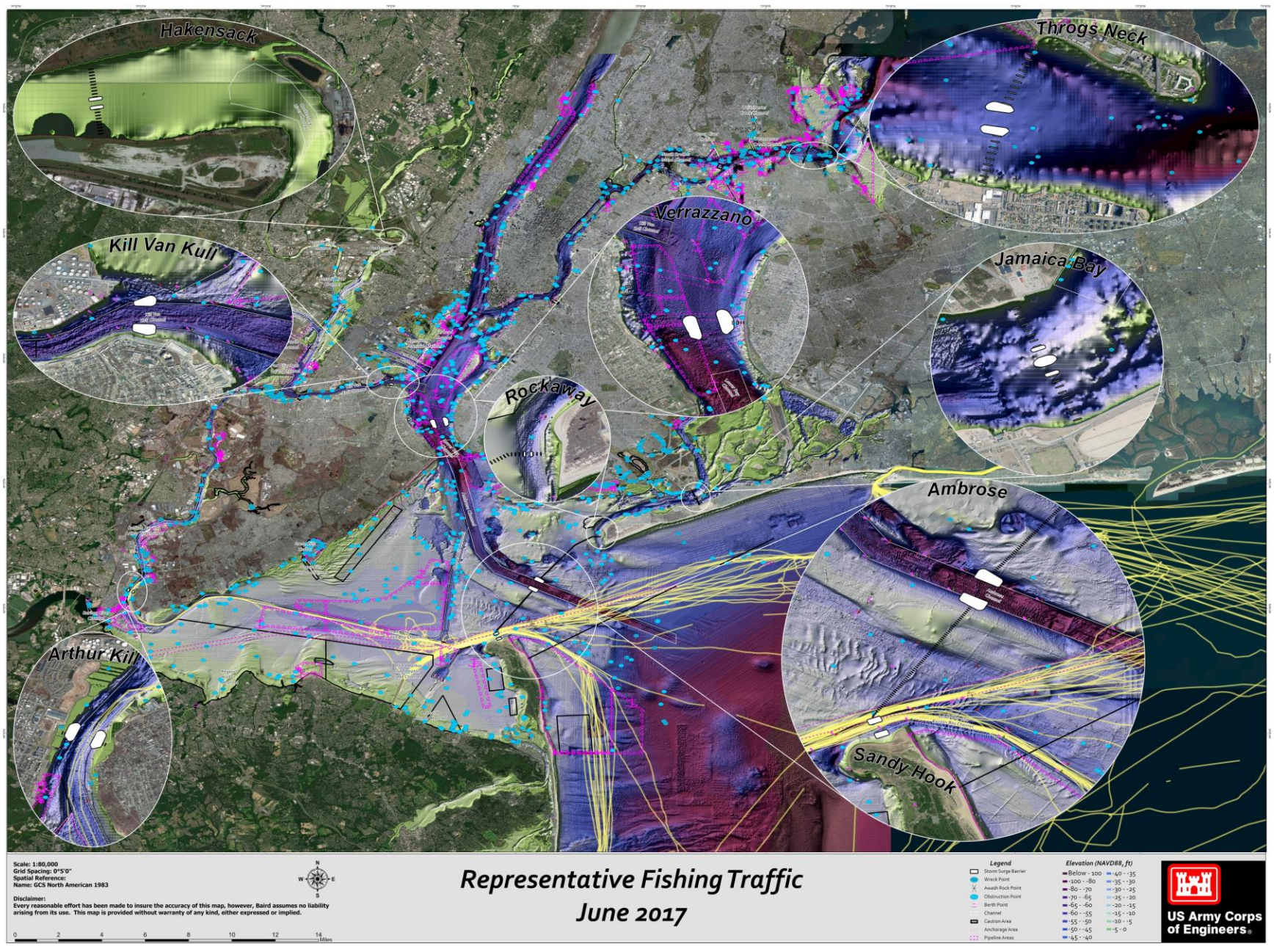
0 2 4 6 8 10 12 14 Miles
Representative Tug Traffic
June 2017
Legend
Storm Surge Barrier
Wreck Point
Awash Rock Point
Obstruction Point
Berth Point
Channel
Caution Area
Anchorage Area
Pipeline Areas
Elevation (NAVD88, ft)
Below - 100
-100 - -80
-80 - -70
-70 - -65
-65 - -60
-60 - -55
-55 - -50
-50 - -45
-45 - -40
-40 - -35
-35 - -30
-30 - -25
-25 - -20
-20 - -15
-15 - -10
-10 - -5
-5 - 0
US Army Corps of Engineers®


Hakensack
Throgs Neck
Verrazzano
Kill Van Kull
Jamaica Bay
Rockaway
Ambrose
Arthur Kill
Sandy Hook
Scale: 1:80,000
Grid Spacing: 0°5'0"
Spatial Reference:
Name: GCS North American 1983
Disclaimer:
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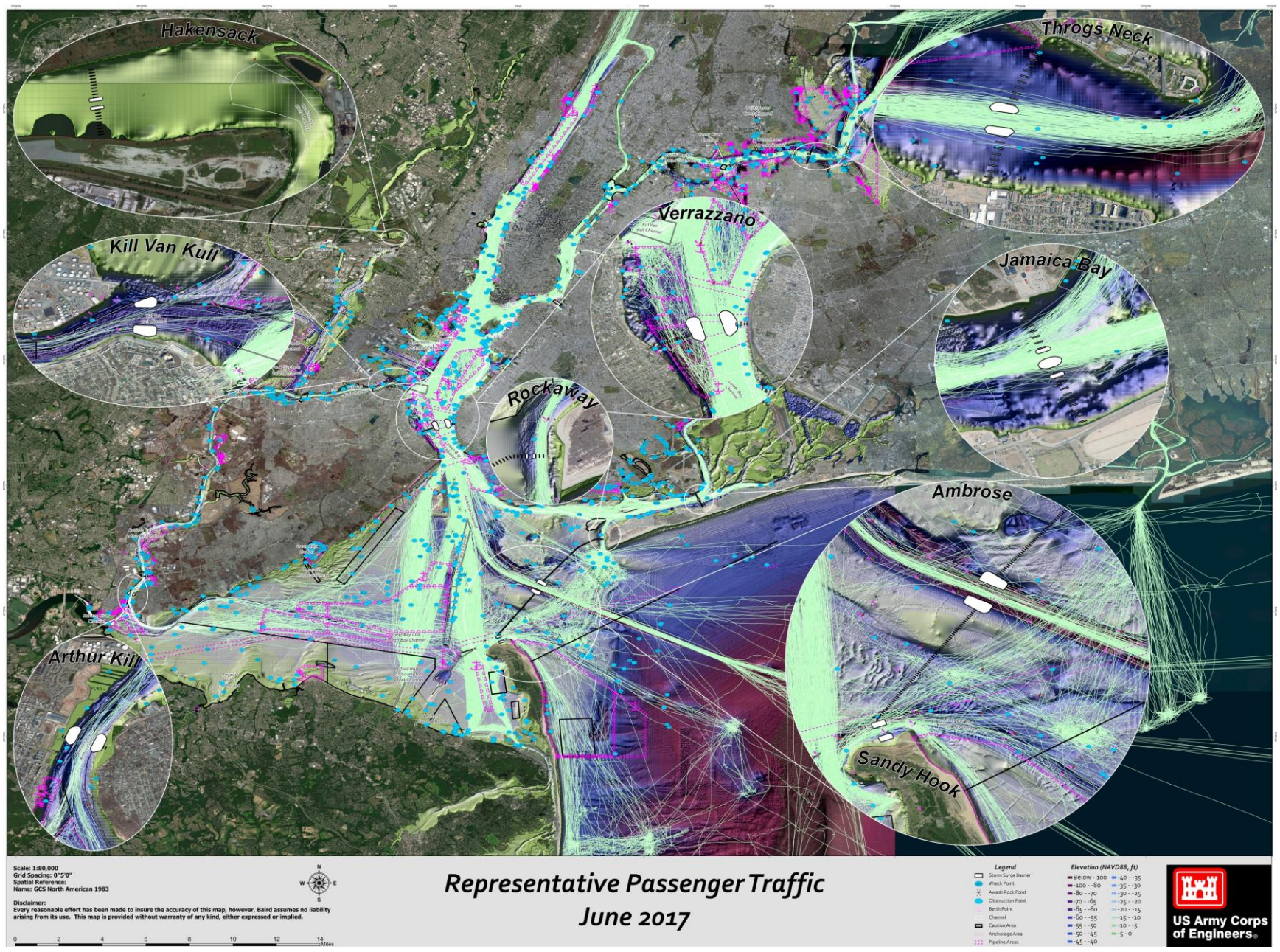
0 2 4 6 8 10 12 14 Miles
Representative Fishing Traffic
June 2017
Legend
Storm Surge Barrier
Wreck Point
Awash Rock Point
Obstruction Point
Berth Point
Channel
Caution Area
Anchorage Area
Pipeline Areas
Elevation (NAVD88, ft)
Below - 100
-100 - -80
-80 - -70
-70 - -65
-65 - -60
-60 - -55
-55 - -50
-50 - -45
-45 - -40
-40 - -35
-35 - -30
-30 - -25
-25 - -20
-20 - -15
-15 - -10
-10 - -5
-5 - 0
US Army Corps of Engineers®


Hakensack
Throgs Neck
Verrazzano
Kill Van Kull
Jamaica Bay
Rockaway
Ambrose
Arthur Kill
Sandy Hook
Scale: 1:80,000
Grid Spacing: 0°5'0"
Spatial Reference:
Name: GCS North American 1983
Disclaimer:
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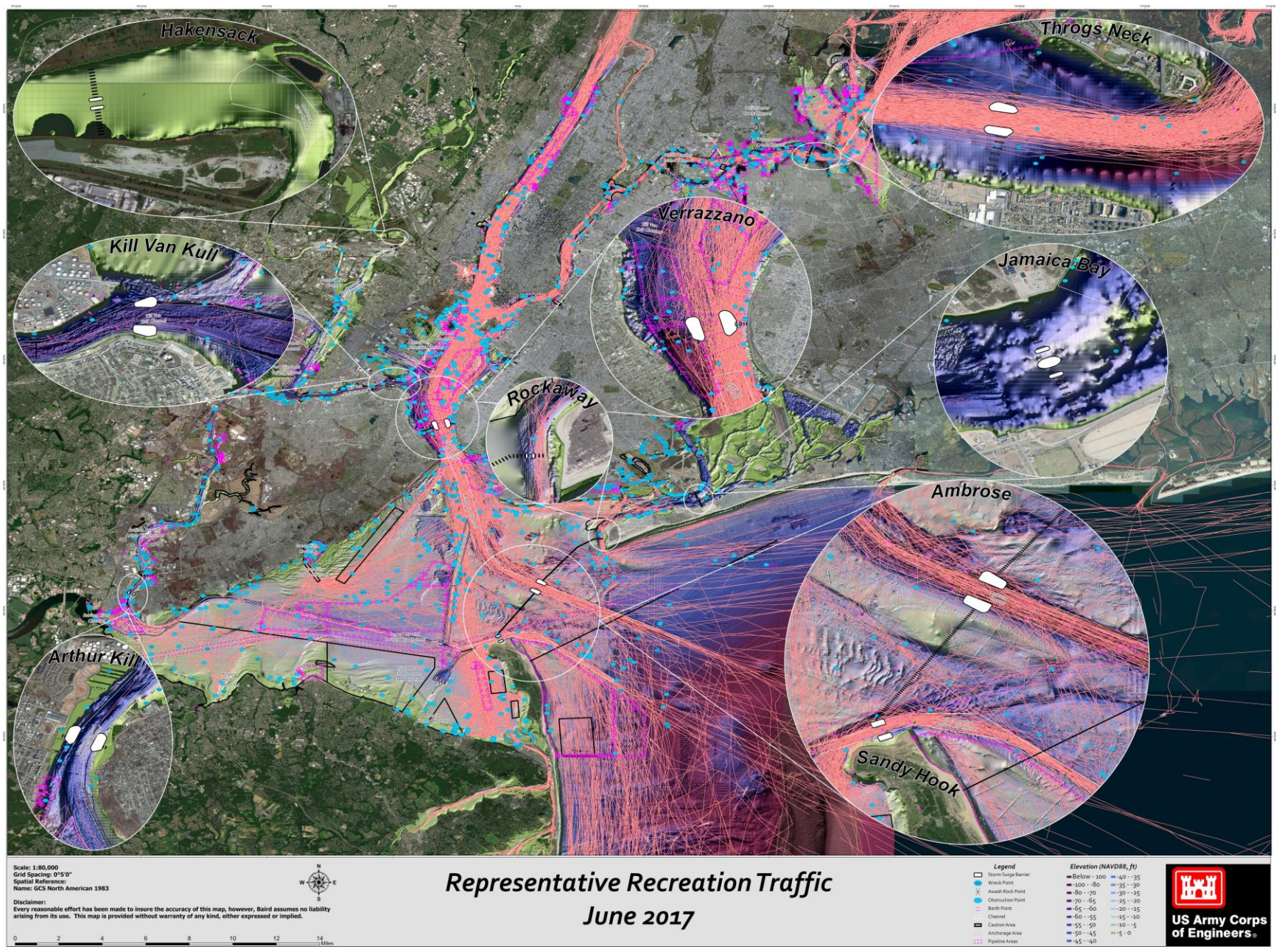
0 2 4 6 8 10 12 14 Miles
Representative Passenger Traffic
June 2017
Legend
Storm Surge Barrier
Wreck Point
Awash Rock Point
Obstruction Point
Berth Point
Channel
Caution Area
Anchorage Area
Pipeline Areas
Elevation (NAVD88, ft)
Below - 100
-100 - -80
-80 - -70
-70 - -65
-65 - -60
-60 - -55
-55 - -50
-50 - -45
-45 - -40
-40 - -35
-35 - -30
-30 - -25
-25 - -20
-20 - -15
-15 - -10
-10 - -5
-5 - 0
US Army Corps of Engineers®


Hakensack
Throgs Neck
Verrazzano
Kill Van Kull
Jamaica Bay
Rockaway
Ambrose
Arthur Kill
Sandy Hook
Scale: 1:80,000
Grid Spacing: 0°5'0"
Spatial Reference:
Name: GCS North American 1983
Disclaimer:
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0 2 4 6 8 10 12 14 Miles
Representative Recreation Traffic
June 2017
Legend
Storm Surge Barrier
Wreck Point
Awash Rock Point
Obstruction Point
Berth Point
Channel
Caution Area
Anchorage Area
Pipeline Areas
Elevation (NAVD88, ft)
Below - 100
-100 - -80
-80 - -70
-70 - -65
-65 - -60
-60 - -55
-55 - -50
-50 - -45
-45 - -40
-40 - -35
-35 - -30
-30 - -25
-25 - -20
-20 - -15
-15 - -10
-10 - -5
-5 - 0
US Army Corps of Engineers®