Hudson County, NJ
Preliminary Work Map

Miles

0 0.125 0.25 0.5 0.75 1

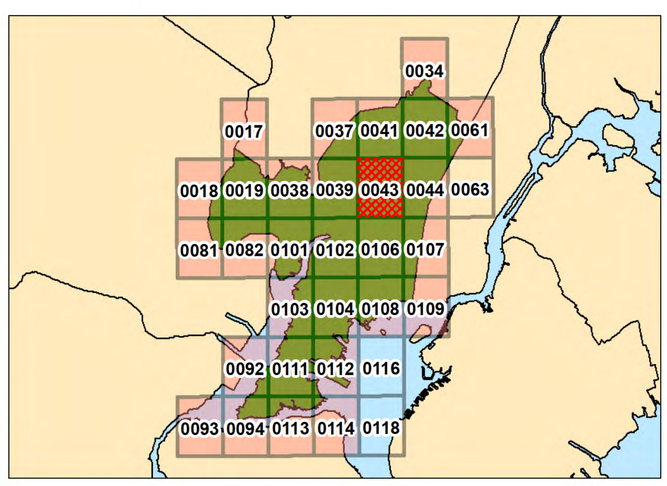
Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary
- Elevation: 4, 8, 12, 16

Elevation information is provided in feet NAVD88.
High water marks are provided for reference to a historical storm event. They are not intended to be used for validation of the coastal mapping and are not expected to match the coastal BFEs.

Panel 0043

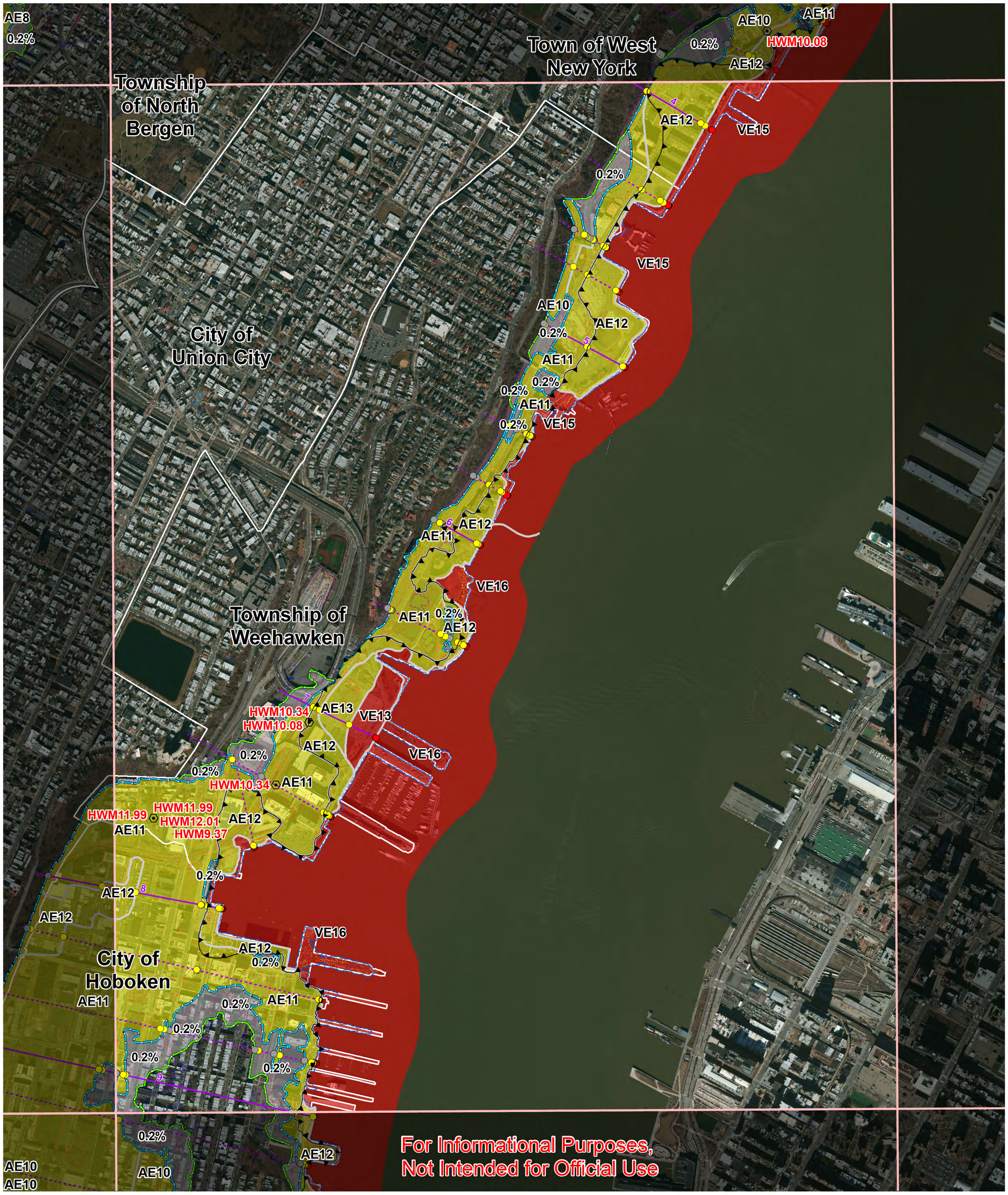
This preliminary work map contains coastal flood hazard information only, riverine flood hazard information not included



FEMA

A JV of Dewberry, URS and ESP
RAMPP
Risk Assessment, Mapping, and Planning Partners

Hudson County, NJ
Preliminary Work Map



0 0.125 0.25 0.5 0.75 1 Miles

Flood Hazard Information

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- 1% Annual Chance Boundary
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- Shoreline
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- Elevation: 4, 8, 12, 16

AE
VE
X

Elevation information is provided in feet NAVD88.
High water marks are provided for reference to a historical storm event. They are not intended to be used for validation of the coastal mapping and are not expected to match the coastal BFEs.

Panel 0044

This preliminary work map contains coastal flood hazard information only, riverine flood hazard information not included

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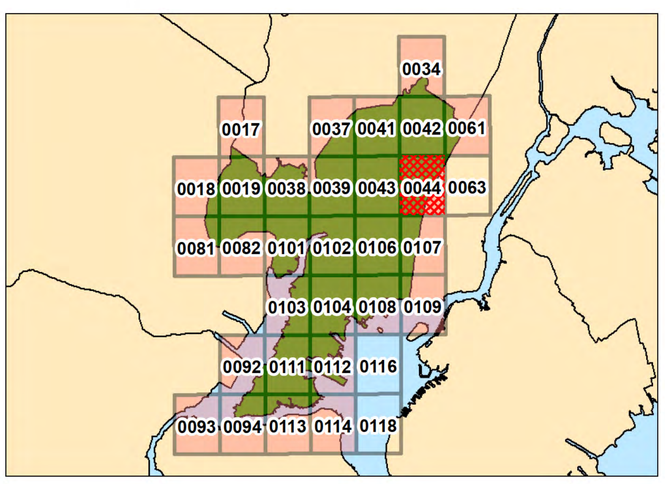
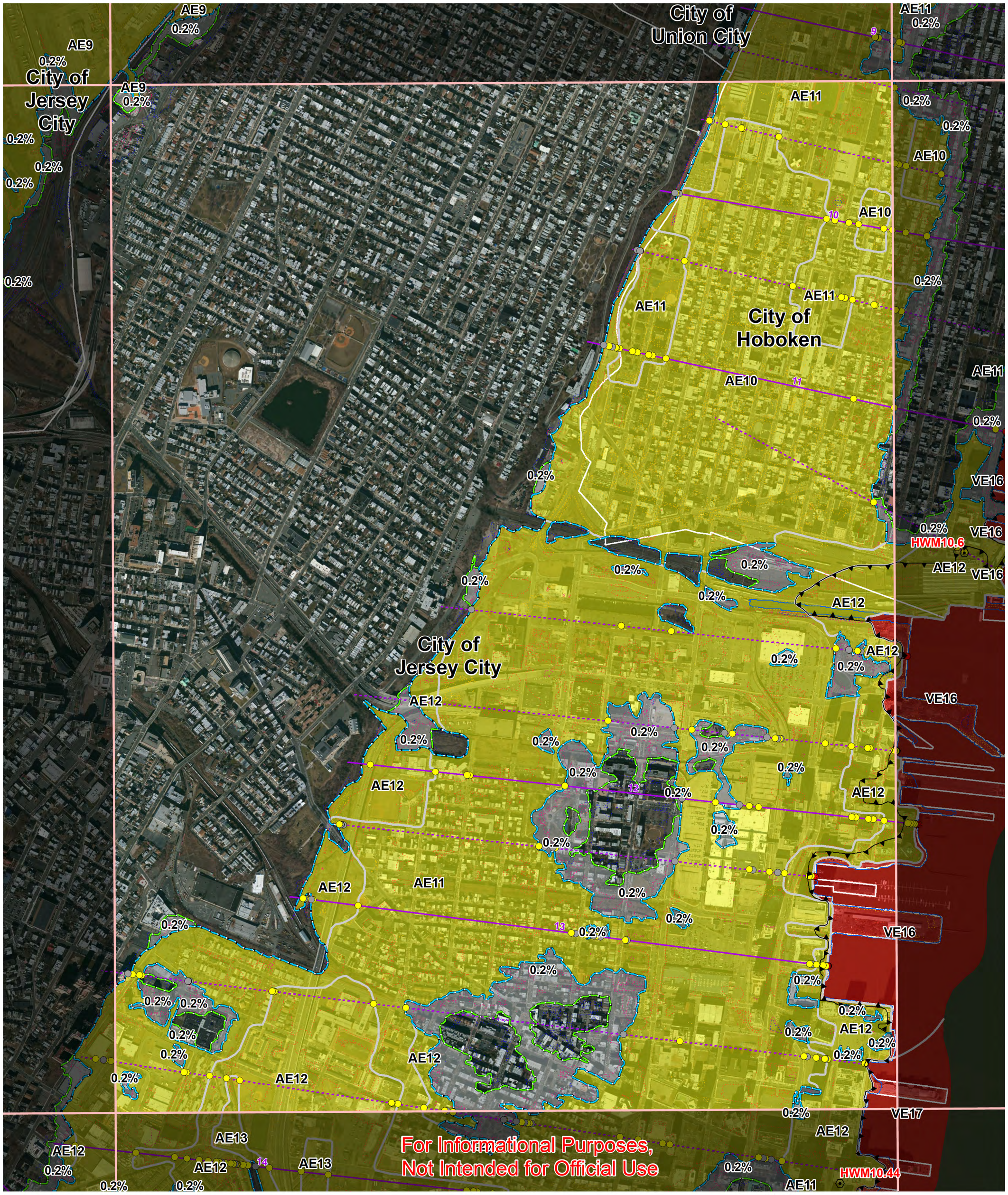
Risk Assessment, Mapping, and Planning Partners



Hudson County, NJ
Preliminary Work Map



0 0.125 0.25 0.5 0.75 1 Miles

Flood Hazard Information

- 0.2% Annual Chance Boundary
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- Gutter Line
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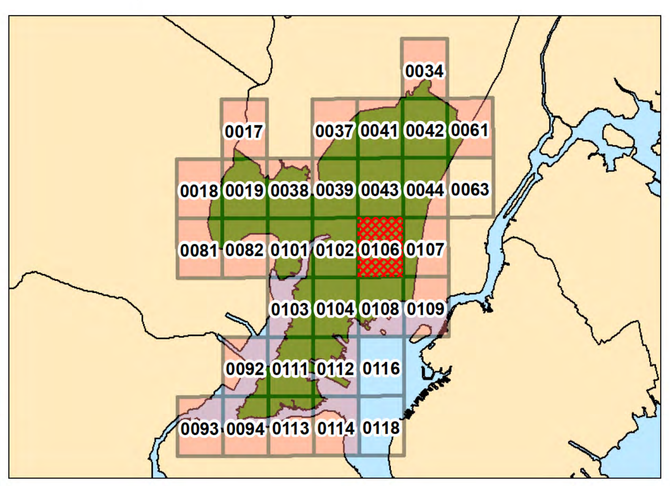
- Elevation: 4, 8, 12, 16

Elevation information is provided in feet NAVD88.
High water marks are provided for reference to a historical storm event. They are not intended to be used for validation of the coastal mapping and are not expected to match the coastal BFEs.

Panel 0106

This preliminary work map contains coastal flood hazard information only, riverine flood hazard information not included



FEMA

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RAMPP
Risk Assessment, Mapping, and Planning Partners

Hudson County, NJ
Preliminary Work Map

Miles

0 0.125 0.25 0.5 0.75 1

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
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- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary

Transect Station: AE, VE, X

Elevation: 4, 8, 12, 16

Elevation information is provided in feet NAVD88.
High water marks are provided for reference to a historical storm event. They are not intended to be used for validation of the coastal mapping and are not expected to match the coastal BFEs.

Panel 0107

This preliminary work map contains coastal flood hazard information only, riverine flood hazard information not included

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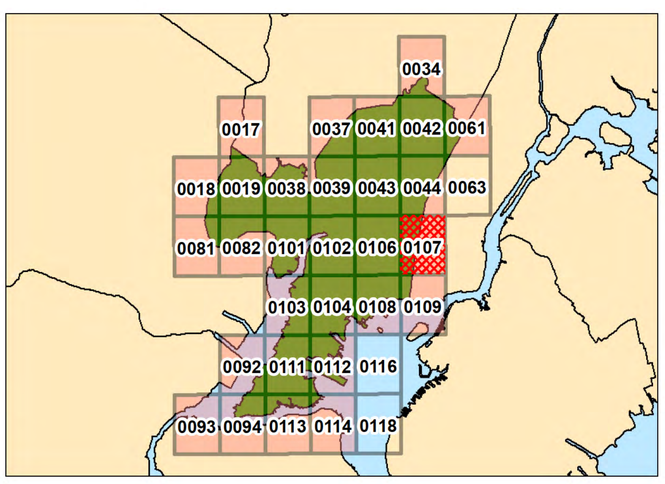
Risk Assessment, Mapping, and Planning Partners



Advisory Base Flood Elevation (ABFE) Information for New Jersey and New York: Glossary of Map Layers and Key Terms

This document contains a description of map layers available on the ABFE maps developed for certain communities in New York and New Jersey and definitions of other useful terms.

Advisory Base (1% Annual Chance) Flood Elevation [ABFE]

The coastal water surface elevation of a flood having a 1% annual chance of being equaled or exceeded in any given year. It is expressed in feet referenced to the North American Vertical Datum of 1988 (NAVD88) and can reflect the elevation of an Advisory Flood Zone V or A.

Advisory 0.2% Annual Chance Flood Elevation

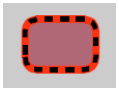
The coastal water surface elevation of a flood having a 0.2% annual chance of being equaled or exceeded in any given year. It is expressed in feet referenced to the North American Vertical Datum of 1988 (NAVD88).

Advisory Base Flood Elevation Zones

This map layer indicates whether the zone is designated as a V or A flood hazard zone and the 0.2% Advisory Flood Elevation and the 1% Advisory Base Flood Elevation (ABFE) in feet referenced to the North American Vertical Datum of 1988 (NAV88) for the zone. Different ABFE zones are distinguished by yellow lines.

Advisory Flood Hazard Zones V and A

The Advisory 1% annual chance floodplain includes both A and V Advisory flood hazard zones.



Advisory Zone V is comprised of the area subject to high velocity wave action (a 3-foot breaking wave) from the 1% annual chance coastal flood. Zone V is subject to more stringent building requirements than other zones because these areas are exposed to a higher level of risk.

Advisory Zone A is comprised of the area subject to storm surge flooding from the 1% annual chance coastal flood. These areas are not subject to high velocity wave action but are still considered high risk flooding areas.

Advisory Limit of the 1% Annual Chance Flood Hazard Area

The limit of the Advisory 1% annual chance floodplain. The Advisory 1% annual chance floodplain includes both V and A Advisory flood hazard zones.

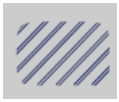
Advisory Map Panels

On the interactive FEMA GeoPortal ABFE Map available through the FEMA Region 2 Coastal Outreach website at http://www.region2coastal.com/, the Advisory Map Panels layer shows the map paneling scheme used to produce the Advisory flood hazard information. The symbology shown for each map panel in this layer indicates its current availability:

- Green: Advisory information for the panel is currently available
- Yellow: Advisory information for the panel is partially available
- Diagonal hatching: Advisory information is not yet available for the panel.

If there is no panel outline shown on the map, currently there are no plans to produce Advisory flood hazard information for that area.

To download a .pdf version of a map panel showing the Advisory information once available, simply click on the desired map panel while the Advisory Map Panel layer is turned on and click on the 'PDF Map Hyperlink' field in the pop up window. The .pdf map panels are produced at a scale of 1" = 1,000 feet.



Advisory Shaded Zone X

The Advisory Shaded Zone X layer shows areas of moderate coastal flood risk outside the regulatory 1% annual chance flood but within the limits of the 0.2% annual chance flood level.

Advisory Zone V-A Boundary

The division between the Advisory flood hazard Zone V and Advisory flood hazard Zone A. This is where the high velocity wave action greater than 3 feet in height is anticipated to end for a coastal 1% annual chance flood. Zone V, also known as the coastal high hazard area, is subject to more stringent building requirements than other zones because these areas are exposed to a higher level of risk.

Area of MOderate Wave Action (MOWA)

The portion of the 1% annual chance coastal Advisory flood hazard area referenced by building codes and standards, where base flood wave heights are between 1.5 and 3 feet, and where wave characteristics are deemed sufficient to damage many National Flood Insurance Program (NFIP)-compliant structures on shallow or solid wall foundations.

Base Flood

A flood having a 1% chance of being equaled or exceeded in any given year. The base flood is the national regulatory standard used by the National Flood Insurance Program (NFIP) and all Federal agencies for the purposes of requiring the purchase of flood insurance and regulating new development. Base Flood Elevations (BFEs) are typically shown on Flood Insurance Rate Maps (FIRMs).

Coastal Barrier Resources Act (CBRA) Zones

The Coastal Barrier Resources Act (CBRA) established the John H. Chafee Coastal Barrier Resources System (CBRS), a defined set of geographic units along the Atlantic, Gulf of Mexico, Great Lakes, U.S. Virgin Islands, and Puerto Rico coasts. Most new Federal expenditures and financial assistance (including flood insurance) are prohibited within the CBRS, with some exceptions. The U.S. Fish and Wildlife Service is responsible for administering CBRA. CBRS boundaries shown on FEMA mapping products are for informational purposes only. For the best available CBRS boundary data, visit: http://www.fws.gov/cbra/Maps/Mapper.html. For additional information on the CBRA and the CBRS, visit: http://www.fws.gov/cbra.

Effective Flood Insurance Rate Map (FIRM) Panel

The FIRM is the official map of a community on which FEMA has delineated the 1% annual chance (base) floodplain or Special Flood Hazard Area, the Base Flood Elevations (BFEs), and the risk premium zones applicable to the community. The FIRM is used to determine who must buy flood insurance and where floodplain development regulations apply.

The map area shown on each Advisory Map panel overlays exactly with the boundary of the respective effective FIRM panels for ease of comparison between the two products. Typically, the effective FIRM panels are at a scale of 1"=500' scale, so four effective FIRM panels will fit within one Advisory Map panel shown at 1"=1000.'

Limit of Advisory Base Flood Elevations

The Limit of Advisory Base Flood Elevations depicts the location at which the dominant flood hazard transitions from the 1% annual chance coastal Advisory Base Flood Elevation (ABFE) to the riverine flood hazard, as presented on the effective Flood Insurance Rate Map (FIRM). Users should access the Effective FIRM to get further information on their flood hazard beyond this limit.

Limit of Moderate Wave Action (LiMWA)

The LiMWA depicts the limit of the Area of Moderate Wave Action (MOWA), the portion of the 1% annual chance coastal Advisory flood hazard area referenced by building codes and standards, where base flood wave heights are between 1.5 and 3 feet, and where wave characteristics are deemed sufficient to damage many National Flood Insurance Program (NFIP)-compliant structures on shallow or solid wall foundations.

National Geodetic Vertical Datum (NGVD) of 1929

National standard reference datum for elevations, formerly referred to as Mean Sea Level (MSL) of 1929. NGVD 29 is used as the reference datum on some Flood Insurance Rate Maps (FIRMs).

North American Vertical Datum (NAVD) of 1988

The vertical control datum established for vertical control surveying in the Unites States of America based upon the General Adjustment of the North American Datum of 1988. It replaces the National Geodetic Vertical Datum of 1929. All Advisory flood hazard elevations on this map are referenced to NAVD 88.

Provisional Hurricane Sandy Storm Surge Elevation

Observed storm surge flood elevations from Hurricane Sandy, collected by the U.S. Geological Survey (USGS). These elevations, expressed in feet referenced to the North American Vertical Datum of 1988 (NAVD88), represent provisional USGS high water marks and storm tide sensors. These elevations are provided as a point of context between the Advisory Base Flood Elevations (ABFEs) and the storm surge elevation from Hurricane Sandy.

U.S. Department of Homeland Security
Washington, DC 20472

FEMA

APR 30 2013

MEMORANDUM FOR: Federal Coordinating Officers,
New York (4085-DR-NY)
New Jersey (4086-DR-NJ)
Pennsylvania (4099-DR-PA)
Ohio (4098-DR-OH)
Massachusetts (4097-DR-MA)
District of Columbia (4096-DR-DC)
Delaware (4090-DR-DE)
Rhode Island (4089-DR-RI)
Connecticut (4087-DR-CT)

Regional Mitigation Division Directors

Regional Recovery Division Directors

FROM: David L. Miller
Associate Administrator
Federal Insurance and Mitigation Administration

Joseph L. Nimmich
Associate Administrator
Office of Response and Recovery

SUBJECT: Revised Guidance for use of Best Available Data to Implement Federal Flood Risk Reduction Standards for Areas Impacted by Hurricane Sandy

This memorandum provides guidance on the requirement in 44 CFR 9.7(c) and Executive Order (EO) 11988 Sec. 2(a)(1) on the use of best available flood hazard information for all federally funded rebuilding undertaken as part of recovery from Sandy. This guidance supersedes the previous guidance, "Guidance for use of Best Available Data in complying with 44 CFR Part 9 and Executive Order 11988 (Floodplain Management) for Areas Impacted by Hurricane Sandy in New Jersey and New York" issued on November 16, 2012, by the Federal Insurance and Mitigation Administration and the Office of Response and Recovery. The guidance has been updated to reflect a single uniform flood risk reduction standard that will guide all federal recovery activities for Sandy-impacted areas.

On April 4, 2013, the Hurricane Sandy Rebuilding Task Force announced that the Administration has adopted a single, government-wide flood risk reduction standard for

federally-funded rebuilding undertaken as part of the recovery from Sandy. Where the elevation requirement is triggered for federal projects, the flood risk reduction standard will require that projects **elevate or otherwise flood-proof (commercial structures only) to the best available flood hazard data (e.g. FIRM, Pre-FIRM, ABFE) plus one foot of additional elevation.** All federally funded Sandy-related rebuilding projects must meet this flood risk reduction standard.

The best available data plus one standard is informed by the best science and best practices including assessments taken following Hurricane Sandy and brings the federal standard into alignment with many state and local standards already in place. It also takes into account the increased risk the region is facing from extreme weather events, sea level rise and other impacts of climate change and provides a reasonable approach for ensuring that the decision to use federal dollars for recovery should consider this increased risk.

The best available data plus one foot standard is based on the most recent available flood risk guidance FEMA has provided, whether that is the new Advisory Base Flood Elevations (ABFEs) or existing the FIRM. Recognizing that even the most recent information does not account for all possible risk, and that risk continuously changes and is expected to increase in many areas, the standard also builds in an extra buffer of one foot above the best available data to ensure long term resilience of communities. This buffer is reasonable given of the potential for larger storms than the 100-year flood, expected sea level rise, and inherent uncertainties associated with estimating flood probabilities. State and local governments are encouraged to review local conditions and needs and, where appropriate, build to an even higher standard where they are planning critical infrastructure projects and/or where flood hazards are expected to grow with time. Where state and local standards exceed this standard, Federal agencies will be guided by the higher standard.

Best Available Data for Affected Communities

To ease review, a GIS data layer has been established (http://184.72.33.183/best/) that provides the Best Available Data for the Hurricane Sandy affected areas in New Jersey and New York. This layer will be maintained until it is superseded by new National Flood Insurance Program Flood Insurance Rate Maps adopted into local ordinances. The GIS layer will serve as FEMA's definitive depiction of the Best Available Data for the New York and New Jersey impacted areas. New data, presented after identified key decision points, will not retroactively apply. Rather, its use will be optional. As changes to the Best Available data occur, they will be archived to maintain a clear record of what information was available and when.

For areas where ABFEs are not available, FEMA must continue to ensure compliance with 44 CFR Part 9 and EO 11988 by utilizing the most recent publically available flood guidance to determine best available data.

NFIP Requirements for Communities on the Use of Draft or Preliminary FIS Data

FEMA has provided guidance to communities participating in the NFIP on the use of draft or Preliminary Flood Insurance Study (FIS) data as available data for regulating floodplain development in Floodplain Management Bulletin 1-98, *Use of Flood Insurance Study Data as Available Data* (FPM 1-98). The key points for communities in using draft or Preliminary FIS data for regulating floodplain development are:

- The guidance in FPM 1-98 specifies situations in Zone A (without designated Base Flood Elevations (BFE)) where draft flood hazard data or Preliminary FISs are required to be used by communities.

- This guidance also describes how communities should use draft or Preliminary FIS data in Zones AE, A1-30, AH, AO, VE, and V1-30 (where BFEs have been identified). In these Zones, the NFIP does not require communities to use BFE data from draft data or Preliminary FIS. The reason is that the existing effective BFE data has gone through the statutory appeals process which gives the effective BFE data a presumption of validity. This is also the BFE data that has been adopted by the community. However, FEMA encourages communities to use the draft flood hazard data or Preliminary FIS if BFEs increase. In cases where BFEs decrease, communities should not use the information to regulate development until all appeals have been resolved to ensure lives and property are not placed at increased risk in case a valid appeal results in an increase in BFEs.

Determining Best Available Data for Recovery and Mitigation Decisions

As recovery associated with Hurricane Sandy continues and to ensure compliance with 44 CFR Part 9 and EO 11988, it is important to understand what represents best available flood data. The best available flood risk data should be used to determine the zone, including the coastal high hazard area, and for elevation and reconstruction requirements when making recovery and mitigation decisions for FEMA grants.

What is considered best available data depends on 1) the flood hazard data adopted by the community; or 2) advisory or preliminary flood hazards data when the base flood elevation have increased or the Zone V/A line has migrated inland.

It should be expected that what constitutes best available data may change over the course of the recovery process. To be consistent with 44 CFR 9.11(d)(6), no project shall be built to a floodplain management standard that is inconsistent with the NFIP or less restrictive community floodplain management regulations. That information must be considered when making recovery decisions. In all cases, if Best Available Data is not clear, any facility or structure damaged by flooding may be considered to be in a floodplain (44 CFR 9.7(b)).

This best available data plus one standard does not retroactively affect federal aid that has previously been given to property owners and communities in the Sandy-impacted areas. It also does not impact insurance rates under the National Flood Insurance Program. Moving forward the federal standard applies to substantial rebuilding projects (e.g. when damage exceeds 50 percent of the value of the structure) that will rely on federal funding.

Use of Best Available Data for Hazard Mitigation Assistance (HMA) Projects

For HMA projects that have not been obligated as of the date of this memorandum, best available data, plus one foot, will be used as a minimum design standard unless higher elevation are required by locally adopted codes or standards.

For current HMA projects utilizing BFEs lower than was used for the BCA analysis, the BCA must be re-run to reflect the revised cost and benefits calculated for the lower elevation.

Use of Best Available Data for Recovery Projects

Per 44 CFR 9.7(c) and 9.13(d)(1) projects funded through the Recovery programs must utilize the best available flood data to guide recovery decisions. For all Public Assistance projects for which funds have not been obligated as of the date of this memo, the project must be designed using the GIS layer described above (whichever is higher or more restrictive, per 44 CFR 9.11(c)(1)) or higher elevations if they are required by locally adopted code or standards.

If you have any questions or need additional information regarding this guidance, please contact Keith Turi, Recovery Division, (202) 646-4077, or Rachel Sears, Federal Insurance and Mitigation Administration, at (202) 646-2977.

Cc: MaryAnn E. Tierney, Acting Regional Administrator, Region II

Deb Ingram, Assistant Administrator, Recovery

William Roche, Director, Public Assistance Division, Recovery

Roy Wright, Deputy Associate Administrator for Mitigation, Federal Insurance and Mitigation Administration

James Walke, Director, Risk Reduction Division, Federal Insurance and Mitigation Administration

Coastal Hazard Analysis Modeling Program (CHAMP) Database Interpretation

Overview

FEMA is committed to continuing the recovery process in New Jersey by providing the best available flood risk assessments to help guide communities in their efforts to reduce the impact of flood events and protect lives and property from future damages. To accomplish this, FEMA is implementing a comprehensive outreach initiative to share data and to ensure that affected communities are fully engaged and informed throughout the Flood Insurance Rate Map (FIRM) development process.

FEMA has prepared a series of fact sheets that provide important information regarding the specific types of data that communities will receive. In addition to describing the data, these fact sheets provide guidance on how communities can use the data to better understand their own flood risk, as a tool in the decision making process, and to plan for mitigation activities. Other fact sheets available in this series include:

- Transect Data and Field Reconnaissance: Important Mapping Process Inputs
- Storm Surge GIS Data: Important Mapping Process Input
- New Jersey Preliminary Work Map Interpretation

Key Terms

Stillwater Elevation (SWEL)
Projected elevation flood waters would rise to in the absence of waves which is determined when modeling coastal storm surge.

Wave Runup
The rush of water that extends inland when waves come ashore.

Wave Height
The vertical distance between the wave crest and the wave trough.

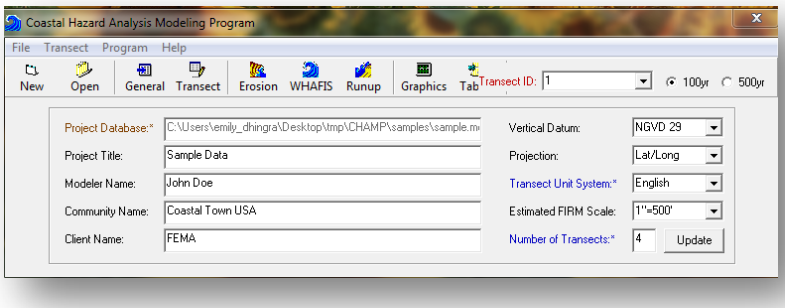
Bathymetry
The measurement of ocean, sea, or lake bottom elevation.

WHAFIS
A model used to perform a coastal flood study which incorporates the effects of wind-borne wave action for communities along the Atlantic and Gulf Coasts.

Coastal Hazard Analysis Modeling Program (CHAMP)

The Coastal Hazard Analysis Modeling Program (CHAMP) is a software program used by coastal engineers to conduct coastal flood hazard assessments for Flood Insurance Studies. The program allows users to enter data, perform coastal engineering analyses, view and tabulate results, and collect summary information for representative transect locations along a coastline. To use the model, the modeler needs an understanding of the input and output data in addition to coastal engineering and mapping principles. The model requires starting wave conditions (significant wave height and wave period), stillwater elevation (SWEL) data, terrain (topography and bathymetry) data, and the obstructions to waves.

Using CHAMP, coastal engineers evaluate storm-induced erosion, wave height and wave runup analyses, plot summary graphics of the results, and create summary tables and reports. The graphic below shows the graphical user interface with the "Erosion," "WHAFIS," and "Runup" tabs at the top.



CHAMP Graphical User Interface

The model output lists the wave height and the final Base Flood Elevation (BFE) which will be included on the FIRM. This data is listed in tabular form with a list of the station locations (along the transect), the controlling (final) wave height, and the wave crest elevation (which is the BFE). Below is an example of the model output.

PART2: CONTROLLING WAVE HEIGHTS, SPECTRAL PEAK WAVE PERIOD, AND WAVE CREST ELEVATIONS

LOCATION	CONTROLLING WAVE HEIGHT	SPECTRAL PEAK WAVE PERIOD	WAVE CREST ELEVATION
-23.00	9.45	12.70	19.01
.00	7.95	12.70	17.97
101.25	5.92	12.70	16.54
202.50	3.86	12.70	15.10
225.00	3.40	12.70	14.78
317.00	1.55	12.70	13.49
319.00	.01	12.70	12.41
590.00	.00	.00	12.40
650.00	.23	.57	12.52
700.00	.35	.69	12.57
800.00	.54	.86	12.63

Controlling wave height. The transition between greater than 3 ft. to less than 3 ft. is the transition between Zones VE and AE.

Base Flood Elevation (BFE)

Station location along transect

Why this Data is Important

The results of the CHAMP modeling are a key component to the final BFEs shown on the FIRMs. The breaking wave height is what determines the difference between a Zone VE and Zone AE within the coastal Special Flood Hazard Area (SHFA), which changes the way a structure has to be built to be compliant with minimum flood plain regulation.

How the Data can be Used

CHAMP allows the coastal engineer to visualize the profile data and modeling results. It can also be used by others to verify the erosion analysis and obstruction data used in the models, although specialized knowledge of coastal processes is needed to review and interpret the model input and output files.

Where to Go for More Information

The New Jersey Department of Environmental Protection in coordination with FEMA will be hosting a series of webinars and community meetings to further explain the data that is received and answer questions about next steps. Please visit http://www.Region2Coastal.com for more information on FEMA's data sharing initiative with New Jersey's coastal communities.

More Key Terms

Zone AE
An area of high flood risk subject to inundation by the 1% annual-chance flood (or Base Flood). Mandatory flood insurance purchase requirements and floodplain management standards apply within Zone AE on effective FIRMs.

Zone VE
An area of high flood risk with BFEs which is subject to inundation by the 1% annual-chance flood (or Base Flood) with additional hazards due to storm-induced velocity wave action. Zone VE is subject to more stringent building requirements and different flood insurance rates than other flood zones because these areas are exposed to a higher level of risk.

Storm Surge GIS Data: Important Mapping Process Input

Overview

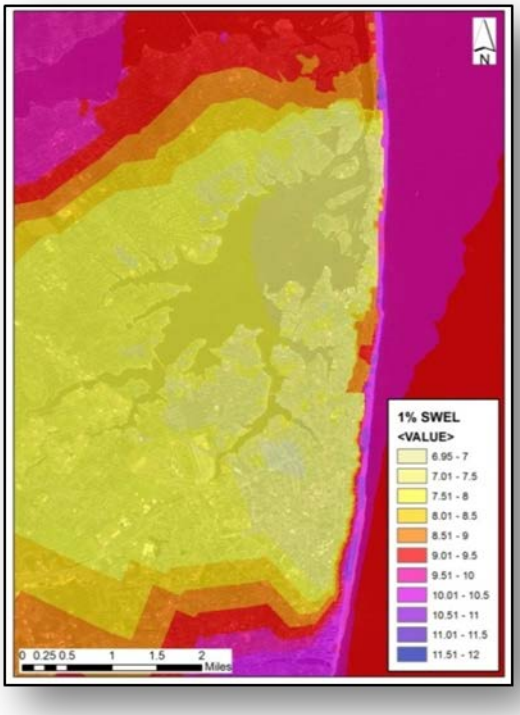
FEMA is committed to continuing the recovery process in New Jersey by providing the best available flood risk data to help guide communities in their efforts to reduce the impact of flood events and protect lives and property from future damages. To accomplish this, FEMA is implementing a comprehensive outreach initiative to share data and to ensure that affected communities are fully engaged and informed throughout the Flood Insurance Rate Map (FIRM) development process.

FEMA has prepared a series of fact sheets that provide important information regarding the types of data that communities will receive. In addition to describing the data, these fact sheets provide guidance on how communities can use that data to better understand their flood risk, as a tool in the decision making process, and to plan for mitigation activities. Other fact sheets available in this series include:

- Field Reconnaissance and Transect Data: Important Mapping Process Inputs
- Coastal Hazard Analysis Modeling Program (CHAMP) Database Interpretation
- New Jersey Preliminary Work Map Interpretation

Storm Surge and how it is Modeled

Storm surge is the amount of water, combined with the effect of normal tides, which is pushed towards the shore during a storm. The height of the storm surge is driven by many variables, such as the strength, size, and direction of the storm. The ADCIRC (ADvanced CIRCulation) coastal circulation and storm surge computer model in conjunction with the Simulating Waves Nearshore (SWAN) computer model was used to model the effects of storm surge in this coastal flood study. Specifically, the models were used to determine the probability of storm surge events of the 10 percent, 2 percent, 1 percent, and 0.2 percent annual chance magnitudes.



GIS showing one percent SWEL surface

Storm Surge Data

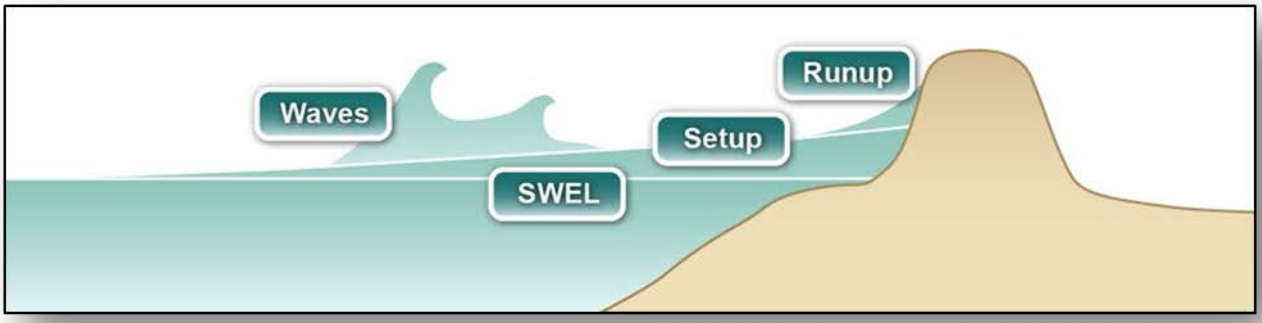
The digital storm surge data is initially developed as a series of points. Then, using GIS software, the points are connected to make a seamless surface of pixels called a "raster." This surface shows how the water surface is connected between the points. These data are also called the Stillwater Elevation (or SWEL) surfaces.

The graphic above shows a sample 1 percent annual chance SWEL surface. The line where the surface is at the same elevation as the ground is the flood hazard boundary for the various annual chance events. Keep in mind a stillwater elevation does not take into account all effects from waves coming ashore during a storm event. The storm surge GIS dataset includes digital data for the 10 percent-, 2 percent -, 1 percent -, and 0.2 percent-annual-chance events.

Why this Data is Important

The 1 percent SWEL surface is used as the starting stillwater elevation for the erosion analysis, overland wave height modeling, and runup modeling, which have also been performed as part of this coastal flood study, and are necessary to accurately determine coastal flood hazards in conjunction with storm surge. The 1 percent SWEL is one of three components that must be combined to create the Base Flood Elevations (BFEs) included on the FIRMs. The three components are:

- Storm Surge Stillwater Elevation (SWEL) and wave setup
- Wave height above storm surge (stillwater) elevation
- Wave runup above storm surge elevation.



Coastal storm surge stillwater elevation (SWEL), wave setup, and wave runup

How the Data can be Used

These data can be reviewed to see the storm surge elevations for the various return intervals. In most cases, these data will be lower than the final BFEs included on the FIRM, but can give a sense of the location of the mapped flood hazard areas before erosion and wave runup are taken into account.

Where to Go for More Information

The New Jersey Department of Environmental Protection will be hosting a series of webinars and community meetings in coordination with FEMA to further explain the data that is received and answer questions about next steps. Please visit http://www.region2coastal.com/ for more information on FEMA's data sharing initiative with New Jersey coastal communities.

Interpreting New Jersey Preliminary Work Maps

Overview

FEMA is committed to continuing the recovery process in New Jersey by providing the best available flood risk assessments. This will help guide communities in their efforts to reduce the impact of flood events and protect lives and property from future damages. To accomplish this, FEMA is implementing a comprehensive outreach initiative to share data and to ensure that affected communities are fully engaged and informed throughout the Flood Insurance Rate Map (FIRM) development process.

FEMA has prepared this fact sheet to provide important information regarding the specific types of data that communities will receive. In addition to describing the data, it provides guidance on how communities can use the data to better understand their own flood risk, use as a tool in the decision making process, and to plan for mitigation activities.

Release of Preliminary Work Maps

The FEMA preliminary work maps are an interim product created during the process of developing preliminary FIRMs. This information will replace the Advisory Base Flood Elevation (ABFE) maps that were made available to impacted communities as the best available flood hazard data for rebuilding and recovery efforts in the aftermath of Hurricane Sandy. FEMA strongly encourages communities to reasonably use this information in instances where Base Flood Elevations (BFEs) increase, floodways are revised, and/or new Special Flood Hazard Areas (SFHAs) are shown on the on the preliminary work maps. This will help community members make decisions to reduce their flood risk until the preliminary FIRMs become effective.

Preliminary Work Map Data

The coastal hazard analysis and mapping process involves a series of steps to produce preliminary work maps and ultimately the effective FIRMs, which become the regulatory basis of flood insurance ratings and floodplain management requirements. These steps include:

- Defining a base topographic data set to be used for analysis and mapping
- Defining shoreline transects to represent terrain and variability of shoreline features
- Conducting analyses to characterize 1% storm-induced erosion
- Conducting overland wave modeling to define coastal hazard areas and establish BFEs
- Creating preliminary work maps of coastal hazard areas utilizing the results of modeling and analysis
- Producing FIRMs and Flood Insurance Study (FIS) reports

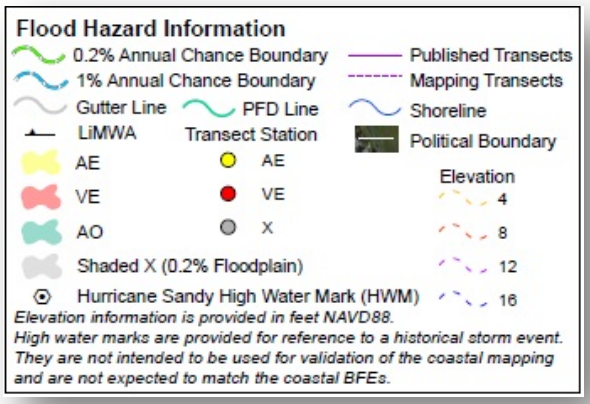
The preliminary work maps have been refined from the information shown on the ABFE maps. Community officials should review them to identify any areas of concern with the mapping of the proposed SFHAs (the area inundated by a flooding event having a 1% chance of occurring in any given year). The flood hazard information contained on the preliminary work maps is shown in the legend and the most pertinent items are described in more detail below.

Interpreting the Preliminary Work Map Data

To appropriately interpret the preliminary work map data there must be an understanding of the information shown on the preliminary work maps. The most pertinent flood hazard features are defined below along with an image showing how the preliminary work maps will look.

Zone AE - A yellow shaded area of high flood risk subject to inundation by the 1% annual-chance flood event determined by detailed methods. Base Flood Elevations are shown and mandatory flood insurance purchase requirements and floodplain management standards apply within AE zones included on effective FIRMs.

Zone AO - A blue shaded area of high flood risk subject to inundation by 1% annual-chance shallow flooding where average depths are between one and three feet. Average flood depths derived from detailed hydraulic analyses are shown in this zone. Mandatory flood insurance purchase requirements and floodplain management standards apply within AO zones included on effective FIRMs.



Zone VE - A light-red shaded area of high flood risk subject to inundation by the 1% annual-chance flood event with additional hazards due to storm-induced velocity wave action (a 3-foot or higher breaking wave). BFEs derived from detailed hydraulic analyses are shown. Mandatory flood insurance purchase requirements, specific construction requirements, and floodplain management standards apply within VE zones included on effective FIRMs.

Shaded Zone X - A gray shaded area of moderate flood risk subject to inundation by the 0.2% annual-chance flood event. Although mandatory purchase of flood insurance doesn't apply in Shaded Zone X, property owners are encouraged to do so to reduce their flood risk.

LiMWA - The black line denoting the Limit of Moderate Wave Action (LiMWA) is the landward limit of the area where base flood wave heights are between 1.5 and 3 feet and where wave characteristics are deemed sufficient to damage many structures on shallow or solid wall foundations. Triangular marks point toward the deeper flooding section of the area.

AE 10 (example) - Zone AE having a Base Flood Elevation of 10 feet as referenced to North American Vertical Datum of 1988 (NAVD 88).

VE 11 (example) - Zone VE having a Base Flood Elevation of 11 feet as referenced to NAVD 88.

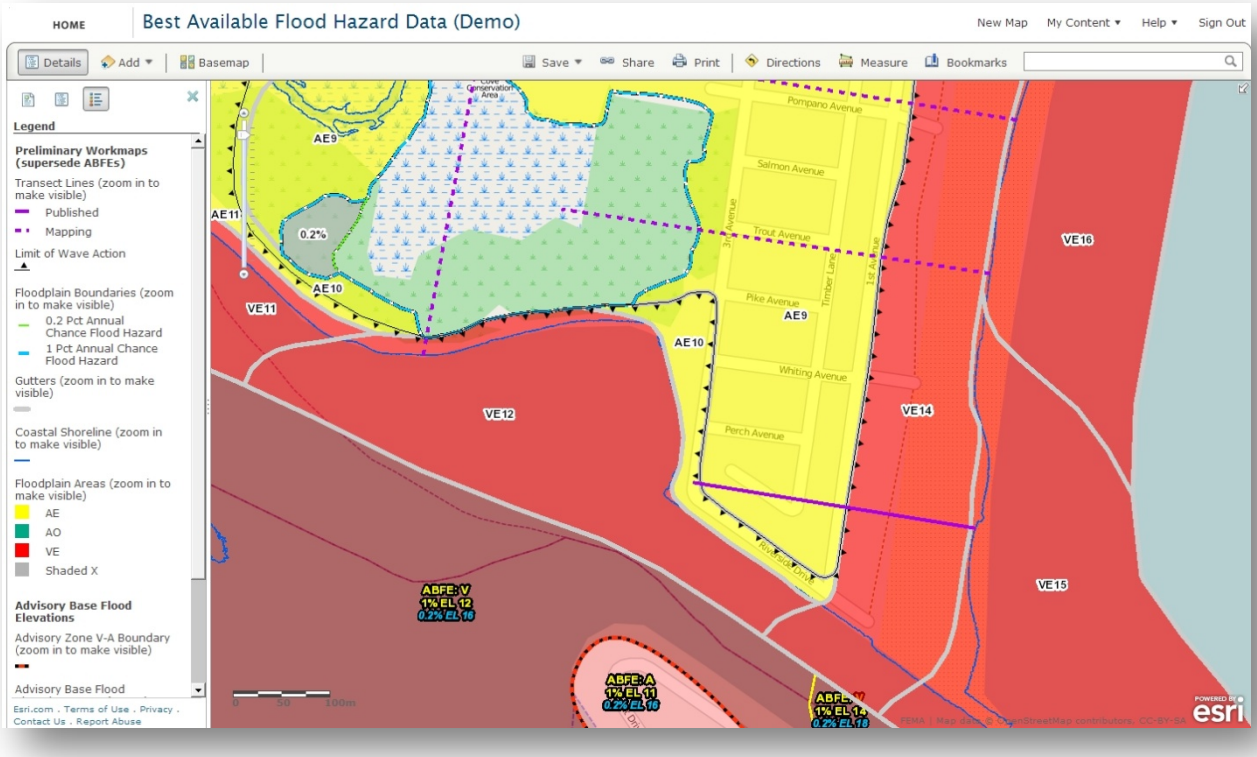
Gutter Line - A gray colored line dividing two different flood zones (AE, AO, or VE) or dividing the same zone when there is more than one BFE. In the example image there is a gutter line dividing VE15 and VE16.

PFD Line - A teal colored line denoting the location of the Primary Frontal Dune. The PFD is used to delineate the limit of the coastal high hazard area.

Transect - A purple line depicting a surveyed cross section taken perpendicular to the shoreline to represent the coastal and overland characteristics present in the area. Transect data is used when performing overland wave modeling and mapping for a coastal flood study.

Transect Station - The distance along a profile (transect) in reference to a common starting point. Transect stations define the points where information is being provided for the modeling and define the location of the BFE and zone changes along a transect.

Hurricane Sandy High Water Mark (HWM) data - The Hurricane Sandy HWM is based on data collected by the U.S. Geologic Survey (USGS). These data are shown for informational purposes and are not intended to be used to validate the coastal mapping or the coastal BFEs.



Where the Preliminary Work Maps Can Be Viewed

The preliminary work maps, including tutorials, user guides, and other learning resources, are available through the FEMA Region II Coastal Analysis and Mapping website at www.region2coastal.com.

How the Data can be Used

Community officials will have the opportunity to comment on the preliminary work maps at any point in time once they are issued and during meetings that are planned to review the maps. It is important for community officials to identify areas in their community where they believe the risk is inappropriately mapped (understated or overstated) and to be prepared to discuss those concerns at the meeting. Hard data is encouraged, if available. Additionally, if more detailed local information is available such as terrain data, corrected street names, building features, and land features, this information is requested to be provided to FEMA for review.

Following this review, FEMA may incorporate this information into the regulatory products. By actively engaging in the mapping process, officials can help to ensure more precise effective FIRMs. Community officials are also encouraged to proactively communicate this information to ensure residents and property owners fully understand the changes in the maps and have an opportunity to discuss potential mitigation options.

Next Steps

Preliminary FIRMs will be released mid-to-late summer 2013. After their release, there will be a statutory 90-day appeal period during which FEMA will accept technical information submitted by the community that better characterizes local conditions and flood risk. Data submitted for potential refinement of the preliminary FIRMs must be comprehensive and detailed enough to be consistent with the process for developing the preliminary FIRMs.

Following the end of the appeal period and the resolution of any submitted concerns, FEMA will finalize the maps and initiate a six-month compliance period for formal map adoption. It will be after that six-month period when the revised FIRMs will become effective and once this occurs, they will become the basis for flood insurance requirements and insurance premiums. It typically takes 18 to 24 months from release of the preliminary FIRMs for the maps to complete the regulatory process and become effective.

Where to Go for More Information

The New Jersey Department of Environmental Protection (NJDEP), in coordination with FEMA, will be hosting webinars and community meetings to further explain the data that is received and answer questions about next steps. Please visit www.Region2Coastal.com for more information on FEMA's data sharing initiative with New Jersey.

FEMA (Federal Emergency Management Agency)

Historic Preliminary Work Map

Last Modified: June 15, 2013

Description

Before Hurricane Sandy, FEMA had begun a coastal flood study to update Flood Insurance Rate Maps (FIRMs) for portions of New York and New Jersey using improved methods and data to better reflect coastal flood risk. After Sandy, FEMA released Advisory Base Flood Elevation (ABFE) information based on the partially completed flood study for certain communities which were designed to help in rebuilding and recovery efforts. FEMA is now releasing preliminary work map data including the full results of the coastal flood study. The preliminary work map data is a "draft" product that FEMA is sharing in advance of the upcoming release of the preliminary FIRMs. The preliminary work map data replaces the ABFE information (where released) as the best available flood hazard data until the release of the preliminary FIRMs.

This historical map serves as an archive of all preliminary work map information released to date since June 2013 for New Jersey and New York communities affected by the coastal flood study. When an updated version of the preliminary work map data is released, a new layer will be added to this map, with the layer name reflecting the original release date of the information.

Access and Use Constraints

The preliminary work map data replaces the ABFE information (where released) as the best available flood hazard data until the release of the preliminary FIRMs. Until preliminary FIRMs are released for a community, the preliminary work map information will represent the best available flood hazard data in those areas. To find the best flood hazard data currently available for New Jersey and New York communities affected by the coastal flood study, visit the Region 2 Coastal Outreach website.

For most communities, the preliminary work map data shows coastal flood hazard areas only. Updates to riverine flood hazards in most cases will not be reflected. Both coastal and riverine areas will be included on the official preliminary FIRMs once released.

The preliminary work maps are not intended to support regulatory flood hazard zone designation or insurance ratings.

Properties

Before building, property and business owners should consult their local government officials to determine the mandatory elevations for their home or building.

FEMA MOTF-Hurricane Sandy Impact Analysis

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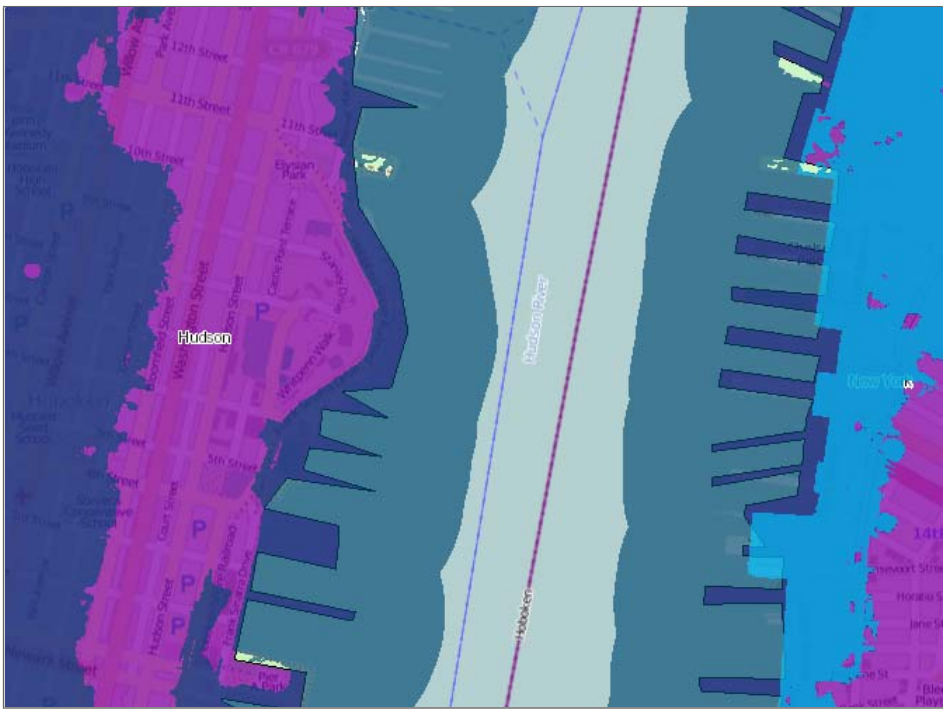

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TITLE: PRELIMINARY WORK MAP DATA

DATE: JUNE 18, 2013

PRODUCER: RAMPP
8401 ARLINGTON BLVD
FAIRFAX,VA 22031

PURPOSE: DISSEMINATION OF PRELIMINARY WORK MAP DATA
The preliminary work map data is an interim product created by FEMA in the development of preliminary Flood Insurance Rate Maps (FIRMs) which reflect the results of an ongoing coastal flood hazard study for the New York/New Jersey coast.

FEATURE CLASS:

FP_Boundaries.shp: A spatial data set depicting the limit of the coastal floodplains

Fields:

Ln_TYP: Floodplain boundary line type. Includes 1% AND 0.2% annual chance floodplains
COUNTY: Name of the County
STATE: Name of the State

FP_Polygons.shp: A spatial data set depicting the polygon of coastal floodplain zones.

Fields:

FLD_ZONE: Floodplain polygon zone type. Includes VE, AE, AO, A, shaded X, and Unshaded X
Floodway: Identifies a polygon as being within the floodway.
STATIC_BFE: Base Flood elevation. Elevations are expressed in whole feet referenced to the North American Vertical Datum of 1988 (NAVD88).
Note: For AO Zones, this attribute represents average depth of flooding in feet.
COUNTY: Name of the County
STATE: Name of the State

Gutters.shp: A spatial data set that identifies the transitions between the coastal flood zones

Fields:

Id: Primary key for table lookup. Assigned by table creator.
COUNTY: Name of the County
STATE: Name of the State

S_CST_TSCT_LN.shp: A spatial data set consisting of lines that depict the location that was used to provide representative information for the coastal flood models.
Required when transect-based analyses were performed.

Fields:

TRAN_LN_ID: Primary key for table lookup. Assigned by table creator.
TRAN_NO: Transect Number. Transect Number referenced to FIS report and printed FIRM panel.
Each transect is normally numbered sequentially.
CST_MDL_ID: Surge_Wave. Indicates the type of analysis that was performed.
SETUP_DPTH: Wave Setup depth in feet. Indicates if additional wave setup was added to the stillwater.
SIG_HT: Significant Wave Height. This is the wave height associated with the 1-percent-annual-chance storm event. It is the average height of the highest 1/3 of all waves. It is used in WHAFIS and RUNUP models. Normally shown in feet.
SIG_PD: Significant Wave Period. This is the wave period associated with the 1-percent-annual-chance storm event. It is the time it takes for a wave of the significant wave height to pass a point. Normally shown in seconds.
CON_HT: Controlling Wave Height. The controlling wave height value is 1.6 times the significant wave height. This field is populated when the significant wave height is available for the start of each transect.

This field is not required if the significant wave height is not available for the start of each transect, and WHAFIS default values are used.

MEAN_HT: Mean Wave Height. Average height of all waves. The mean wave height is 0.626 times the significant wave height. Normally shown in feet.

MEAN_PD: Mean Wave Period. Average period of all waves. The mean wave period is 0.85 times the significant wave period. Normally shown in seconds.

SHOWN_FIRM: Indicates if a transect line will be shown on a printed FIRM panel.

XCOORD: X-Coordinate. The X-coordinate of the 0.0-foot elevation point along the transect. This point must fall on the transect and have the same horizontal datum of the subsequent DFIRM study. The coordinates must be entered using the same coordinate system intended for the DFIRM Database. Typically the 0.0-foot elevation point is represented in the S_Tsct_Basln spatial file.

YCOORD: Y-Coordinate. The Y-coordinate of the 0.0-foot elevation point along the transect. This point must fall on the transect and have the same horizontal datum of the subsequent DFIRM study. The coordinates must be entered using the same coordinate system intended for the DFIRM Database. Typically the 0.0-foot elevation point is represented in the S_Tsct_Basln spatial file.

HYDROID: Unique ID number for each transect that references modeling input and output files.

COUNTY: Name of the County

STATE: Name of the State

S_FIRM_PAN.shp: The S_FIRM_Pan table contains information about the FIRM panel area. A spatial file with location information also corresponds with this data table.

Fields:

FIRM_ID: Primary key for table lookup. Assigned by table creator.

ST_FIPS: State FIPS. This is the two-digit code that corresponds to the State Federal Information Processing Standard (FIPS) code. This is a standard numbering system used by the Federal government, defined in FIPS Pub 6-4. These two numbers correspond to the first two digits of the panel number. Acceptable values for this field are listed in the D_State_FIPS table.

PCOMM: Community or County Identification Number. This is the third through the sixth digits of the panel number. For community based maps this corresponds to the FEMA Community Identification number. For countywide maps this is the county (or county equivalent) FIPS code with a “C.”

PANEL: Panel Number. This is seventh through the 10th digits in the complete panel number. This is assigned by the scale of the map and the position within the community or county. The panel number scheme is described in detail in Appendix K of these Guidelines.

SUFFIX: Map Suffix. This is the final digit in the complete panel number. This is a letter suffix at the end of the panel number. The map suffix is incremented one letter every time the panel gets republished.

FIRM_PAN: FIRM Panel Number. This is the complete 11-digit FIRM panel number, which is made up of ST_FIPS, PCOMM, PANEL, and SUFFIX. This is the FIRM panel number that is shown in the title block of the map.

Work_Map: Yes or No. This field indicates if the panel has been revised with new data.

PANEL_TYP: Panel Type. The type of FIRM panel identifies whether the panel is printed or not, and whether it is community based or countywide. Acceptable values for this field are listed in the D_Panel_Typ table.

SCALE: Map Scale. This is the denominator of the FIRM scale as a ratio. For example, 24000 is the denominator for a 1? = 2000' map. Acceptable values for this field are listed in the D_Scale table.

PNP_REASON: Panel Not Printed Reason. This is the explanation for the FIRM panels that are not printed. Only completed if the hardcopy panel is not printed by FEMA. For example “No Special Flood Hazard Areas.” See Appendix K of these Guidelines for commonly used values.
NW_LAT: Latitude of North West corner of the panel.
NW_LONG: Longitude of North West corner of the panel.
SE_LAT: Latitude of South East corner of the panel.
SE_LONG: Longitude of South East corner of the panel.
COUNTY: Name of the County
STATE: Name of the State

S_LIMWA.shp: A spatial data set consisting of lines that depict the limit of 1.5 foot or greater coastal waves in a Coastal AE Zone. required when a Limit of Moderate Wave Action is delineated within the coastal floodplain.

Fields:

ID: Primary key for table lookup. Assigned by table creator.
COUNTY: Name of the County
STATE: Name of the State

S_SHORE_LN.shp: A spatial data set consisting of lines that represent the 0.0-foot elevation contour.

Fields:

COUNTY: Name of the County
STATE: Name of the State

S-PFD_LN: A spatial data set containing the location of the landward heel of the Primary Frontal Dune (PDF)

Fields:

PFD_ID: Primary key for table lookup. Assigned by table creator.
COUNTY: Name of the County
STATE: Name of the State

PROJECTION: NAD_1983_StatePlane_New_Jersey_FIPS_2900_Feet (EPSG:3424)

QUESTIONS:
Email: region2coastal@rampp-team.com

Using the FEMA GeoPlatform
Best Available Flood Hazard Data Map

Before Hurricane Sandy, FEMA had begun a coastal flood study to update Flood Insurance Rate Maps (FIRMs) for portions of New York and New Jersey using improved methods and data to better reflect coastal flood risk. After Sandy, FEMA released Advisory Base Flood Elevation (ABFE) map information through the online FEMA GeoPlatform which was based on the partially completed flood study for certain communities which were designed to help in rebuilding and recovery efforts.

FEMA is now in the process of releasing preliminary work map data including the full results of the coastal flood study. This preliminary work map data will be added to the FEMA GeoPlatform Best Available Flood Hazard Data Map as it becomes available. Where applicable, ABFE information for communities where preliminary work map data has not yet been released will continue to be made available through this same map since it will continue to represent the best available flood hazard data until the work map data is released. On the map, the symbology for the preliminary work map data is different than the ABFE information in order to distinguish between the two data sets.

The Best Available Flood Hazard Data Map and additional information about the data provided, can be accessed through FEMA's Region 2 Coastal Outreach website at www.region2coastal.com. This document provides step-by-step information on how to use the map.

1. Map Overview

Once you are on the Best Available Flood Hazard Data Map homepage, your screen should appear similar to Figure 1 below. Notice the 3 buttons at the top of the left hand 'Details' panel which are circled in red below.

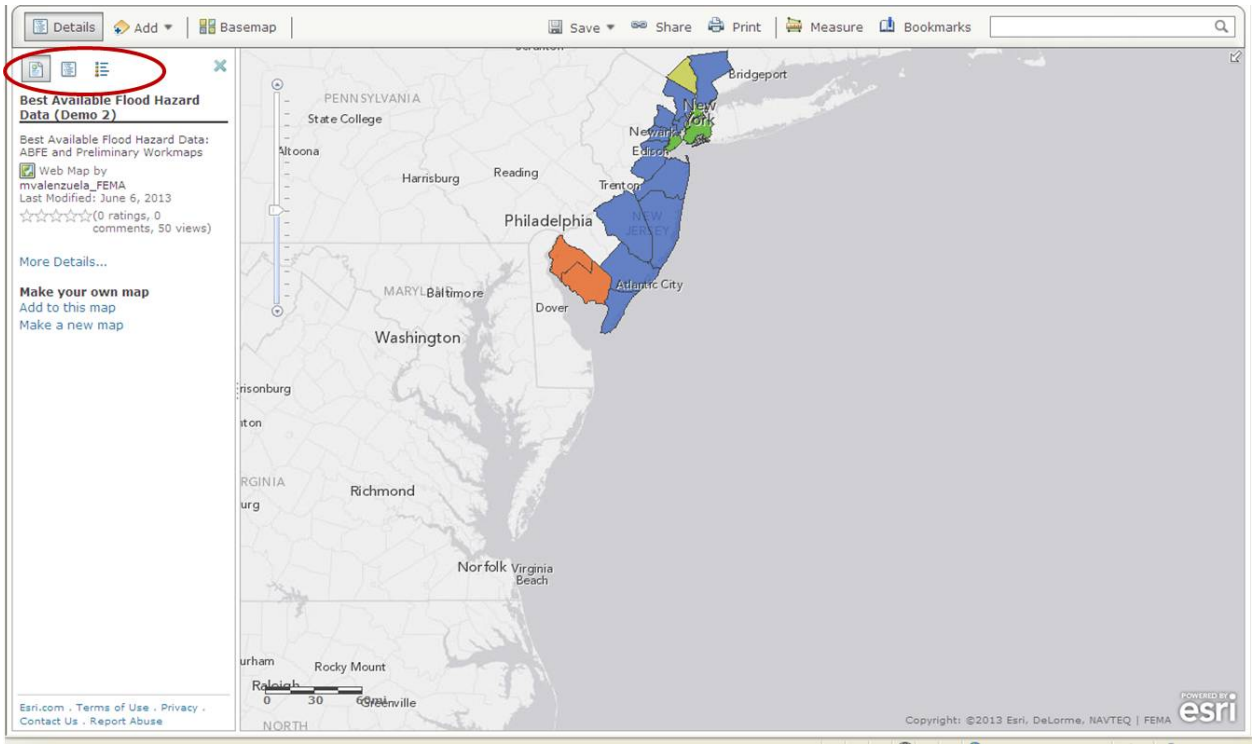


Figure 1

You are currently on the default left hand “About this Map” ‘tab’ which provides additional details about the map. Click on the ‘More Details’ link to go to the “About this Map’ page.

On this page you can view a description of the map and constraints on access and use. Experienced GIS users can view the map in ArcGIS desktop software by using the ‘Open’ button above the map description. Metadata about data layers included on the map is also available on this page.

Click your browser’s ‘Back’ button or the ‘Map’ button at the top of your screen to return to the map homepage.

2. Turning Map Layers on and Off

Once you are back on the map homepage, click the middle button at the top of the left hand panel (shown circled in red in Figure 2.)

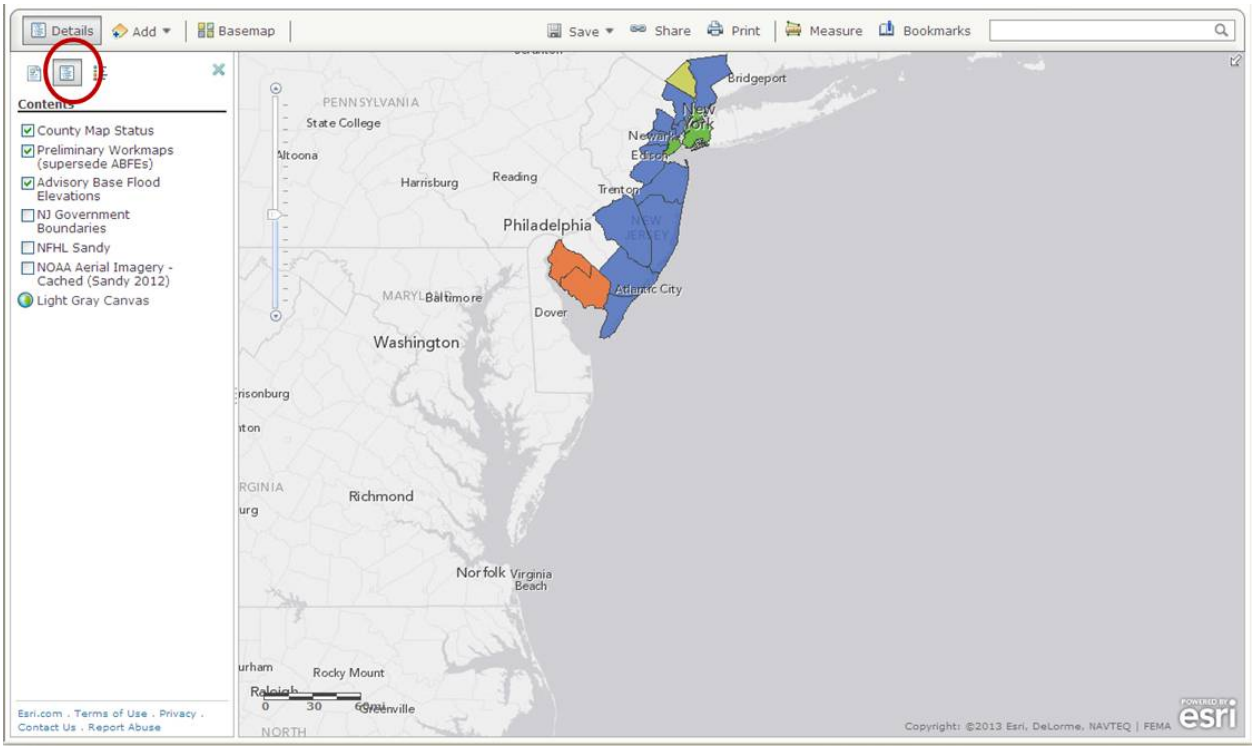


Figure 2

Here you can see the table of contents showing the datasets included in the map. Now click on the name of one of the datasets (Figure 3).

You will now see an expanded list of all map layers included in that dataset. You can check or uncheck the boxes to the left of each layer and dataset to turn the map layers on and off in the map. Keep in mind that even if there is a check mark next to a layer, it may not currently be visible in the map. This is because some layers are only visible if you have zoomed in or out to a certain level on the map.

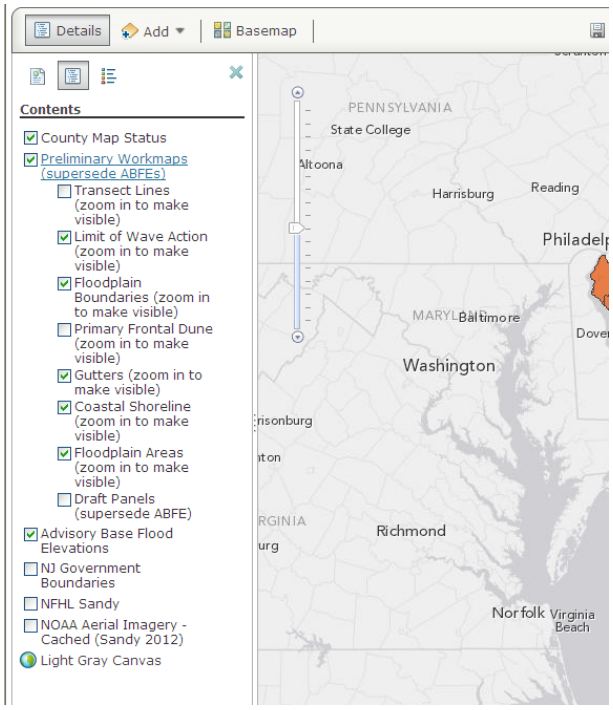


Figure 3

Notice that there are separate datasets listed in the table of contents for preliminary work map data and for Advisory Base Flood Elevation (ABFE) data.

If you click on the map layer names within these datasets, the symbology for that map layer will appear underneath the name. Notice that the symbology used for the preliminary work map data is different than the ABFE data to distinguish the different data sets.

3. Viewing the Map Legend

Now click on the right button at the top of the left hand panel, shown circled in red in Figure 4.

This is the map legend which shows all layers visible on the map. The map layers shown will change based on the layers turned on in the middle button and based on how much you have zoomed in or out on the map. Notice the colors that correspond to the type of data (e.g. ABFE or preliminary work map) and status of release.

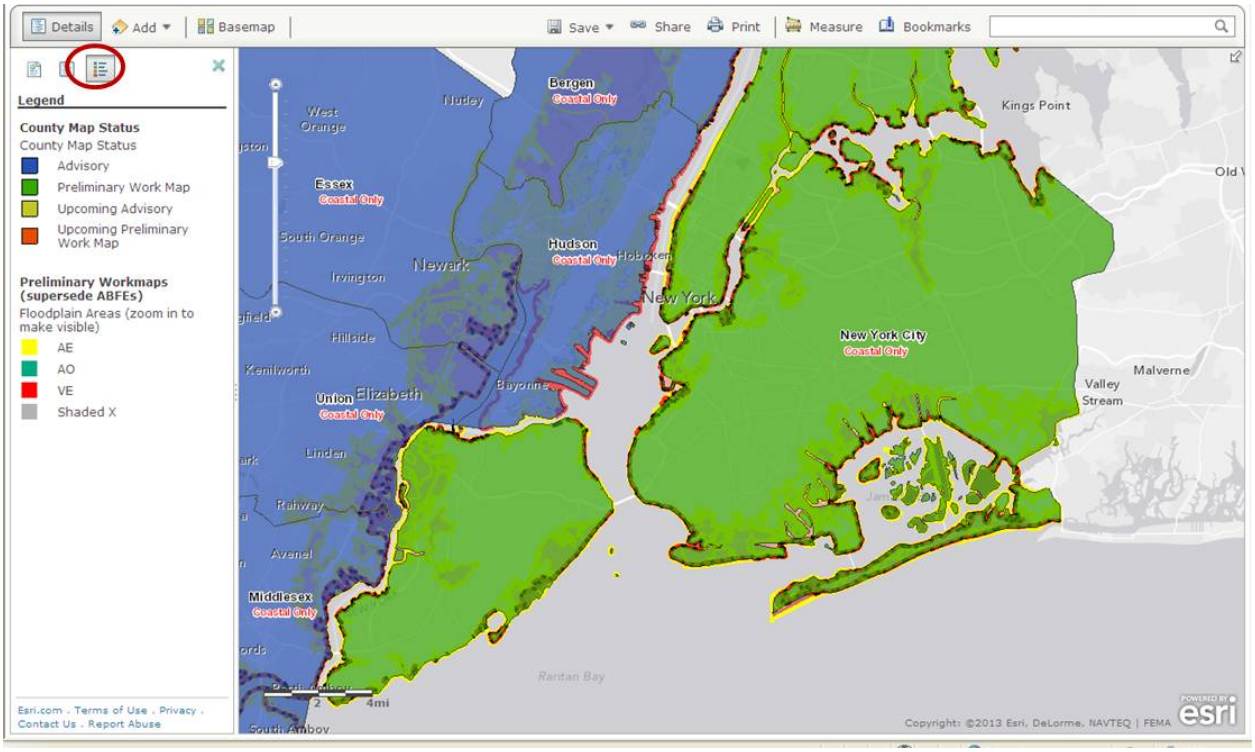


Figure 4

4. Find Your Location on the Map and Get Best Available Flood Hazard Information

To find a location of interest on the map, either zoom to the desired location using the zoom controls on the left side of the map and your left mouse button to pan, or type in an address in the upper right field (Figure 5).

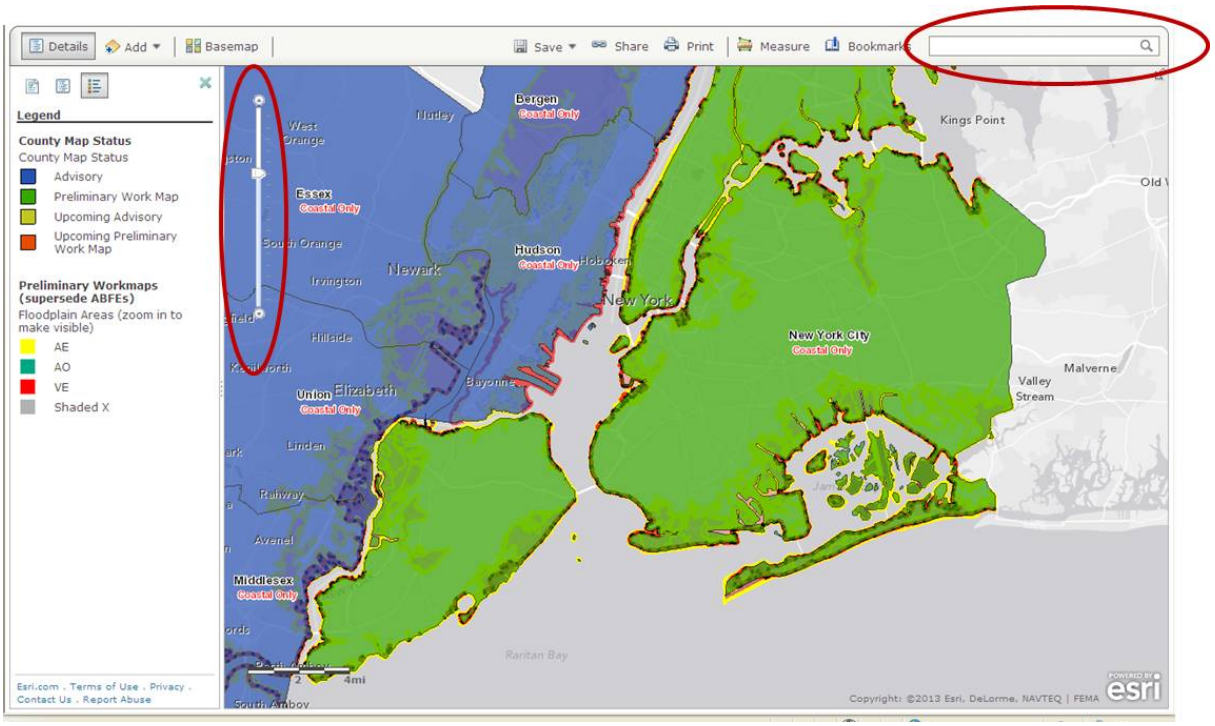


Figure 5

You should now be zoomed in to the map and be able to see your location of interest and the best available flood hazard information for that location. Remember that the best available flood hazard information could be preliminary work map data or ABFE data depending on the location and when preliminary work map data is released for that location.

Now, left click your mouse on the map at your location of interest. The layers selected will be highlighted in blue on the map.

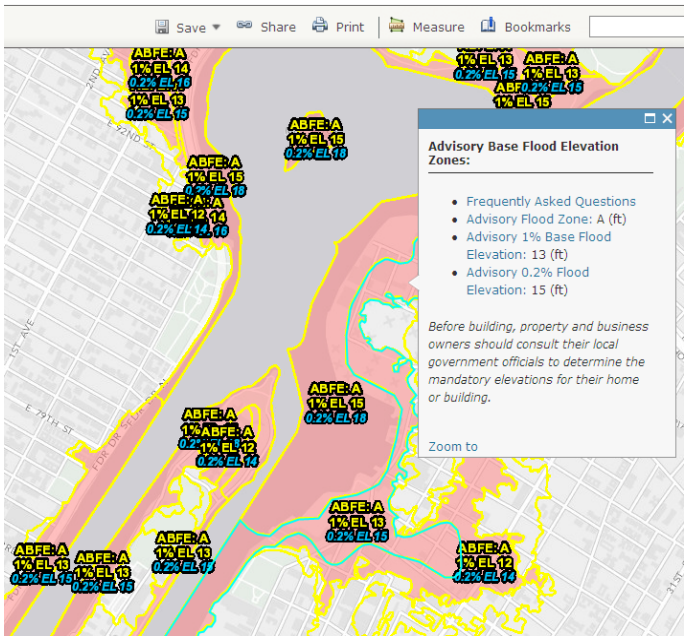


Figure 6

A pop up window will appear which lists the updated flood zone and elevation information and other visible map layers for that location (Figure 6). Only layers that are turned on and currently visible in the map will appear in the pop up window.

In the pop up window, you will also see a hyperlink to view a Frequently Asked Questions document about the information shown. Additionally, to get more information about a specific layer shown, simply click on the hyperlinked layer name. This will take you to a glossary of layer descriptions and definitions for other important terms. Note that the pop up window may have more than one screen depending on the number of layers selected– use the arrows at the top right hand side of the pop up window to navigate through the screens.

You will also be able to download maps in .pdf format (with the exception of areas located in New York City) and GIS shapefiles from hyperlinks in the pop up window which include your location of interest. To download these files, the Map Panels layer must be visible in the map.

5. Other Features

The horizontal bar at the top of the map homepage has the additional features described below.

- The 'Basemap' button allows you to select a different base map than the one currently shown on the map. You can choose different street maps, topographic data sets, or imagery.
- You can print the map using the 'Print' option or by using your browser's 'Print Screen' option and pasting into a separate document.
- The 'Add' button allows users to add their own map layers to the map or create their own layers.
- The 'Bookmarks' button allows you to remember specific locations on the map.
- You can measure distances or areas on the map by using the 'Measure' tool.
- Options to share the map via link or embed the map into a webpage are also provided using the 'Share' button.

Using the FEMA GeoPortal Advisory Base Flood Elevations Map

FEMA, as the administrator of the National Flood Insurance Program (NFIP), has created Advisory Base Flood Elevations (ABFEs) to show a more current picture of flood risk for certain communities in New Jersey and New York affected by Hurricane Sandy. ABFE information can be accessed through FEMA's interactive ABFE map. The map and additional information about FEMA's Advisory products, including a listing of affected New Jersey and New York counties, can be accessed through FEMA's Region 2 Coastal Outreach website at www.region2coastal.com.

This document provides step-by-step information on how to use FEMA's interactive ABFE map.

1. Map Overview

Once you are on the ABFE map homepage, your screen should appear similar to Figure 1 below. Notice the 3 buttons at the top of the left hand 'Details' panel which are circled in red below.

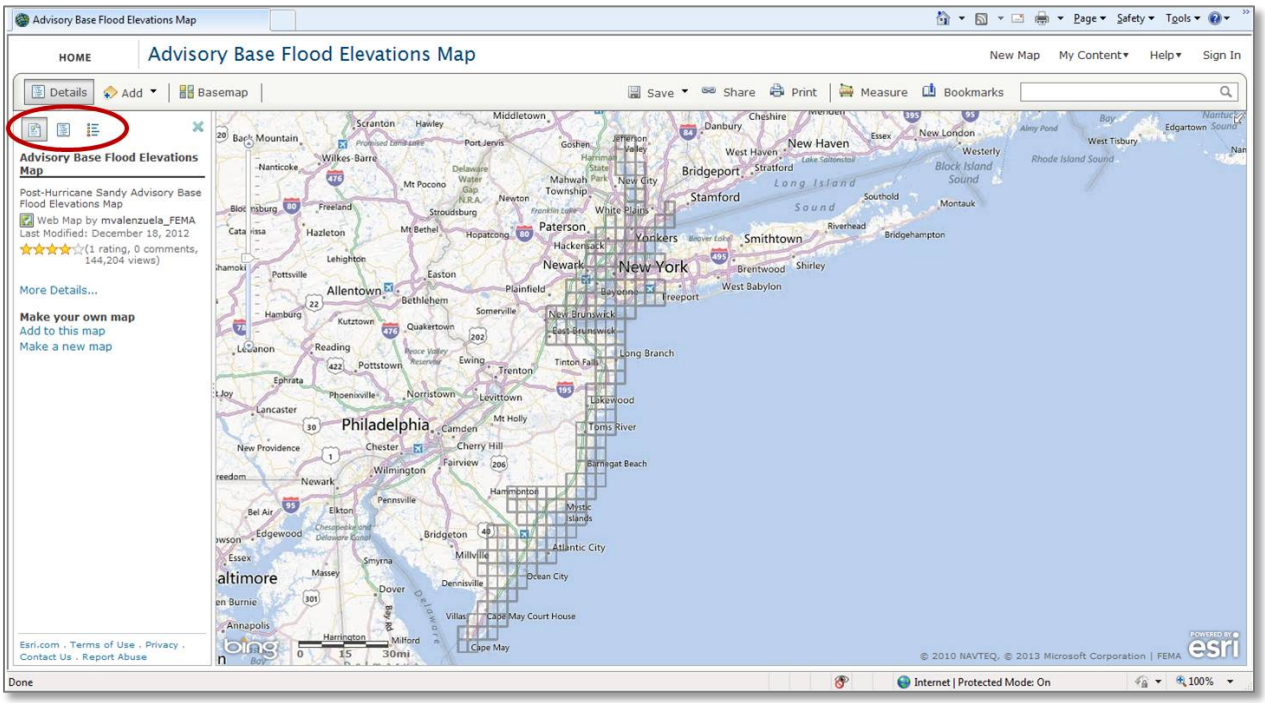


Figure 1

You are currently on the default left hand "About this Map" 'tab' which provides additional details about the map. Click on the 'More Details' link to go to the "About this Map" page (Figure 2).

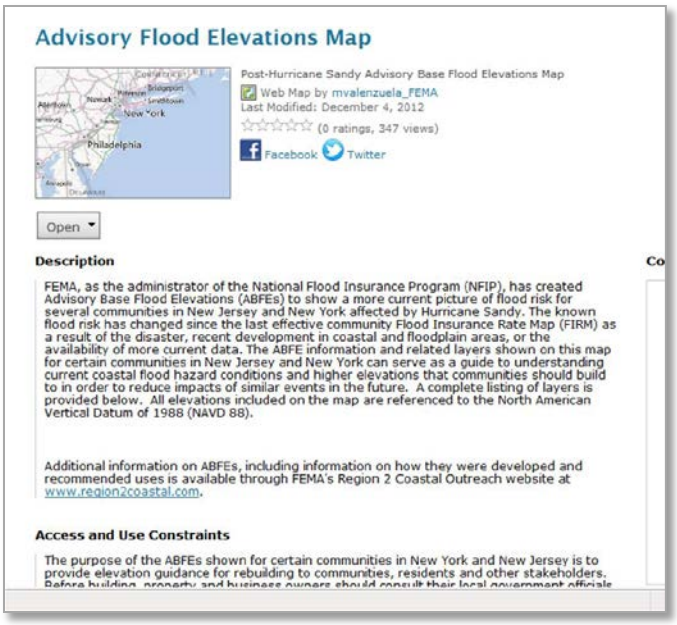


Figure 2

On this page you can view a description of the map and constraints on access and use. Experienced GIS users can view the map in ArcGIS desktop software by using the 'Open' button above the map description. Metadata about data layers included on the map is also available on this page.

Click your browser's 'Back' button or the 'Map' button at the top of your screen to return to the map homepage.

2. Turning Map Layers on and Off

Once you are back on the map homepage, click the middle button at the top of the left hand panel (shown circled in red in Figure 3.)

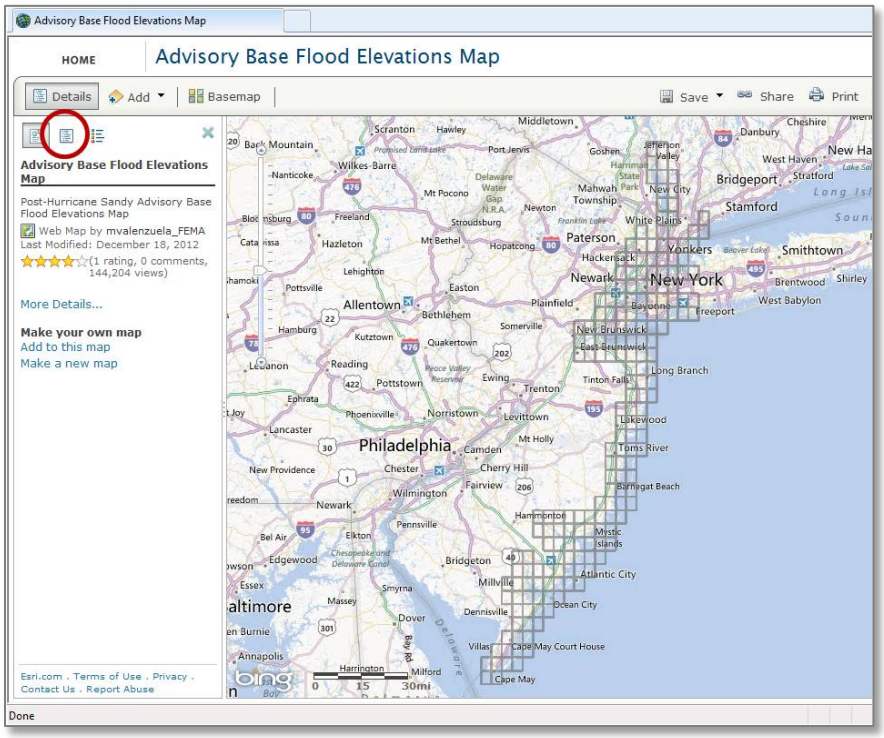


Figure 3

Here you can see the table of contents of datasets included in the map. Now click on the name of the top dataset (Figure 4).

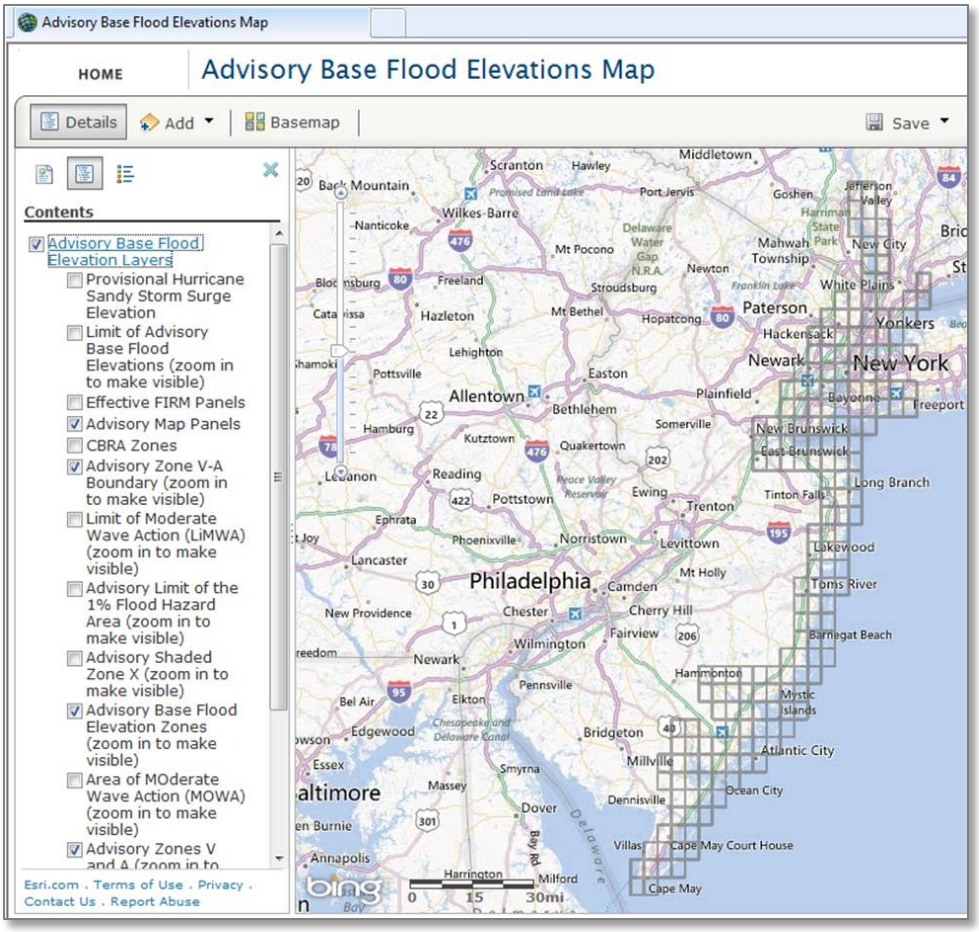


Figure 4

You will now see an expanded list of all map layers included in that dataset. You can check or uncheck the boxes to the left of each layer and dataset to turn the map layers on and off in the map. Keep in mind that even if there is a check mark next to a layer, it may not currently be visible in the map. This is because some layers are only visible if you have zoomed in or out to a certain level on the map.

Next, click on one of the map layer names. The symbology for that map layer will appear underneath the name.

3. View the Map Legend

Now click on the right button at the top of the left hand panel, shown circled in red in Figure 5.

This is the map legend which shows all layers visible on the map. The map layers shown will change based on the layers turned on in the middle button and based on how much you have zoomed in or out on the map.

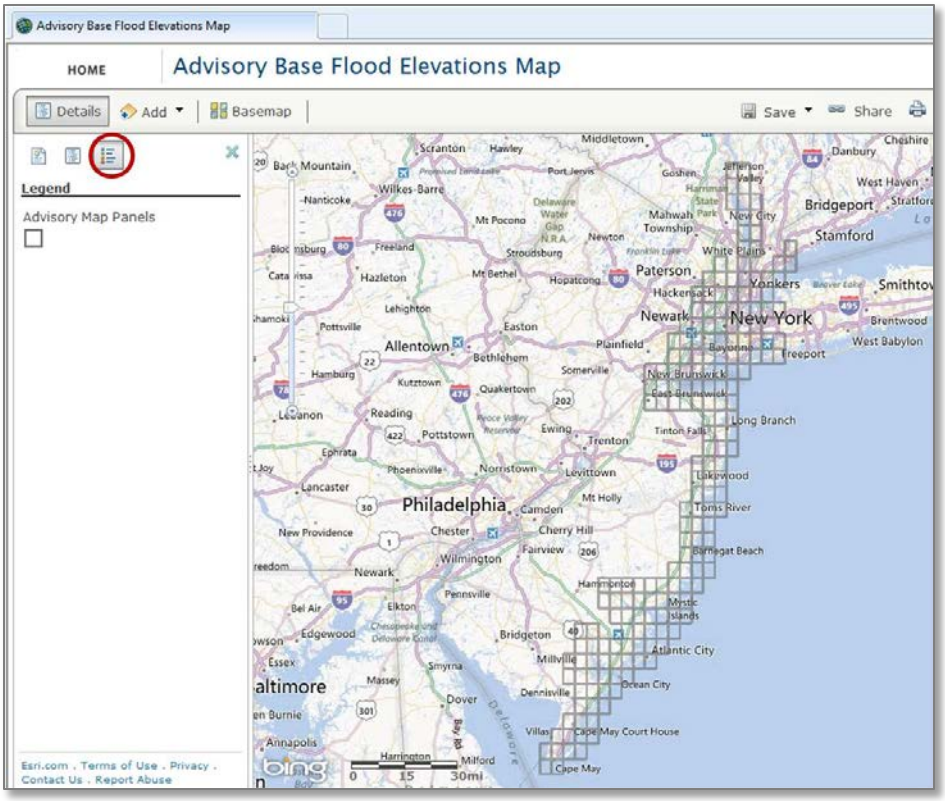


Figure 5

4. Find Your Location on the Map and Get ABFE Information

To find a location of interest on the map, either zoom to the desired location using the zoom controls on the left side of the map and your left mouse button to pan, or type in an address in the upper right field (Figure 6).

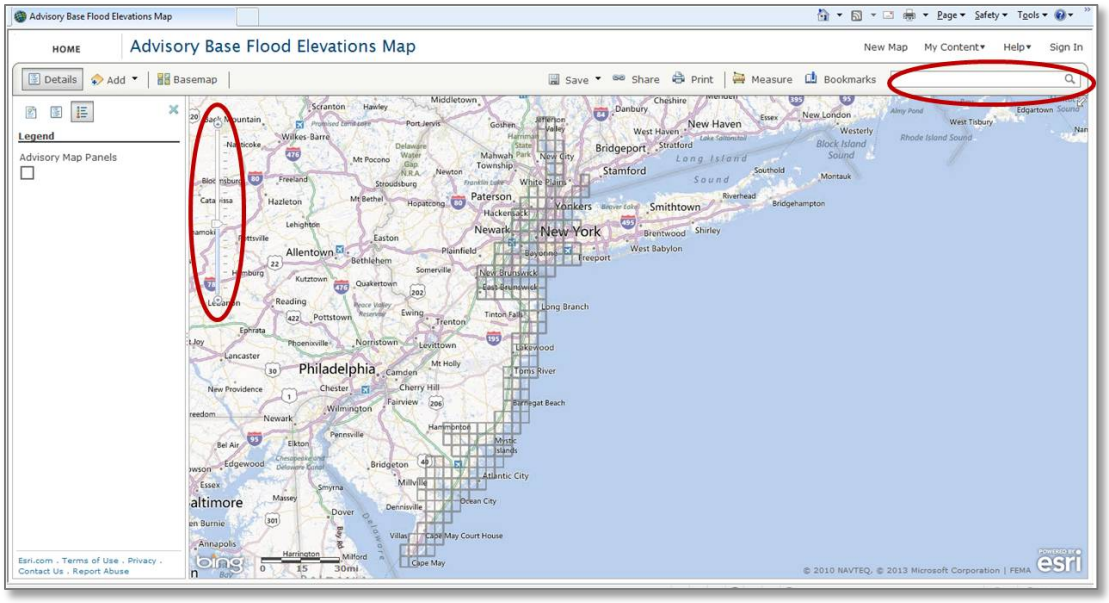


Figure 6

You should now be zoomed in to the map and be able to see your location of interest and the Advisory BFE information.

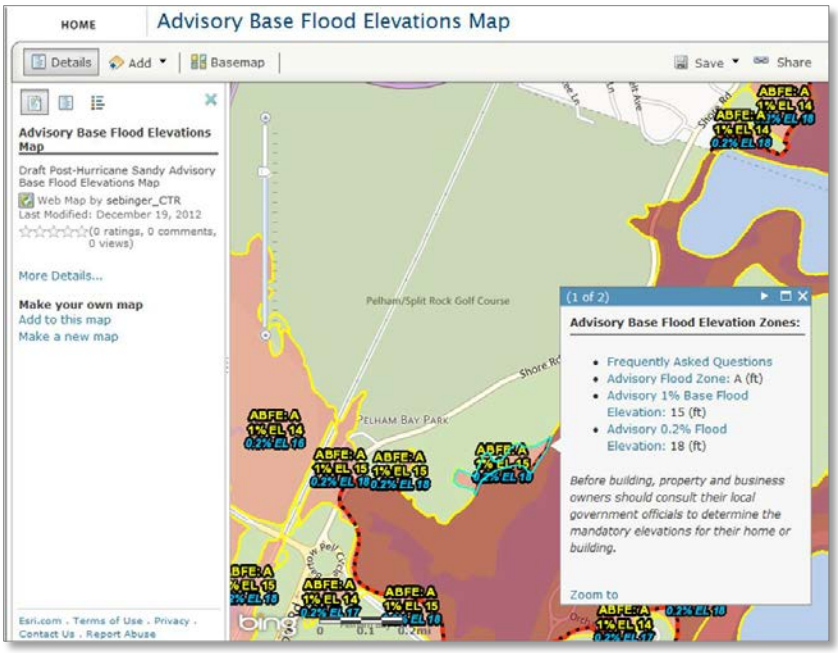


Figure 7

Now, left click your mouse on the map at your location of interest. The layers selected will be highlighted in blue on the map. A pop up window will appear which lists the Advisory Flood Hazard Zone, ABFE and 0.2% Advisory Flood Elevation and other visible map layers for that location (Figure 7). Only layers that are turned on and currently visible in the map will appear in the pop up window.

In the pop up window, you will also see a hyperlink to view a Frequently Asked Questions document about the ABFEs. Additionally, to get more information about a specific layer shown, simply click on the hyperlinked layer name. This will take you to a glossary of layer descriptions and definitions for other important terms. Note that the pop up window may have more than one screen

depending on the number of layers selected– use the arrows at the top right hand side of the pop up window to navigate through the screens (Figure 7).

You will also be able to download maps in .pdf format and GIS shapefiles from hyperlinks in the pop up window which include your location of interest. To download these files, the Advisory Map Panels layer must be visible in the map.

5. Other Features

The horizontal bar at the top of the map homepage has the additional features described below.

- The 'Basemap' button allows you to select a different base map than the one currently shown on the map. You can choose different street maps, topographic data sets, or imagery.
- You can print the map using the 'Print' option or by using your browser's 'Print Screen' option and pasting into a separate document.
- The 'Add' button allows users to add their own map layers to the map or create their own layers.
- The 'Bookmarks' button allows you to remember specific locations on the map.
- You can measure distances or areas on the map by using the 'Measure' tool.
- Options to share the map via link or embed the map into a webpage are also provided using the 'Share' button.

FEMA (Federal Emergency Management Agency)

Historic Preliminary Work Map

Last Modified: June 15, 2013

Description

Before Hurricane Sandy, FEMA had begun a coastal flood study to update Flood Insurance Rate Maps (FIRMs) for portions of New York and New Jersey using improved methods and data to better reflect coastal flood risk. After Sandy, FEMA released Advisory Base Flood Elevation (ABFE) information based on the partially completed flood study for certain communities which were designed to help in rebuilding and recovery efforts. FEMA is now releasing preliminary work map data including the full results of the coastal flood study. The preliminary work map data is a "draft" product that FEMA is sharing in advance of the upcoming release of the preliminary FIRMs. The preliminary work map data replaces the ABFE information (where released) as the best available flood hazard data until the release of the preliminary FIRMs.

This historical map serves as an archive of all preliminary work map information released to date since June 2013 for New Jersey and New York communities affected by the coastal flood study. When an updated version of the preliminary work map data is released, a new layer will be added to this map, with the layer name reflecting the original release date of the information.

Access and Use Constraints

The preliminary work map data replaces the ABFE information (where released) as the best available flood hazard data until the release of the preliminary FIRMs. Until preliminary FIRMs are released for a community, the preliminary work map information will represent the best available flood hazard data in those areas. To find the best flood hazard data currently available for New Jersey and New York communities affected by the coastal flood study, visit the Region 2 Coastal Outreach website.

For most communities, the preliminary work map data shows coastal flood hazard areas only. Updates to riverine flood hazards in most cases will not be reflected. Both coastal and riverine areas will be included on the official preliminary FIRMs once released.

The preliminary work maps are not intended to support regulatory flood hazard zone designation or insurance ratings.

Properties

Before building, property and business owners should consult their local government officials to determine the mandatory elevations for their home or building.

Hudson County, NJ
Preliminary Work Map

Miles

0 0.125 0.25 0.5 0.75 1

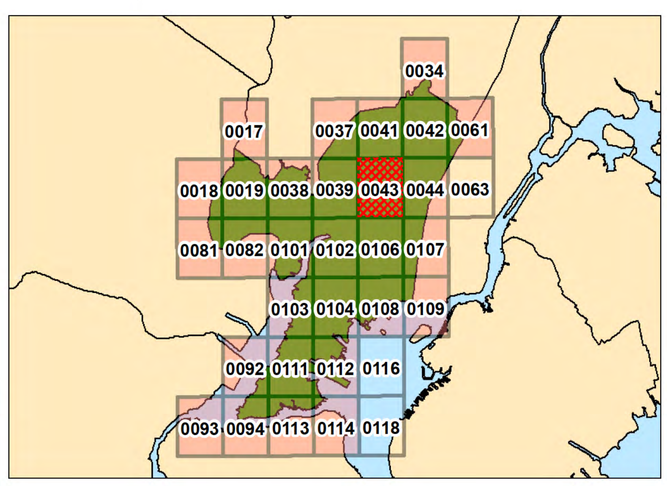
Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary
- Elevation: 4, 8, 12, 16

Elevation information is provided in feet NAVD88.
High water marks are provided for reference to a historical storm event. They are not intended to be used for validation of the coastal mapping and are not expected to match the coastal BFEs.

Panel 0043

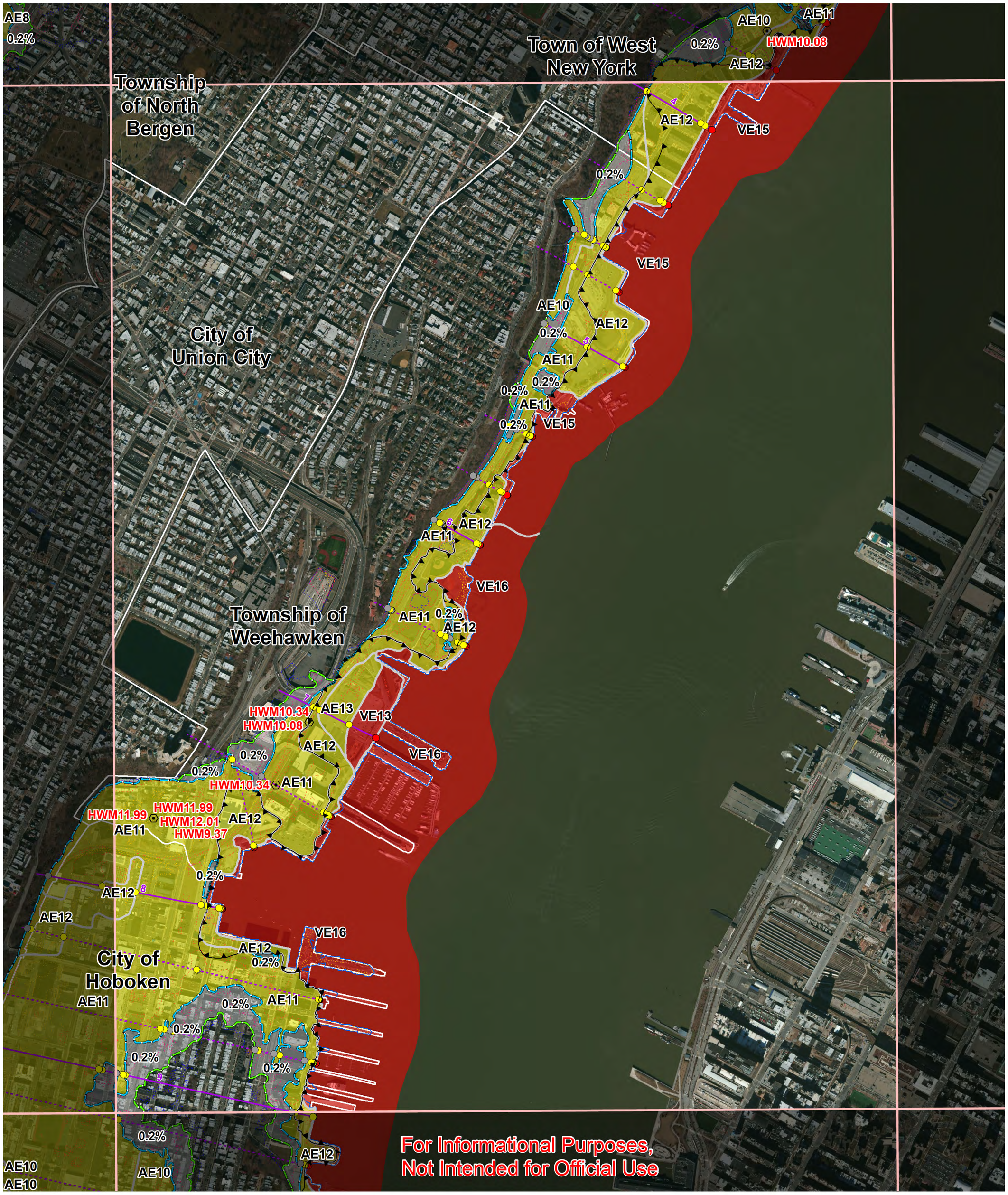
This preliminary work map contains coastal flood hazard information only, riverine flood hazard information not included



FEMA

A JV of Dewberry, URS and ESP
RAMPP
Risk Assessment, Mapping, and Planning Partners

Hudson County, NJ
Preliminary Work Map



0 0.125 0.25 0.5 0.75 1 Miles

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary
- Elevation: 4, 8, 12, 16

AE
VE
X

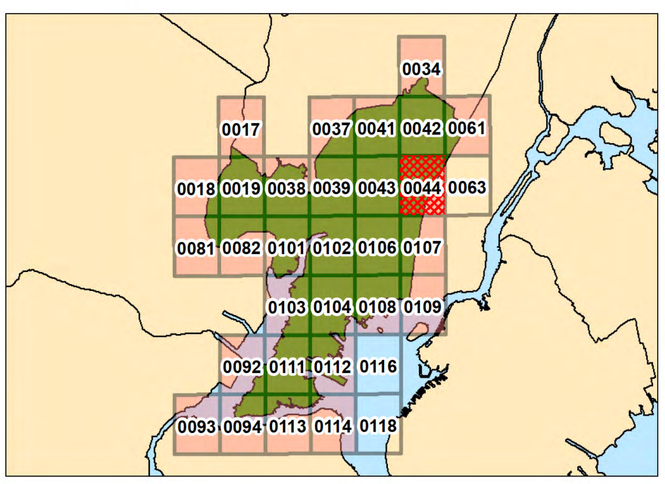
Elevation information is provided in feet NAVD88.
High water marks are provided for reference to a historical storm event. They are not intended to be used for validation of the coastal mapping and are not expected to match the coastal BFEs.

Panel 0044

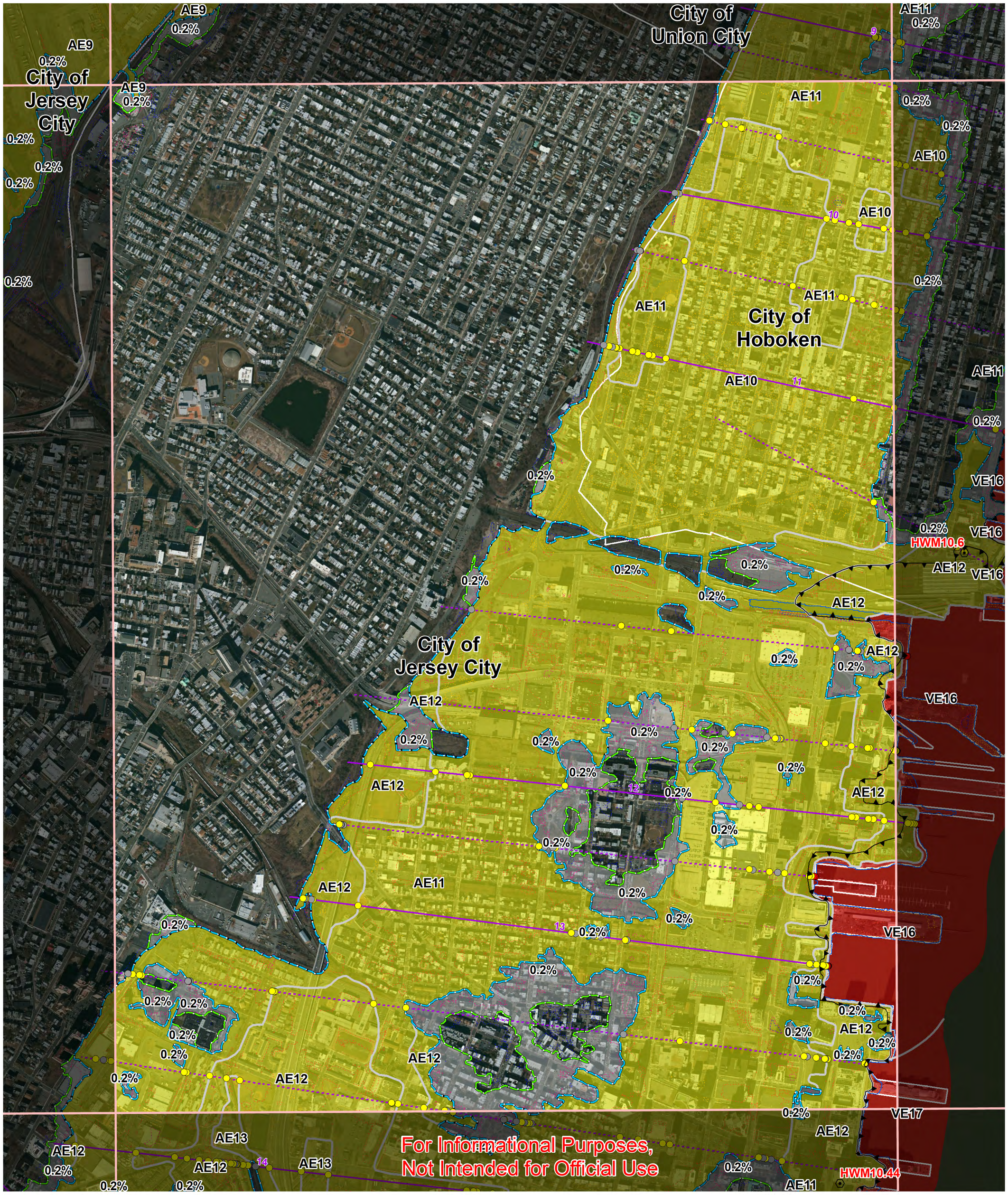
This preliminary work map contains coastal flood hazard information only, riverine flood hazard information not included

FEMA

A JV of Dewberry, URS and ESP
RAMPP
Risk Assessment, Mapping, and Planning Partners



Hudson County, NJ
Preliminary Work Map



0 0.125 0.25 0.5 0.75 1 Miles

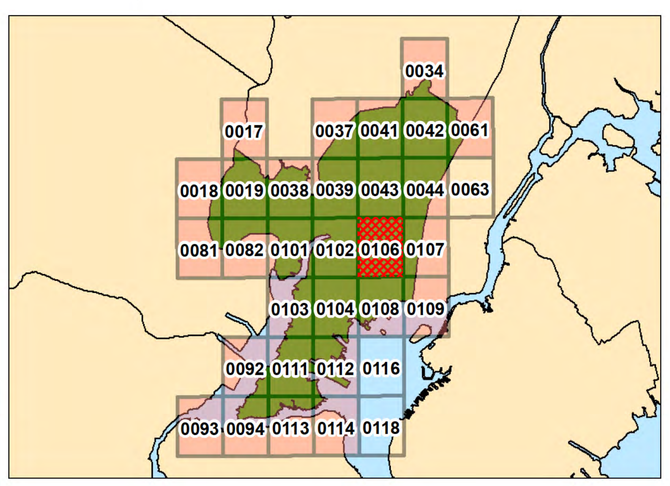
Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary
- Elevation: 4, 8, 12, 16

Elevation information is provided in feet NAVD88.
High water marks are provided for reference to a historical storm event. They are not intended to be used for validation of the coastal mapping and are not expected to match the coastal BFEs.

Panel 0106

This preliminary work map contains coastal flood hazard information only, riverine flood hazard information not included



FEMA

A JV of Dewberry, URS and ESP
RAMPP
Risk Assessment, Mapping, and Planning Partners

Hudson County, NJ
Preliminary Work Map

Miles

0 0.125 0.25 0.5 0.75 1

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary

Transect Station: AE, VE, X

Elevation: 4, 8, 12, 16

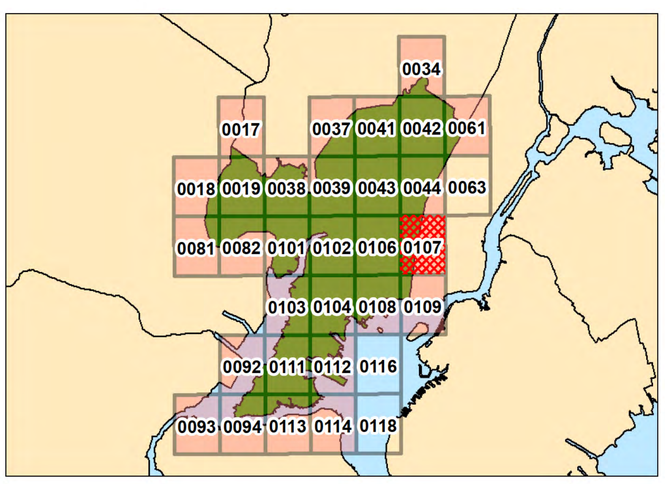
Elevation information is provided in feet NAVD88.
High water marks are provided for reference to a historical storm event. They are not intended to be used for validation of the coastal mapping and are not expected to match the coastal BFEs.

Panel 0107

This preliminary work map contains coastal flood hazard information only, riverine flood hazard information not included

FEMA

A JV of Dewberry, URS and ESP
RAMPP
Risk Assessment, Mapping, and Planning Partners



Historic Preliminary Work Map

Thumbnail

Historic Preliminary Work Map

Web Map Web Map by mvalenzuela_FEMA
Last Modified: June 15, 2013

(0 ratings, 4,608 views)Sign in to rate this item.
FacebookTwitter
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Open

Description

Before Hurricane Sandy, FEMA had begun a coastal flood study to update Flood Insurance Rate Maps (FIRMs) for portions of New York and New Jersey using improved methods and data to better reflect coastal flood risk. After Sandy, FEMA released Advisory Base Flood Elevation (ABFE) information based on the partially completed flood study for certain communities which were designed to help in rebuilding and recovery efforts. FEMA is now releasing preliminary work map data including the full results of the coastal flood study. The preliminary work map data is a "draft" product that FEMA is sharing in advance of the upcoming release of the preliminary FIRMs. The preliminary work map data replaces the ABFE information (where released) as the best available flood hazard data until the release of the preliminary FIRMs.

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Access and Use Constraints

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data currently available for New Jersey and New York communities affected by the coastal flood study, visit the Region 2 Coastal Outreach website.

For most communities, the preliminary work map data shows coastal flood hazard areas only. Updates to riverine flood hazards in most cases will not be reflected. Both coastal and riverine areas will be included on the official preliminary FIRMs once released.

The preliminary work maps are not intended to support regulatory flood hazard zone designation or insurance ratings.

Before building, property and business owners should consult their local government officials to determine the mandatory elevations for their home or building.

Map ContentsPreliminary Work Map (current):http://fema-services2.esri.com/arcgis/rest/services/ABFE_pub/Preliminary_Work_Map/MapServerPreliminary Work Map (as of June 06, 2013):http://fema-services2.esri.com/arcgis/rest/services/ABFE_pub/Preliminary_Work_Map_06102013/MapServerNational Flood Hazard Layer (Sandy Area):http://fema-services2.esri.com/arcgis/rest/services/Best_Available/NFHL_Sandy_Current/MapServerNOAA Aerial Imagery - Cached (Sandy 2012):http://arcgis-sandy-659341956.us-west-1.elb.amazonaws.com/arcgis/rest/services/Sandy/NOAA_Aerials/ImageServerLight Gray Canvas:http://services.arcgisonline.com/ArcGIS/rest/services/Canvas/World_Light_Gray_Base/MapServerLight Gray Canvas:http://services.arcgisonline.com/ArcGIS/rest/services/Canvas/World_Light_Gray_Reference/MapServer

Properties

Tags Preliminary

Credits FEMA

Size 28 KB

Extent

Left: -77.99 Right: -71.43

Top: 41.64 Bottom: 38.51

Hudson County, New Jersey

Transect No. 1 - Point No. 1

Team: Jesse Hayden, Andy Read, Joseph Faries, Amelia Vincent

8/7/2010 07:50:06am

Location Description :	River road. Fence blocks coast access, riprap protects condos to the south 4ft high. Across River Road steep cliff 70ft high.
Point Type :	Coastal
Latitude, Longitude (decimal degrees):	40.798772, -73.994767
Building Description:	Multi-unit on grade
Vegetation Description:	
Marsh Description:	
Coast Description:	Rocky
Fetch Description:	Limited Fetch

Photographs and Descriptions

Photo Type: Offshore
Description: Natural coastline looking across Hudson towards New York City
Direction: 110

Photo Type: Onshore
Description: Elevation quickly rises behind condo landward
Direction: 290

Photo Type: Left
Description: Riprap protects condos
Direction: 150

Photo Type: Right
Description: Natural coast to the north
Direction: 75

Hudson County, New Jersey

Transect No. 2 - Point No. 1

Team: Jesse Hayden, Andy Read, Joseph Faries, Amelia Vincent

8/7/2010 08:03:32am

Location Description :	River road. Seawall and riprap in front of condos, protection is all 4ft high, cliff on other side of road.
Point Type :	Coastal
Latitude, Longitude (decimal degrees):	40.791451, -73.996362
Building Description:	Multi-unit on grade
Vegetation Description:	
Marsh Description:	
Coast Description:	Rocky, Bulkhead
Fetch Description:	Limited Fetch

Photographs and Descriptions

Photo Type: Offshore
Description: Park area borders river
Direction: 140

Photo Type: Onshore
Description: Multi unit condos
Direction: 320

Photo Type: Left
Description: Seawall to the south
Direction: 250

Photo Type: Right
Description: Riprap to the north
Direction: 40

Hudson County, New Jersey

Transect No. 3 - Point No. 1

Team: Jesse Hayden, Andy Read, Joseph Faries, Amelia Vincent

8/7/2010 08:20:37am

Location Description :	Avenue Port Imperial. 6ft riprap in front of river walkway and multi unit on grade buildings. Piers visible are on piles.
Point Type :	Coastal
Latitude, Longitude (decimal degrees):	40.784693, -74.001459
Building Description:	Multi-unit on grade
Vegetation Description:	
Marsh Description:	
Coast Description:	Rocky
Fetch Description:	Limited Fetch

Photographs and Descriptions

Photo Type: Offshore
Description: Park area with fountain at coast
Direction: 145

Photo Type: Onshore
Description: Terrain quickly rises across road
Direction: 320

Photo Type: Left
Description: Riprap protection along river walkway
Direction: 250

Photo Type: Right
Description: Piers nearby are on piles
Direction: 50

Hudson County, New Jersey

Transect No. 4 - Point No. 1

Team: Jesse Hayden, Andy Read, Joseph Faries, Amelia Vincent

8/7/2010 08:34:55am

Location Description :	River Walk. 6ft riprap in front of river walkway and condos. Piers located nearby are solid.
Point Type :	Coastal
Latitude, Longitude (decimal degrees):	40.780836, -74.006388
Building Description:	Multi-unit on grade
Vegetation Description:	
Marsh Description:	
Coast Description:	Rocky, Bulkhead
Fetch Description:	Limited Fetch

Photographs and Descriptions

Photo Type: Offshore
Description: View across Hudson River from river walkway
Direction: 140

Photo Type: Onshore
Description: Terrain rises landward of point
Direction: 320

Photo Type: Left
Description: Riprap protection
Direction: 220

Photo Type: Right
Description: Riprap protection north
Direction: 50

Hudson County, New Jersey

Transect No. 5 - Point No. 1

Team: Jesse Hayden, Andy Read, Joseph Faries, Amelia Vincent

8/7/2010 08:46:48am

Location Description :	Ferry boulevard. 6ft riprap in front of river walkway, 100ft cliff across main road.
Point Type :	Coastal
Latitude, Longitude (decimal degrees):	40.773457, -74.010395
Building Description:	
Vegetation Description:	
Marsh Description:	
Coast Description:	Rocky
Fetch Description:	Limited Fetch

Photographs and Descriptions

Photo Type: Offshore
Description: View across Hudson River
Direction: 120

Photo Type: Onshore
Description: Cliffs across road
Direction: 330

Photo Type: Left
Description: Riprap protection
Direction: 180

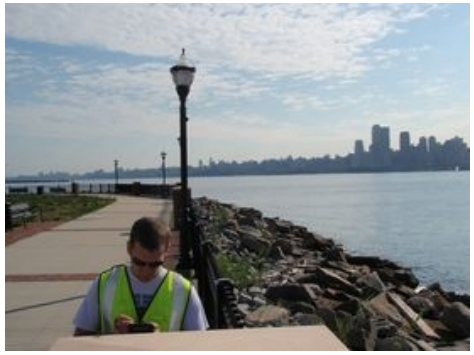


Photo Type: Right
Description: Riprap protection along river walkway
Direction: 50

Hudson County, New Jersey

Transect No. 6 - Point No. 1

Team: Jesse Hayden, Andy Read, Joseph Faries, Amelia Vincent

8/7/2010 09:02:08am

Location Description :	Port Imperial Blvd. 6ft riprap in front of river walkway, seawall ends just north of point, also 6ft high.
Point Type :	Coastal
Latitude, Longitude (decimal degrees):	40.766387, -74.017221
Building Description:	Multi-unit on grade
Vegetation Description:	
Marsh Description:	
Coast Description:	Rocky, Seawall
Fetch Description:	Limited Fetch

Photographs and Descriptions

Photo Type: Offshore
Description: Small vegetated patch
Direction: 110

Photo Type: Onshore
Description: Park and cliff landward
Direction: 300

Photo Type: Left
Description: Riprap protection to the south
Direction: 150

Photo Type: Right
Description: Riprap and seawall to the north
Direction: 30

Hudson County, New Jersey

Transect No. 7 - Point No. 1

Team: Jesse Hayden, Andy Read, Joseph Faries, Amelia Vincent

8/7/2010 09:16:08am

Location Description :	Harbor Blvd. 7.5ft seawall in front of parking lot, piers located nearby solid with continuous bulkhead.
Point Type :	Coastal
Latitude, Longitude (decimal degrees):	40.761841, -74.020283
Building Description:	Commercial on grade, one building on pier elevated
Vegetation Description:	
Marsh Description:	
Coast Description:	Seawall
Fetch Description:	Limited Fetch

Photographs and Descriptions

Photo Type: Offshore
Description: Pier extends into Hudson River
Direction: 130

Photo Type: Onshore
Description: Mostly open space landward
Direction: 310

Photo Type: Left
Description: Seawall protection nearby
Direction: 240

Photo Type: Right
Description: Seawall transitions to riprap north
Direction: 40

Hudson County, New Jersey

Transect No. 8 - Point No. 1

Team: Jesse Hayden, Andy Read, Joseph Faries, Amelia Vincent

8/7/2010 09:33:59am

Location Description :	Hudson Street. 8ft seawall in front of condos, which are on grade. Broken seawall toward river.
Point Type :	Coastal
Latitude, Longitude (decimal degrees):	40.75492, -74.024326
Building Description:	Multi-unit on grade
Vegetation Description:	
Marsh Description:	
Coast Description:	Seawall
Fetch Description:	Limited Fetch

Photographs and Descriptions

Photo Type: Offshore
Description: Broken down seawall offshore of point, land area is undeveloped
Direction: 90

Photo Type: Onshore
Description: Seawall extends landward to riprap
Direction: 290

Photo Type: Left
Description: Seawall around embayment
Direction: 200

Photo Type: Right
Description: Continuous seawall to the north
Direction: 10

Hudson County, New Jersey

Transect No. 9 - Point No. 1

Team: Jesse Hayden, Andy Read, Joseph Faries, Amelia Vincent

8/7/2010 09:54:04am

Location Description :	12th Street. 8ft seawall in front of condos and commercial buildings, all buildings on grade, large pier on piles.
Point Type :	Coastal
Latitude, Longitude (decimal degrees):	40.750162, -74.023566
Building Description:	Multi-unit on grade
Vegetation Description:	
Marsh Description:	
Coast Description:	Seawall
Fetch Description:	Limited Fetch

Photographs and Descriptions

Photo Type: Offshore
Description: Pier is on piles
Direction: 80

Photo Type: Onshore
Description: Buildings landward
Direction: 260

Photo Type: Left
Description: Walkway on piles and riprap protection to the south
Direction: 170

Photo Type: Right
Description: Ferry pier is on piles
Direction: 60

Hudson County, New Jersey

Transect No. 10 - Point No. 1

Team: Jesse Hayden, Andy Read, Joseph Faries, Amelia Vincent

8/7/2010 10:09:03am

Location Description :	Frank Sinatra Blvd. Riprap at toe of seawall, parts of river walkway are on piles. 50ft cliff across street.
Point Type :	Coastal
Latitude, Longitude (decimal degrees):	40.743934, -74.02325
Building Description:	
Vegetation Description:	
Marsh Description:	
Coast Description:	Rocky, Seawall
Fetch Description:	Limited Fetch

Photographs and Descriptions

Photo Type: Offshore
Description: View across Hudson River
Direction: 130

Photo Type: Onshore
Description: Cliff immediately landward of point
Direction: 310

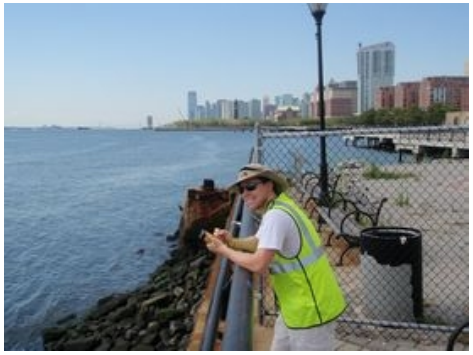


Photo Type: Left
Description: Small riprap and seawall protection
Direction: 240

Photo Type: Right
Description: Portions of walkway on piles
Direction: 50

Hudson County, New Jersey

Transect No. 11 - Point No. 1

Team: Jesse Hayden, Andy Read, Joseph Faries, Amelia Vincent

8/7/2010 10:19:51am

Location Description :	Frank Sinatra Blvd. 15ft seawall in front of commercial buildings, playground and piers located nearby are on piles.
Point Type :	Coastal
Latitude, Longitude (decimal degrees):	40.740022, -74.02666
Building Description:	Commercial buildings on grade
Vegetation Description:	
Marsh Description:	
Coast Description:	Seawall
Fetch Description:	Limited Fetch

Photographs and Descriptions

Photo Type: Offshore
Description: Playground on piles in Hudson River
Direction: 90

Photo Type: Onshore
Description: Commercial buildings nearby
Direction: 270

Photo Type: Left
Description: Seawall along river walk
Direction: 180

Photo Type: Right
Description: Seawall extends to the north
Direction: 0

Hudson County, New Jersey

Transect No. 12 - Point No. 1

Team: Jesse Hayden, Andy Read, Joseph Faries, Amelia Vincent

8/7/2010 10:44:48am

Location Description :	Newport Pkwy. 8ft high riprap in front of river walkway and buildings, bulkheads shelter marina from waves and wakes.
Point Type :	Coastal
Latitude, Longitude (decimal degrees):	40.726398, -74.030243
Building Description:	Commercial buildings and condos on grade
Vegetation Description:	
Marsh Description:	
Coast Description:	Rocky
Fetch Description:	Limited Fetch

Photographs and Descriptions

Photo Type: Offshore
Description: Riprap protection along river walkway
Direction: 110

Photo Type: Onshore
Description: Commercial and multi-unit buildings
Direction: 315

Photo Type: Left
Description: Marina to the south has bulkheads to block wake
Direction: 210

Photo Type: Right
Description: Various protection to the north
Direction: 5

Hudson County, New Jersey

Transect No. 13 - Point No. 1

Team: Jesse Hayden, Andy Read, Joseph Faries, Amelia Vincent

8/7/2010 11:06:14am

Location Description :	6th street. 8ft seawall in front of hotels and commercial buildings which are on grade. Piers located nearby are solid with continuous bulkhead.
Point Type :	Coastal
Latitude, Longitude (decimal degrees):	40.723974, -74.03382
Building Description:	Commercial buildings on grade
Vegetation Description:	
Marsh Description:	
Coast Description:	Seawall
Fetch Description:	Limited Fetch

Photographs and Descriptions

Photo Type: Offshore
Description: Seawalled land extends into river
Direction: 140

Photo Type: Onshore
Description: Buildings on grade landward
Direction: 320

Photo Type: Left
Description: Seawall along river walkway
Direction: 230

Photo Type: Right
Description: Seawall and old piles
Direction: 50

Hudson County, New Jersey

Transect No. 14 - Point No. 1

Team: Jesse Hayden, Andy Read, Joseph Faries, Amelia Vincent

8/7/2010 11:18:41am

Location Description :	Grand Street. 8ft seawall in front commercial buildings, piers located nearby are on piles.
Point Type :	Coastal
Latitude, Longitude (decimal degrees):	40.714601, -74.032863
Building Description:	Commercial buildings on grade
Vegetation Description:	
Marsh Description:	
Coast Description:	Seawall
Fetch Description:	Limited Fetch

Photographs and Descriptions

Photo Type: Offshore
Description: View of downtown across Hudson River
Direction: 120

Photo Type: Onshore
Description: Urban buildings
Direction: 310

Photo Type: Left
Description: Seawall along river walkway
Direction: 30

Photo Type: Right
Description: Seawall and urban buildings to the north
Direction: 220

Hudson County, New Jersey

Transect No. 15 - Point No. 1

Team: Jesse Hayden, Andy Read, Joseph Faries, Amelia Vincent

8/7/2010 12:31:12pm

Location Description :	Liberty State Park. 10ft high riprap in front of open park. Ellis Island offshore has seawall, Statue of Liberty island also has seawall.
Point Type :	Coastal
Latitude, Longitude (decimal degrees):	40.702832, -74.04452
Building Description:	
Vegetation Description:	
Marsh Description:	
Coast Description:	Rocky
Fetch Description:	Limited Fetch

Photographs and Descriptions

Photo Type: Offshore
Description: View of Ellis Island offshore
Direction: 160

Photo Type: Onshore
Description: Park with sparse trees
Direction: 340

Photo Type: Left
Description: Riprap protection in front of park
Direction: 250

Photo Type: Right
Description: Riprap protection
Direction: 70

Hudson County, New Jersey

Transect No. 15 - Point No. 2

Team: Jesse Hayden, Andy Read, Joseph Faries, Amelia Vincent

8/7/2010 12:42:30pm

Location Description :	Freedom Way. Patch of forest in park.
Point Type :	Interior
Latitude, Longitude (decimal degrees):	40.703786, -74.047284
Building Description:	
Vegetation Description:	Surrounding: Mixed forest with significant undergrowth. Average 4 inch diameter, 2 feet spacing, and 25 feet average height.
Marsh Description:	
Coast Description:	
Fetch Description:	

Photo Type: Representative Vegetation
Description: Brushy vegetation in park
Direction: 340

Hudson County, New Jersey

Transect No. 16 - Point No. 1

Team: Jesse Hayden, Andy Read, Joseph Faries, Amelia Vincent

8/7/2010 01:03:13pm

Location Description :	Chapel Avenue. 8ft seawall in front of commercial buildings and industrial buildings on grade. Community nearby has canals with 6ft bulkheads.
Point Type :	Coastal
Latitude, Longitude (decimal degrees):	40.685016, -74.070292
Building Description:	Commercial buildings on grade
Vegetation Description:	
Marsh Description:	
Coast Description:	Seawall
Fetch Description:	Limited Fetch

Photographs and Descriptions

Photo Type: Offshore
Description: Bulkhead protects marina entry
Direction: 70

Photo Type: Onshore
Description: Military buildings onshore
Direction: 250

Photo Type: Left
Description: Seawall protection
Direction: 140

Photo Type: Right
Description: Marina and canals in community have uniform seawall
Direction: 340

Hudson County, New Jersey

Transect No. 17 - Point No. 1

Team: Jesse Hayden, Andy Read, Joseph Faries, Amelia Vincent

8/7/2010 01:34:00pm

Location Description :	Port Jersey Rd. Vantage on port area to the north, port has 8ft seawall and barges, may be USACE.
Point Type :	Coastal
Latitude, Longitude (decimal degrees):	40.673791, -74.076594
Building Description:	
Vegetation Description:	
Marsh Description:	
Coast Description:	Seawall
Fetch Description:	Limited Fetch

Photo Type: Other 1
Description: Seawall visible to the north
Direction: 35

Hudson County, New Jersey

Transect No. 18 - Point No. 1

Team: Jesse Hayden, Andy Read, Joseph Faries, Amelia Vincent

8/7/2010 01:24:12pm

Location Description :	Pulaski Rd. 8ft high riprap in front of commercial buildings on grade, port toward river has 8ft seawall.
Point Type :	Coastal
Latitude, Longitude (decimal degrees):	40.67576, -74.095508
Building Description:	Commercial buildings on grade
Vegetation Description:	
Marsh Description:	
Coast Description:	Rocky
Fetch Description:	Limited Fetch

Photographs and Descriptions

Photo Type: Offshore
Description: View offshore at embayment
Direction: 140

Photo Type: Onshore
Description: Industrial buildings
Direction: 330

Photo Type: Left
Description: Isolated riprap and vegetation
Direction: 240

Photo Type: Right
Description: Riprap protection around industrial buildings
Direction: 70

Hudson County, New Jersey

Transect No. 19 - Point No. 1

Team: Jesse Hayden, Andy Read, Joseph Faries, Amelia Vincent

8/7/2010 01:46:39pm

Location Description :	Bayonne cruise terminal. 4ft high seawall with patches of marsh, nearby commercial buildings and condos are on grade.
Point Type :	Coastal
Latitude, Longitude (decimal degrees):	40.670329, -74.106282
Building Description:	Commercial buildings and multi-unit on grade
Vegetation Description:	
Marsh Description:	
Coast Description:	Seawall, Marsh
Fetch Description:	Limited Fetch

Photographs and Descriptions

Photo Type: Offshore
Description: Seawall and marsh in embayment
Direction: 110

Photo Type: Onshore
Description: Head of embayment
Direction: 290

Photo Type: Left
Description: Riprap protects commercial area
Direction: 240

Photo Type: Right
Description: Industrial area
Direction: 40

Hudson County, New Jersey

Transect No. 20 - Point No. 1

Team: Jesse Hayden, Andy Read, Joseph Faries, Amelia Vincent

8/7/2010 02:42:29pm

Location Description :	Bayonne Golf Course. 10ft high seawall in front of 20ft high vegetated hills, 8ft high riprap and breakwaters to the south.
Point Type :	Coastal
Latitude, Longitude (decimal degrees):	40.664367, -74.089578
Building Description:	
Vegetation Description:	Surrounding: Mixed forest with none undergrowth. Average 2 inch diameter, 2 feet spacing, and 5 feet average height.
Marsh Description:	
Coast Description:	Rocky, Seawall
Fetch Description:	Limited Fetch

Photographs and Descriptions

Photo Type: Offshore
Description: Offshore New York Harbor
Direction: 120

Photo Type: Onshore
Description: Large shrubby dunes border Bayonne Golf Course
Direction: 290

Photo Type: Left
Description: Seawall around walkway, breakwaters in far field
Direction: 170

Photo Type: Right
Description: Seawall extends around Golf Course
Direction: 30

Hudson County, New Jersey

Transect No. 21 - Point No. 1

Team: Jesse Hayden, Andy Read, Joseph Faries, Amelia Vincent

8/7/2010 03:07:03pm

Location Description :	New Hook Rd. Oil tanks about 30fth high, no access to property or coast.
Point Type :	Interior
Latitude, Longitude (decimal degrees):	40.655505, -74.094461
Building Description:	Oil tanks on grade
Vegetation Description:	
Marsh Description:	
Coast Description:	
Fetch Description:	

Photo Type: Other 1
Description: Typical oil tanks
Direction: 140

Hudson County, New Jersey

Transect No. 23 - Point No. 1

Team: Jesse Hayden, Andy Read, Joseph Faries, Amelia Vincent

8/7/2010 03:25:39pm

Location Description :	5th St walkway. Natural marsh at end of walkway with oil tanks surrounding. Pipelines elevated 8ft, cannot see seawall in front oil tanks. Old wrecks protect small residential dock.
Point Type :	Coastal
Latitude, Longitude (decimal degrees):	40.649526, -74.115219
Building Description:	Houses on top of 6ft dock
Vegetation Description:	
Marsh Description:	Dense Big Cordgrass, 9 feet tall, covers 100 percent of marsh.
Coast Description:	Seawall, Marsh
Fetch Description:	Limited Fetch

Photographs and Descriptions

Photo Type: Offshore
Description: Oil pipeline offshore
Direction: 190

Photo Type: Onshore
Description: Narrow park area
Direction: 350

Photo Type: Left
Description: Blocked view of protection at industrial area
Direction: 250

Photo Type: Right
Description: Wrecks and old piles
Direction: 100

Photo Type: Representative Buildings
Description: One dock of shacks in the midst of oil tank fields
Direction: 40

Hudson County, New Jersey

Transect No. 24 - Point No. 1

Team: Jesse Hayden, Andy Read, Joseph Faries, Amelia Vincent

8/7/2010 03:53:44pm

Location Description :	1st Street. 6ft riprap in front of park, sections of seawall. Multi-unit and commercial buildings on grade.
Point Type :	Coastal
Latitude, Longitude (decimal degrees):	40.645189, -74.132596
Building Description:	Multi-unit and commercial buildings on grade
Vegetation Description:	
Marsh Description:	
Coast Description:	Rocky, Seawall
Fetch Description:	Limited Fetch

Photographs and Descriptions

Photo Type: Offshore
Description: Small walkway along Kill Van Kull
Direction: 210

Photo Type: Onshore
Description: Mixed urban buildings onshore
Direction: 30

Photo Type: Left
Description: Riprap along Kill Van Kull
Direction: 310

Photo Type: Right
Description: Riprap along walkway
Direction: 120

Hudson County, New Jersey

Transect No. 26 - Point No. 1

Team: Jesse Hayden, Andy Read, Joseph Faries, Amelia Vincent

8/7/2010 04:02:57pm

Location Description :	Washington Parkway. 25ft elevation above water, houses on grade. 5ft high riprap to the north, 7ft seawall in front of port across Newark Bay in Essex Co.
Point Type :	Coastal
Latitude, Longitude (decimal degrees):	40.661245, -74.131922
Building Description:	Houses on grade elevated from water
Vegetation Description:	Surrounding: Mixed forest with significant undergrowth. Average 2 inch diameter, 2 feet spacing, and 5 feet average height.
Marsh Description:	
Coast Description:	Vegetated
Fetch Description:	Limited Fetch

Photographs and Descriptions

Photo Type: Offshore
Description: Elevated land, view of Essex port area across bay
Direction: 320

Photo Type: Onshore
Description: Buildings at grade, grade is 25ft above water
Direction: 150

Photo Type: Left
Description: Marina to the south
Direction: 270

Photo Type: Right
Description: Riprap around parking lot north
Direction: 350

Hudson County, New Jersey

Transect No. 27 - Point No. 1

Team: Jesse Hayden, Andy Read, Joseph Faries, Amelia Vincent

8/7/2010 04:26:29pm

Location Description :	21st Street. 10ft high seawall in front of condos to the north, 15ft embankment with riprap at the toe, 4ft riprap to the south. 7ft seawall in front of port across Newark Bay in Essex Co.
Point Type :	Coastal
Latitude, Longitude (decimal degrees):	40.666434, -74.127558
Building Description:	Multi-unit and single family homes on grade
Vegetation Description:	
Marsh Description:	
Coast Description:	Seawall
Fetch Description:	Limited Fetch

Photographs and Descriptions

Photo Type: Offshore
Description: View across bay
Direction: 280

Photo Type: Onshore
Description: Residential area onshore
Direction: 110

Photo Type: Left
Description: Seawall around condos to the north
Direction: 0

Photo Type: Right
Description: Natural berm to the south
Direction: 200

Photo Type: Other 1

Description: Seawall in front of port across Newark Bay in Essex Co

Direction: 270

Hudson County, New Jersey

Transect No. 28 - Point No. 1

Team: Jesse Hayden, Andy Read, Joseph Faries, Amelia Vincent

8/7/2010 04:35:03pm

Location Description :	West 30th Street. 15ft high riprap in front of high school, 4ft high riprap in front of houses the north, all buildings on grade.
Point Type :	Coastal
Latitude, Longitude (decimal degrees):	40.673368, -74.122488
Building Description:	High School and multi-unit on grade
Vegetation Description:	
Marsh Description:	
Coast Description:	Rocky
Fetch Description:	Limited Fetch

Photographs and Descriptions

Photo Type: Offshore
Description: Offshore across bay
Direction: 330

Photo Type: Onshore
Description: Residential and High School
Direction: 150

Photo Type: Left
Description: Small riprap and high berm to the north
Direction: 40

Photo Type: Right
Description: Blocked view of coast to the south
Direction: 250

Hudson County, New Jersey

Transect No. 29 - Point No. 1

Team: Jesse Hayden, Andy Read, Joseph Faries, Amelia Vincent

8/7/2010 04:54:18pm

Location Description :	Bayonne Park. 5ft seawall in front of park and 5ft riprap to the north. At ends of river walkway seawall height is 3ft where wall is absent.
Point Type :	Coastal
Latitude, Longitude (decimal degrees):	40.681361, -74.118019
Building Description:	
Vegetation Description:	
Marsh Description:	
Coast Description:	Seawall
Fetch Description:	Limited Fetch

Photographs and Descriptions

Photo Type: Offshore
Description: Short wall extends above walkway
Direction: 330

Photo Type: Onshore
Description: Park is onshore
Direction: 160

Photo Type: Left
Description: Seawall along walkway
Direction: 60

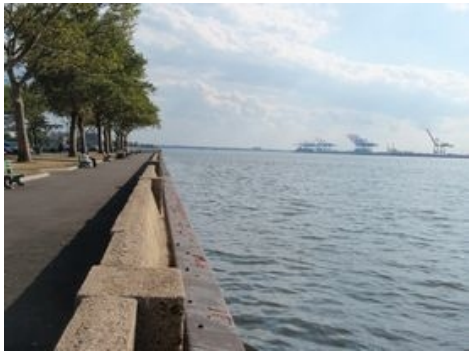


Photo Type: Right
Description: Seawall continues to the south
Direction: 240

Hudson County, New Jersey

Transect No. 29 - Point No. 2

Team: Jesse Hayden, Andy Read, Joseph Faries, Amelia Vincent

8/7/2010 04:46:47pm

Location Description :	Park Drive in Bayonne Park. Large sparse trees in park.
Point Type :	Interior
Latitude, Longitude (decimal degrees):	40.68032, -74.11396
Building Description:	
Vegetation Description:	Surrounding: Deciduous forest with none undergrowth. Average 18 inch diameter, 20 feet spacing, and 55 feet average height.
Marsh Description:	
Coast Description:	
Fetch Description:	

Photo Type: Representative Vegetation
Description: Large trees with no undergrowth in park
Direction: 45

Hudson County, New Jersey

Transect No. 30 - Point No. 1

Team: Jesse Hayden, Andy Read, Joseph Faries, Amelia Vincent

8/8/2010 09:55:19am

Location Description :	Park off 440 South. Riprap 8' high with natural berm behind.
Point Type :	Coastal
Latitude, Longitude (decimal degrees):	40.689681, -74.113055
Building Description:	
Vegetation Description:	
Marsh Description:	
Coast Description:	Rocky
Fetch Description:	Limited Fetch

Photographs and Descriptions

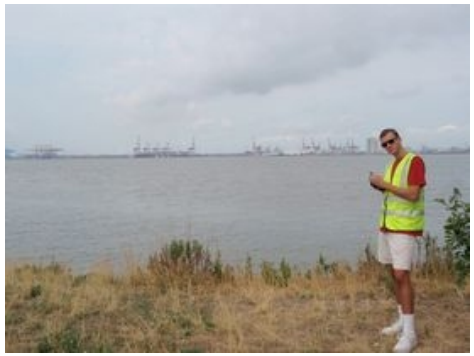


Photo Type: Offshore
Description: High berm at park area
Direction: 260

Photo Type: Onshore
Description: View of berm onshore
Direction: 80

Photo Type: Left
Description: Riprap around lower berm at park
Direction: 340

Photo Type: Right
Description: Riprap continuous around park
Direction: 185

Hudson County, New Jersey

Transect No. 31 - Point No. 1

Team: Jesse Hayden, Andy Read, Joseph Faries, Amelia Vincent

8/8/2010 09:36:11am

Location Description :	440 South. 8' riprap alongside 440 South.
Point Type :	Coastal
Latitude, Longitude (decimal degrees):	40.699721, -74.104281
Building Description:	Single family homes on grade
Vegetation Description:	
Marsh Description:	
Coast Description:	Rocky
Fetch Description:	Limited Fetch

Photographs and Descriptions

Photo Type: Offshore
Description: View offshore across Bay
Direction: 320

Photo Type: Onshore
Description: Neighborhood onshore
Direction: 140

Photo Type: Left
Description: Riprap along roadway
Direction: 50

Photo Type: Right
Description: Riprap continues to the south
Direction: 245

Photo Type: Other 1

Description: View of coast protection across Newark Bay by transect 32

Direction: 5

Hudson County, New Jersey

Transect No. 33 - Point No. 1

Team: Jesse Hayden, Andy Read, Joseph Faries, Amelia Vincent

8/8/2010 09:18:23am

Location Description :	Along Kellog St. 5' dilapidated seawall to the north, riprap reinforced with concrete to the south.
Point Type :	Coastal
Latitude, Longitude (decimal degrees):	40.712331, -74.103497
Building Description:	Commercial buildings on grade and multi-unit on grade
Vegetation Description:	
Marsh Description:	
Coast Description:	Rocky, Seawall
Fetch Description:	Limited Fetch

Photographs and Descriptions

Photo Type: Offshore
Description: Broken seawall to the north and riprap locally
Direction: 320

Photo Type: Onshore
Description: Commercial buildings and condos nearby
Direction: 145

Photo Type: Left
Description: Peninsula has broken seawall around it
Direction: 0

Photo Type: Right
Description: Riprap wall surrounds community
Direction: 295

Hudson County, New Jersey

Transect No. 34 - Point No. 1

Team: Jesse Hayden, Andy Read, Joseph Faries, Amelia Vincent

8/8/2010 09:06:02am

Location Description :	Backside of Hudson Mall. Mixed marsh coastline, riprap to the south.
Point Type :	Coastal
Latitude, Longitude (decimal degrees):	40.720596, -74.097049
Building Description:	Commercial buildings on grade
Vegetation Description:	
Marsh Description:	Dense Med. Saltmeadow Cordgrass, 3 feet tall, covers 50 percent of marsh. Dense Big Cordgrass, 6 feet tall, covers 50 percent of marsh.
Coast Description:	Rocky, Marsh
Fetch Description:	Limited Fetch

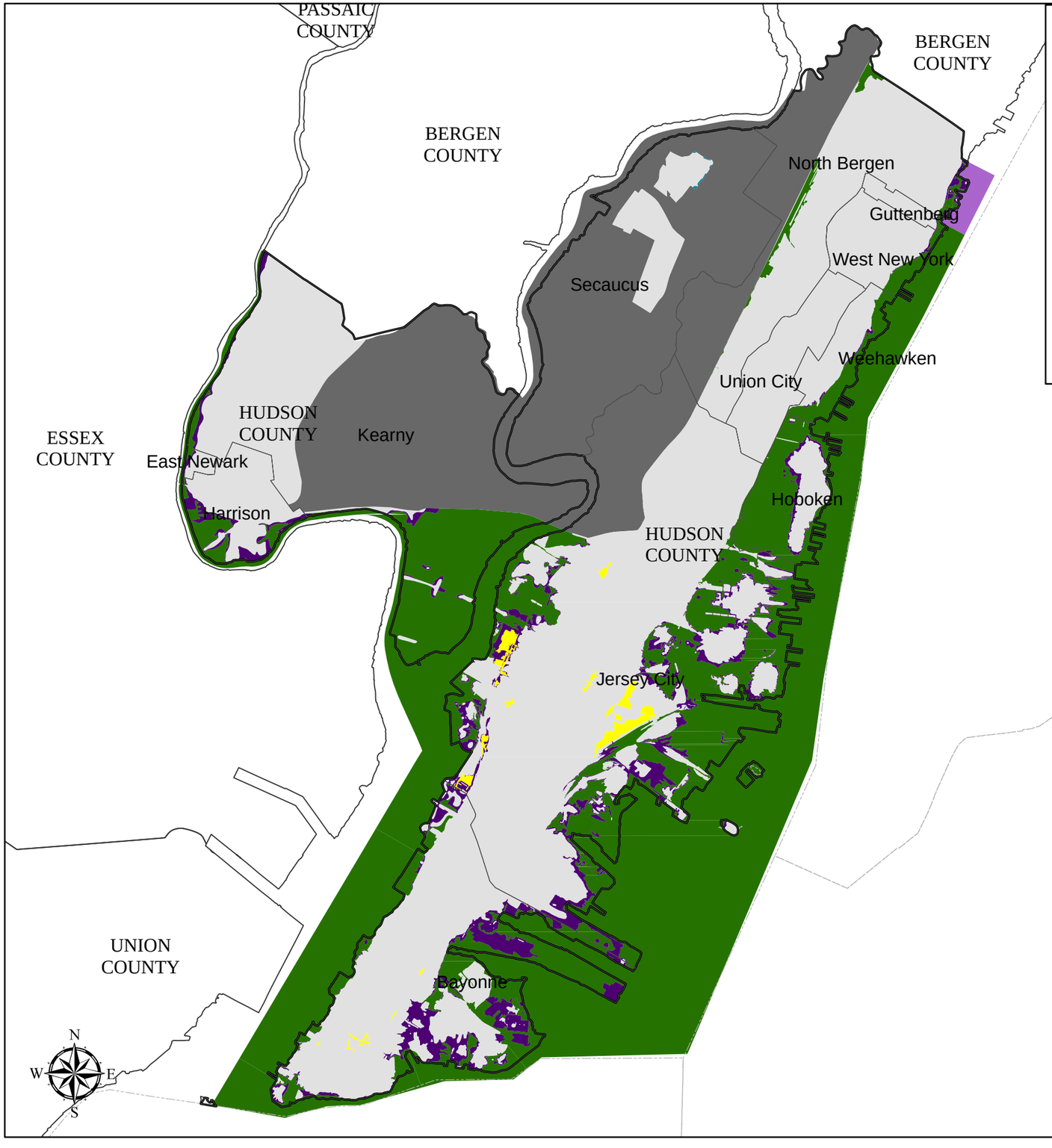
Photographs and Descriptions

Photo Type: Offshore
Description: Marsh along coast
Direction: 315

Photo Type: Onshore
Description: Commercial buildings onshore
Direction: 130

Photo Type: Left
Description: Blocked view, natural coast
Direction: 30

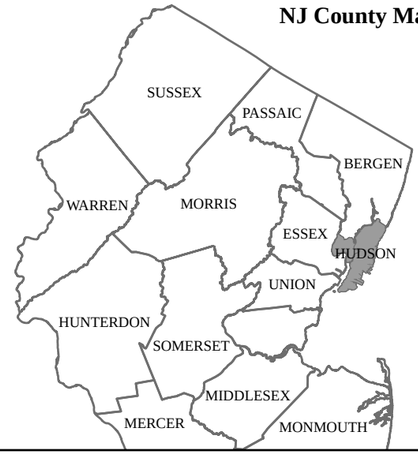
Photo Type: Right
Description: Riprap visible to the south
Direction: 245



FEMA FLOOD ZONES

- 0.2 % CHANCE
- A
- AE
- AH
- ANI
- VE
- X

NJ County Map



NJ Office of Emergency Management
River Road
P.O. Box 7068
West Trenton, NJ 08628

HUDSON COUNTY NEW JERSEY FEMA DFIRM FLOODPLAINS

Legend

- New Jersey Municipal Boundaries
- Hudson County Boundary
- New York County Boundaries
- New Jersey County Boundaries

SOURCES:

1. FEMA DFIRM Floodplain data obtained from the Federal Emergency Management Agency Map Service Center.

2. Other New Jersey political boundary data obtained from the New Jersey Department of Environmental Protection's GIS website.

3. New York political boundary data obtained from the NYS Geographic Information Systems Clearinghouse.

0 7,100 14,200 Feet

Final Report

New York/New Jersey Coastal Advisory Flood Hazard Information Development

March 22, 2013

FEMA

Federal Emergency Management Agency
Department of Homeland Security
500 C Street, SW
Washington DC, 20472

Contract: HSFEHQ-09-D-0369
Task Orders: HSFE02-13-J-0013
HSFE60-13-J-0006
HSFE60-13-J-0007
HSFE02-13-J-0488

This document was prepared by

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Contents

ABFE	Advisory Base Flood Elevation
BFE	Base Flood Elevation
CSLF	Changes Since Last FIRM
DEM	Digital Elevation Model
DFIRM	digital Flood Insurance Rate Map
DTM	Digital Terrain Model
FEMA	Federal Emergency Management Agency
FGDC	Federal Geographic Data Committee
FIRM	Flood Insurance Rate Maps
FIS	Flood Insurance Study
LiDAR	Light Detection and Ranging
NAD83	North American Datum of 1983
NAVD88	North American Vertical Datum of 1988
NFHL	National Flood Hazard Layer
NHD	National Hydrographic Dataset
NOAA	National Oceanic and Atmospheric Administration
NOS	National Ocean Service
NYC DOITT	New York City Department of Information Technology and Telecommunications
QA/QC	Quality Assurance/Quality Control
RAMPP	Risk Assessment, Mapping and Planning Partners
SFHA	Special Flood Hazard Area
TIN	Triangulated Irregular Network
USGS	U.S. Geological Survey
WHAFIS	Wave Height Analysis for Flood Insurance Studies

SECTION ONE INTRODUCTION

Hurricane Sandy struck the Mid-Atlantic States of New Jersey and New York as a Category 1 storm on October 24 through October 31, 2012. The storm resulted in 60 and 34 casualties being reported in New York State (48 in New York City alone) and New Jersey, respectively. With the highest storm surge levels on record, Hurricane Sandy produced widespread damage to coastal and inland communities in both the States. The estimated damage is $42 billion for New York and $30 billion for New Jersey.

Prior to Hurricane Sandy, the Federal Emergency Management Agency (FEMA) had initiated revisions to the Flood Insurance Studies (FISs) for a majority of the counties affected by Hurricane Sandy. The coastal analyses for these counties were advanced to a stage where leveraging the data to develop conservative, technically-backed advisory flood hazard information for Hurricane Sandy recovery was possible. The use of this advisory flood hazard information (as opposed to that on the effective Flood Insurance Rate Maps (FIRMs)) by State agencies, communities, and residents will result in reconstruction and recovery that is in line with the preliminary FIRMs currently scheduled for issuance in 2013. It is important to note that the intended purpose of the advisory elevation products is to provide elevation guidance for rebuilding, not information to support regulatory floodplain designations or insurance ratings.

Following Hurricane Sandy, FEMA contracted Risk Assessment, Mapping, and Planning Partners (RAMPP) to develop coastal advisory flood hazard information for affected counties in New York and New Jersey.

This report documents the methodologies, assumptions, and data sources used to develop the coastal advisory flood hazard information and associated map products.

1.1 FEMA ADVISORY PRODUCTS

The advisory flood hazard information included coastal analyses and mapping that resulted in the following:

1. Advisory Flood Zones that provide full geospatial representation of the Advisory Base Flood Elevations (ABFEs) (1% and 0.2% annual chance coastal flood hazard), including both storm surge and wave components
2. Advisory Limit of the 1% Flood Hazard Area to provide a geospatial limit to the ABFEs, as well as an updated representation of the 1% annual chance coastal flood hazard area
3. Advisory Zone V-A Boundary to approximate the landward limit of the 3-foot breaking wave
4. Advisory Limit of Moderate Wave Action (LiMWA) to approximate the landward limit of the 1.5-foot breaking wave
5. Advisory Area of Moderate Wave Action (MOWA) to approximate the extent of breaking waves less than 3 ft and greater than 1.5-foot in height
6. Advisory Limit of ABFEs to define the transition of the coastal advisory data to the

effective FIRM at riverine confluences

The advisory map products that were developed are:

1. Display of the advisory geospatial information on FEMA's GeoPortal
2. PDF mapping of the advisory flood hazard information

1.2 SCOPE OF WORK

RAMPP was contracted to develop advisory products for the following jurisdictions:

- State of New York: Kings (Brooklyn), Richmond (Staten Island), Queens, Bronx, New York (Manhattan), Westchester, Nassau, and Suffolk Counties
- State of New Jersey: Atlantic, Bergen. Burlington, Cape May (Atlantic Ocean side), Essex, Hudson, Monmouth, Middlesex, Ocean, and Union Counties

SECTION TWO DATA ACQUISITION

Table 1 summarizes the data collected and their origination.

Table 1: Data Sources / Notes

Data	Source / Notes
Stillwater Elevations	Preliminary coastal FEMA FIS Update for New York City and New Jersey, 2012.
Bathymetry Data	National Oceanic and Atmospheric Administration (NOAA) National Geophysical Data Center, NOAA Office of Coast Survey, U.S. Army Corps of Engineers New York and Philadelphia Districts, New York State GIS Clearinghouse, and the New Jersey Department of Environmental Conservation. Details of terrain processing can be found in the report prepared by RAMPP titled "Region II Coastal Terrain Processing Methodology Documentation Report," dated December 2011.
Shoreline Data	Shoreline data used in this study was developed digitally as part of the FEMA Region II Coastal Study Task Order.
Topography Data	**New York:** Topographic information developed by the Research Foundation of the City University of New York as part of the Light Detection and Ranging (LiDAR) Campaign (New York, NY) in 2010 was used in this study. **New Jersey:** the following topographic data was used for New Jersey counties: • Bergen, Hudson, Essex, Union, Middlesex, and Upper Monmouth: LiDAR, December 2006 to February 2007 • Lower Monmouth, Ocean and Atlantic: LiDAR, April, 2010 • Burlington: 5' contour, April 2005 and 2011 LiDAR • Cape May, Cumberland, and Salem Counties: LiDAR, April 2008
Effective FIRM Data	Effective data for the study area was obtained from published DFIRM databases and the National Flood Hazard Layer (NFHL).
Base Map	Bing Road map layer was used as the source of base mapping by permission of Microsoft.
CBRA Data	The Coastal Barrier Resources Act (CBRA) established the John H. Chafee Coastal Barrier Resources System (CBRS), a defined set of

Data	Source / Notes
	geographic units along the Atlantic, Gulf of Mexico, Great Lakes, U.S. Virgin Islands, and Puerto Rico coasts. Most new Federal expenditures and financial assistance (including flood insurance) are prohibited within the CBRS, with some exceptions. The U.S. Fish and Wildlife Service is responsible for administering CBRA. CBRS boundaries shown on FEMA mapping products are for informational purposes only. For the best available CBRS boundary data, visit: http://www.fws.gov/cbra/Maps/Mapper.html. For additional information on the CBRA and the CBRS, visit: http://www.fws.gov/cbra.

SECTION THREE METHODOLOGY

3.1 ADVISORY BASE FLOOD ELEVATION COASTAL ANALYSIS & MAPPING (ALL COUNTIES EXCEPT NASSAU AND SUFFOLK)

The ABFEs developed for the geospatial and map products provide full representation of the surge and wave components of the coastal flood hazard. The foundation of the advisory elevations was the draft preliminary coastal storm surge stillwater elevations (SWEL) from the NY/NJ FIS updates. This includes the entire Atlantic coast of New Jersey, New York City, the Hudson Estuary to the Troy Dam, and Westchester County, New York. This does not include Nassau County, east of Jamaica Bay, or Suffolk County, NY. The draft preliminary SWELs lack overland wave effects, a key component of the Base Flood Elevations (BFEs) presented on effective FIRMs. Unfortunately, the ongoing NY/NJ coastal FIS updates had not fully progressed to the stage that such data could be leveraged to support the advisory products. As such, the overland wave effects were estimated using depth limited wave calculations rather than Wave Height Analysis for Flood Insurance Studies (WHAFIS) in most locations.

This shortfall was overcome by applying depth-limited wave theory to estimate the wave effects concomitant with the 1% and 0.2% annual chance coastal SFHAs. Application of the depth-limited wave equation to the draft preliminary surge data provided a proxy for estimating overland wave effects and the resultant BFE. This approach was used in the Hurricane Katrina recovery maps for Mississippi, and has been successfully applied in many other areas of coastal engineering practice.

The depth-limited approach is more conservative than the in-progress detailed overland wave modeling results. As opposed to the WHAFIS model, the approach relies solely on depth-limiting relationships for wave breaking and does not consider wave attenuation by obstructions. The overland wave height elevations, in lieu of WHAFIS modeling, were estimated by multiplying the SWEL by a factor of 0.55. This value represents a simplification of:

- Estimation of the controlling or breaking wave height (H_c) by depth (d) via the empirical factor 0.78: $H_c = 0.78 * d$; and
- Adjustment of the wave height to represent approximately 70% of the wave being above stillwater: $0.7 * H_c$.

The advisory elevation is then calculated by adding the estimated wave elevations on top of the corresponding SWEL (1% or 0.2% annual chance). For example, the ABFE for the 1% annual chance SWEL would be estimated using the following formula:

Advisory elevation = 1% SWEL + (d * 0.55)

The approach is implemented through the following steps:

1. Creation of flood depth grids for the 1% and 0.2% annual chance SWEL;
2. Calculation of the depth-limited wave envelope;
3. Calculation of the ABFE surface layer based on the identified formula, applied in the geospatial environment and resulting in a continuous raster elevation model for each sub-geography; and

4. Smoothing of the resultant surface to promote less detailed linework.

Advisory VE Zone Determination:

The coastal high hazard zone, or advisory VE Zone, was established by a combination of the depth-limited method, supplemented by effective VE zone mapping and draft preliminary primary frontal dune (PFD) delineation (as available). The production process consisted of the following:

1. Extraction of the depth contour corresponding to the limiting depth of the 3-foot wave (which occurs at the 3.85-foot stillwater depth contour);
2. Creation of a depth-limited advisory VE Zone polygon;
3. Merging of the depth-limited advisory VE Zone polygon with the effective VE Zone mapping or draft preliminary PFD delineations; and
4. Selection of the landward-most location of the three layers to provide the most conservative estimate of the advisory VE Zone boundary.

Limit of Moderate Wave Action Determination:

The advisory LiMWA was established by the depth-limited method. The production process consisted of the following:

1. Extraction of the depth contour corresponding to the limiting depth of the 1.5-foot wave (1.92 feet);
2. Creation of a depth-limited advisory Coastal A Zone polygon;

The approach was implemented in ModelBuilder within the ArcGIS 10.0 environment to produce both the 1% and 0.2% advisory elevation surface elevation models, which were then used to generate the advisory mapping layers. The mapping layer production process consisted of the following:

1. Extraction of the 0.5-foot contours (consistent with BFE zone elevation breaks for FIRM mapping) for the range of elevations in the advisory elevation surface raster;
2. Creation of polygons from the extracted contours;
3. Editing of the 1% and 0.2% floodplain polygons to remove small polygons generally less than 160,000 square feet, or narrow pieces of the floodplain generally less than 400 feet in width;
4. Editing of the 1% and 0.2% floodplain areas to remove areas in close proximity to the shoreline or in areas subject to significant erosion;
5. Clipping of the advisory elevation polygons to the edited advisory 1% floodplain;
6. Spatial calculation of the appropriate advisory elevation value by polygonal area from the advisory elevation surface elevation model;
7. Automated removal of undesired small advisory elevation polygons;

8. Manual merging of advisory elevation zones at the edges of land areas and within the advisory floodplain as needed to reduce product complexity while providing appropriate representation of hazards;
9. Intersection of the advisory elevation polygon to identify advisory Zone V and editing of the advisory Zone V/A boundary;
10. Simplification of the vector line work for the advisory LiMWA; and
11. Final simplification of advisory elevation Zone line work.

Accuracy of Advisory Elevations as Compared to Detailed Modeling:

In support of this effort, an evaluation was performed of the proposed depth-limited approach against WHAFIS modeling within the study area. It was found that advisory elevations produced via the proposed method are predominantly equal to or higher than the elevations derived from WHAFIS modeling with few exceptions (90% of points evaluated). Where advisory elevations were lower than WHAFIS-derived BFEs (10% occurrence in sampled area), 95% of the locations were on the beach face, which is subject to erosion in the coastal modeling process. The remaining 5% were within the coastal floodplain and appeared adjacent to an advisory elevation higher than the WHAFIS BFE output. This initial comparison compared point-specific locations and did not factor in merging of the ABFE polygonal areas.

Representation of Erosion:

Due to the time constraints on this product, erosion analysis was not included in the ABFE analysis.

Assessment of Wave Runup:

Runup modeling is complex and very dependent on localized runup slopes. Based on a review of current modeling efforts in New York City, it was not possible to do a detailed analysis of runup for every slope. However, a basic review of the near shore slopes was evaluated for the entire study area by looking at the contour change within a distance from the start of the shoreline. If the slope was steep enough, a buffer approximately 40-60 feet landward of the slope crest to the advisory VE zone was added (to extend the advisory VE zone further inland).

In areas identified as Runup dominated, where the ground elevation rises above the surge SWEL, the VE advisory elevation is the slope crest elevation plus 3 feet to account for larger runup elevations and overtopping areas. Where bluff crests were significantly high, such as 60 to100 feet, runup was not accounted for and the advisory elevations were based on the surge SWELs and the depth limited wave heights, as described above. In areas where steep slopes existed near the shoreline and limited fetches existed where wave energy would be diminished, wave runup elevations were limited to 1-2 feet above the depth limited wave crest elevation and mapped as A Zones.

Figure 1 shows the Advisory Polygon Production Process developed by RAMPP for this study.

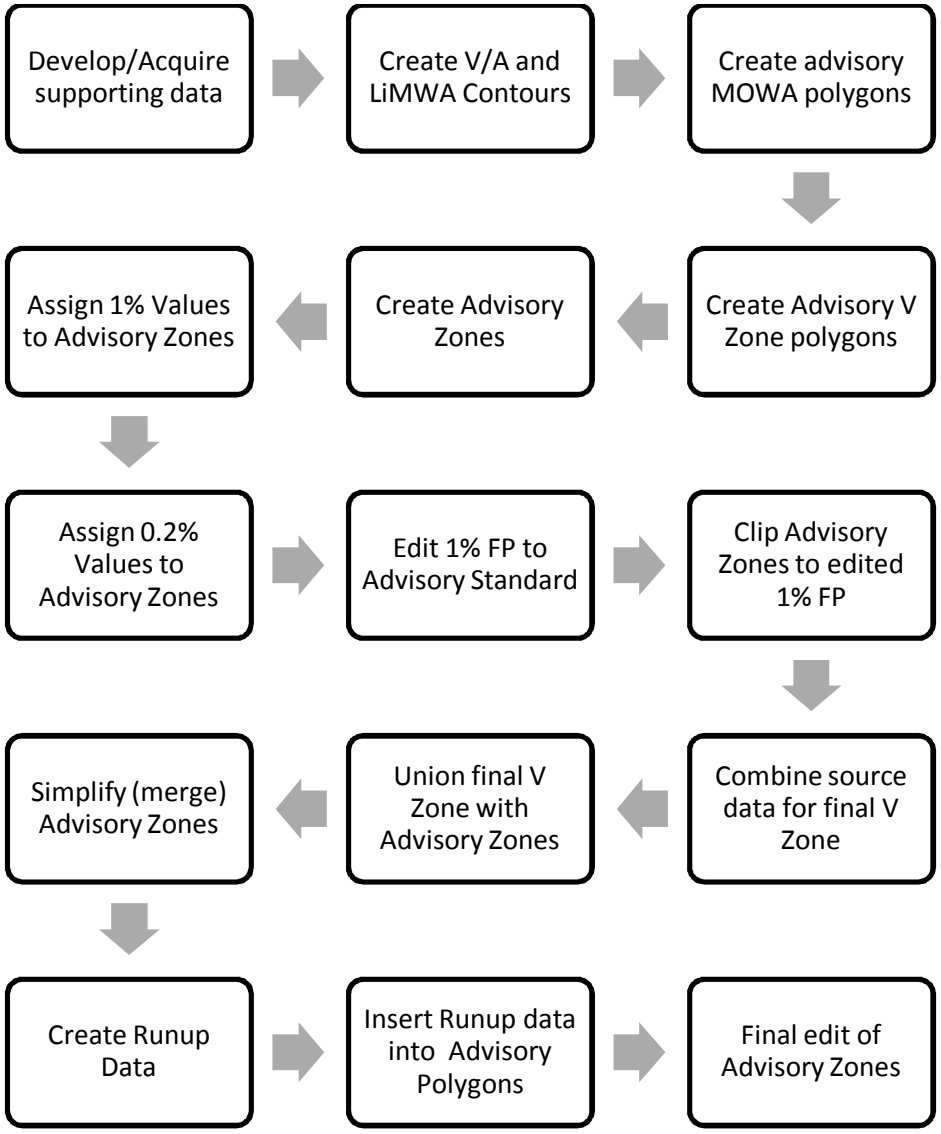


Figure 1: Advisory Polygon Production Process

Special Considerations for the Advisory Elevation Product

To achieve FEMA's specification of developing cartographically simple products that promote ease of use, the following processes were implemented:

- Merging of smaller ABFE zones into larger, adjacent ABFE zones to keep linework and variation of ABFE values to a minimum;

- Merging of adjacent ABFE zones to reduce the number of mapped zones in the final product. The procedure merged ABFE zones into more dominant and consistent value ABFE zones, where justified;
- Merging of narrow ABFE zones at the land/water interface to reduce the number of mapped zones in the final product. The procedure merged these zones into the best representative value, often adopting the zone elevation that exists at the shoreline, in a similar but expanded practice that is typically undertaken in coastal DFIRM mapping;
- Removal of 0.2% floodplain areas and X Zones to promote cartographic simplicity. In general, areas less than 160,000 square feet were targeted for removal; actual removal decision making varied by location and site-specific factors;
- Removal of 0.2% floodplain areas and X Zones in close vicinity to the shoreline and/or in areas subject to significant erosion;
- Areas identified as fetch-limited and not subject to significant wave action will have the ABFE values reduced to the appropriate SWEL (wave effects removed). These areas typically had fetch lengths less than ½ mile and did not have WHAFIS-modeling transect coverage in the preliminary FIS update. The 2D wave modeling results from the preliminary FIS study described below was also used to inform where wave heights would not contribute to the ABFE;
- In some areas the depth limited wave calculation produced V Zones and/or MOWA areas that extended far inland, behind elevated roads, or depressions in the terrain. These areas were mapped as A Zones.

Use of Preliminary Flood Insurance Study Data

Data from the ongoing FIS updates in New York City and New Jersey were used to assist in decision making and as supplemental data in the ABFE production process. The following summarizes the use of these data:

- SWEL surfaces were used as the foundation of the ABFE calculation.
- WHAFIS modeling transect layouts were used to identify areas that should have overland wave effects. Areas without transects were typically reduced to the SWEL and wave effects were removed from the ABFE value.
- Starting wave height values close to shoreline from the FIS surge modeling effort were used to assist in the decision-making process for limiting Zone V and MOWA extents along shorelines. These wave heights were output from the 2D Simulating Waves Nearshore (SWAN) Model and are used in the FIS study to input into WHAFIS for each transect as starting wave conditions.
- The preliminary PFD line was used as an input into the advisory Zone V. Where the advisory Zone V was seaward of the PFD line, the zone was extended to the PFD line location.
- In some areas draft wave runup calculations from the FIS study were available to help inform the reasonableness of the advisory runup elevations being mapped.

Details of the various steps in the analysis and production process are included in Appendix A of this report.

3.2 UPDATE TO NEW YORK CITY ADVISORY BASE FLOOD ELEVATION COASTAL ANALYSIS & MAPPING

Upon further review the draft New York City advisory information was updated using recently completed coastal modeling information. The New York City update to the advisory information was a collaborative effort between New York City, New York City's consultants, FEMA, and FEMA's consultants. The revisions were for areas not directly exposed to the Atlantic Ocean and that have limited width water bodies fronting the shoreline. These revisions were made possible due to the recent completion of the draft coastal modeling for New York City. This modeling is being developed for the Flood Insurance Study FIRM product due out later in the year. Differences between the original advisory information and the results of the coastal modeling in these areas justified updates to the advisory information. The detailed and refined coastal modeling provides for a more complete assessment of the physical processes that result in the coastal flood hazards. The same base storm surge stillwater elevations that were used for the original advisory information were used for the more detailed coastal modeling, hence no updates were made to the advisory floodplain boundaries. Detailed overland wave analysis using refined wave conditions and an assessment of land use conditions that would reduce wave heights were used. In addition detailed wave runup analyses were made on structures and steep shorelines. Zone designations and ABFEs were revised based on this new data. The resulting advisory mapping in these areas are similar to what will be produced for the FIS.

3.3 ADVISORY GUIDANCE – NASSAU AND SUFFOLK

RAMPP developed a stand alone technical memorandum on advisory guidance for Nassau and Suffolk Counties, NY. This memorandum can be found in Appendix B.

3.4 QUALITY ASSURANCE AND QUALITY CONTROL

All the products developed in this study were developed using FEMA recommended RAMPP standard Quality Assurance/Quality Control (QA/QC) procedures. RAMPP implemented a QA/QC plan consistent with the RAMPP Quality Management Plan.

Process documents were developed, refined, and used in product development to ensure consistency in procedures for quality assurance. Quality review checklists were developed and used to ensure that products were reviewed completely and consistently. The reviews, including intermediate product reviews, were strategically integrated into the process to maximize efficiency, ensure accuracy, and minimize rework. The QA/QC products involved the following:

- **Coastal Analysis and ABFE:**
  - Detailed Checks done by production team
  - Independent Technical Review done by RAMPP Joint Venture partner firm
  - Review by FEMA Coastal Subject Matter Expert (SME)

- **PDFs and Changes Since Last FIRM (CSLF) Products:**
  - Detailed Checks done by production team
  - Independent Technical Review done by JV partner firm

SECTION FOUR SUMMARY OF FINDINGS

Advisory Base Flood Elevations

Table 2: ABFE Summary

State	County	1% annual chance ABFE Minimum (ft, NAVD88)	1% annual chance ABFE Maximum (ft, NAVD 88)
New York	New York City (5 Boroughs)	8	27
	Westchester	9	31
New Jersey	Atlantic	8	19
	Bergen	8	18
	Burlington	10	14
	Cape May	8	18
	Essex	10	14
	Hudson	8	23
	Middlesex	12	27
	Monmouth	7	20
	Ocean	7	15
	Union	11	17

SECTION FIVE REFERENCES

RAMPP, Advisory Elevation Data for New Jersey and New York Counties, December 2012.

Delaware Valley Regional Planning Commission, Burlington County 5' contour data, April 2005

FEMA, Flood Insurance Study and FIRM Database for Bergen County, NJ, September 2005

FEMA, Flood Insurance Study and FIRM Database for Essex County, NJ, June 2007

FEMA, Flood Insurance Study and FIRM Database for Union County, NJ, September 2006

FEMA, Flood Insurance Study and FIRM Database for Hudson County, August 2006

FEMA, Flood Insurance Study and FIRM Database for Middlesex County, NJ July 2006

FEMA, Flood Insurance Study and FIRM Database for New York City Counties, NY, September 2007

FEMA, Flood Insurance Study and FIRM Database for Monmouth County, NJ, September 2009

FEMA, Flood Insurance Study and FIRM Database for Westchester County, NY, September 2007

FEMA, Flood Insurance Study and FIRM Database for Ocean County, NJ, September 2006

Lower Monmouth, Ocean and Atlantic Counties LiDAR, April 2010

RAMPP, Region II Coastal Terrain Processing Methodology Documentation Report DRAFT, December 2011

RAMPP, Preliminary Coastal FEMA Flood Insurance Study Update for New York City and New Jersey, 2012.

RAMPP, LiDAR data for Burlington County, NJ, under FY 10 Elevation Task Order, June 2011.

Research Foundation of the City University of New York, LiDAR Campaign (New York, NY), May 2010

USGS, Rapid Deployment Gauges and High Water Marks (provisional data dated 11/27/2012, current data at http://water.usgs.gov/floods/events/2012/sandy/)

USGS and NJDEP, Cape May, Cumberland, and Salem Counties LiDAR, April 2008 and March 2009

USNGA, Bergen, Hudson, Essex, Union, Middlesex, and Upper Monmouth Counties LiDAR, December 2006 to February 2007

Appendix A
COASTAL ANALYSIS METHODOLOGY AND PRODUCTION PROCESS

Production Process Steps

1. Development / acquisition of Supporting Data
   The following data elements were required to proceed through production of ABFE polygons:
   - Digital Elevation Model (DEM)
   - 1% and 0.2% annual chance SWEL rasters
   - Effective VE Zone polygons
   - Draft Preliminary PFD delineation
   - Vector shoreline

2. Creation of Zone V/A and MOWA Contours:
   The process of creating the Zone V/A boundary and LiMWA was automated within ArcGIS 10 ModelBuilder. The tool process generated a depth grid which was smoothed to promote cartographic simplicity. The appropriate contours were then extracted from the depth grid and short segments of contour line were removed to eliminate small areas from the final product.

   Inputs:

   - DEM
   - 100-yr SWEL surface
   - Minimum Length - minimum length of contour line that can be included in output (Default = 2,000 feet)

   Outputs:

   - Smoothed LiMWA Gutter
   - Smoothed Zone V/A Gutter
   - 100-year Depth Grid

3. Creation of Advisory MOWA, Zone V polygons:

   Two tools were created in ArcGIS 10 ModelBuilder to automate the following tasks:
   - Tool 1 – addition of bounding linework to facilitate polygon creation.
   - Tool 2 – calculation of values in each polygon to provide an initial selection of polygons that should be included in the MOWA and Zone V output.

   Inputs:

   - 100-year Depth Grid,
   - LiMWA or Zone V/A Gutter, depending on tool

Output:

- Polygons created through the process
- MOWA of VE Zones: Polygons representing Zone V or area of MOWA.

Process Notes:

- Output was checked against line work input into the tool and for large zones that did not become polygons;
- Where polygons did not generate, unsnapped or non-intersecting ends of line work were corrected and ends were extended to ensure polygon creation;
- Tool was rerun to generate polygons subsequent to corrections when/if the initial run failed to create all areas;
- Output polygons were reviewed to ensure all features represented the Zone V or MOWA; and
- Resultant polygons were edited to remove all "island" polygons except those that covered significant land areas and are justified by lack of land cover and/or other justifying factors.

4. Creation of Advisory Zones:

The ABFE polygon generation process was automated within ArcGIS 10 ModelBuilder. A tool was created to generate the 1% and 0.2% annual chance ABFE surfaces applying depth-limited wave theory. The tool then generalized the surface and extracted and smoothed contours lines to create the ABFE polygon coverage.

Inputs:

- DEM
- 1% SWEL raster
- 0.2% SWEL raster
- Minimum Length: minimum length of contour line that can be included in output (Default = 2,000 feet).

Outputs:

- Advisory Polygons: Polygons for all the advisory zones, pre-populated with fields for following steps.
- Advisory Contours: Contours, or gutters at half-foot elevations for the above polygons. This layer was intended to be used as a quality check against the output polygons
- Smoothed 1% Advisory Elevation Surface: Surface elevation model of 1% Advisory Elevations
- Smoothed 0.2% Advisory Elevation Surface: Surface elevation model of 0.2% Advisory Elevations

Process Notes:

- The advisory contours were used as a quality-control measure to ensure all polygons were generated.
- Where polygons were not created, unsnapped or non-intersecting ends of line work were checked and ends were extended to intersect as needed to create polygons.
- "Fix Polygons" tool with the line input file was rerun iteratively once any necessary corrections were made to the linework.

5. Assignment of 1% annual chance SWEL to Advisory Zones

This task was performed to assign advisory elevations to the established polygons using the following steps:

a. "Zonal Statistics as Table" was Run

Inputs:

- Input raster or feature zone data: ABFE Polygons
- Zone field: IDs
- Input value raster: 1% annual chance ABFE Surface Raster
- Output Table: name as desired
- Statistics Type: Mean

b. Output table was joined to the ABFE polygons
c. The mean value field was rounded to the nearest whole integer and populated into the appropriate field.
d. Joins were removed.
e. NULL ABFE polygons, which would occur on the edges of the coverage, were removed.
f. Sliver ABFE polygons were eliminated.

6. Assignment of 0.2% annual chance SWEL to Advisory Zones

This task was performed to assign advisory elevations to the established polygons using the following steps:

a. "Zonal Statistics as Table" was run

Inputs:

- Input raster or feature zone data: ABFE Polygons
- Zone field: IDs
- Input value raster: 500-year ABFE Surface Raster
- Output Table: name as desired
- Statistics Type: Mean

b. Output table was joined to the ABFE polygons.
c. The mean value field was rounded to the nearest whole integer and populated into the appropriate field.
d. Joins were removed.

7. Editing the 1% annual chance SFHA to Advisory Standard.

This step was intended to remove Zone X from areas that require advisory guidance.

Minimum Inclusion Area:
The advisory map panels were produced at a scale of 1:1000 feet. At this scale, and in consideration of the desire to have a cartographically simple product, the minimum distance for linework spacing was set at 400 feet. This standard allowed for a sufficient amount of space between linework to promote identification of underlying and adjacent features.

The square of the minimum linework spacing provided for a minimum area of 160,000 square feet. Polygons less than 160,000 square feet were typically removed from the advisory coverage.

Areas Inundated by Sandy:
Areas inundated during Sandy should not be shown as Zone X, unless extenuating circumstances occur. The analysis utilized the "Preliminary Field Verified 10-meter Storm Surge Extent," a Hurricane Sandy inundation extent developed by the FEMA Modeling Task Force (MOTF), to screen Zone X areas from the advisory product. Guidance was to remove and/or edit Zone X areas where Hurricane Sandy inundation coverage showed that areas were inundated during Hurricane Sandy. This applied only to isolated Zone Xs (areas surrounded by inundation). The landward extent of Zone X was not edited for advisory purposes.

General Rules for Exclusion: The following are some rules of exclusion followed in the mapping process.

Narrow X or 0.2% zones above area criteria If less than 400 feet apart, areas were generally removed.	
Zone X areas above the minimum area cut, but below the width criterion were generally removed. Width for this example is approximately 200 feet.	

Erodable dune features were removed	
Features subject to failure during the 1% event or noted as failing during Hurricane Sandy were removed. Example shows a boardwalk.	
Zone X areas at or near the apparent tipping point of inundation (above flood elevation). Subject to analyst judgment, but typically evidenced by street-level flooding and side intrusion of boundary at isolated Zone Xs. These areas should be verified by querying the topographic DEM against the SWEL surface.	

Zone X areas above the minimum area criterion that do not fully enclose any structures.	

8. Clipping Advisory Zones to edited 1% annual chance SFHAs.

   On completion of the editing to the 1% annual chance SFHA polygon, the ABFE polygons were clipped to the edited SFHA polygon.

9. Combining source data for the advisory Zone V.

   This step was performed to combine all best available data on the Zone V footprint to establish the most landward extent for the advisory maps.

   a. Effective Flood Hazard Area Polygons. The effective Zone VE area was selected and exported to a separate shapefile.
   b. Combination of the Effective VE and depth-limited Zone V Polygons. The effective Zone VE area was merged into the depth-limited Zone V polygon.
   c. Integration of the preliminary study Primary Frontal Dune line. For FIS studies, the Zone V is extended to the PFD line during the mapping process. To ensure that the advisory Zone V would not be seaward of the revised FIS PFD, the combined Zone V polygon was compared against the preliminary FIS PFD delineation line. The combined Zone V polygon was then edited to ensure that it extended to the preliminary PFD line. Engineering judgment was applied to transition the combined polygon to and away from the PFD linework as necessary. Completion of this step provides for the draft advisory Zone V polygon.
   d. Review edited Zone V. The advisory Zone V polygon was reviewed for harsh transitions or undesirable geometry resulting from the merging with the effective Zone VE. Editing was performed as necessary to improve the cartographic representation of the boundary. The edited polygon was reviewed for disconnected Zone V "islands," or areas that theoretically represent interior areas of wave height

regeneration. Typically, island Zone V areas were removed unless engineering judgment indicated that the area should be retained.

e. Check Against Wave Height Outputs from Surge Model: A secondary check on the validity of the Zone V designation was conducted on a as-needed basis when the area extended into sheltered areas or continued for a considerable distance away from open water. In such cases, wave height data from the SWAN model were evaluated to confirm wave elevations. In cases where the SWAN data did not confirm the Zone V designation, the polygon was edited to provide a more accurate representation based on the available data.

f. Removal of Limited Fetch Areas: The advisory Zone V was reviewed for narrow areas of Zone V propagation, such as narrow channels. These areas were removed from the advisory Zone V.

10. Combining final Zone V with Advisory Zones

This step was performed to merge Zone V polygons into the Advisory Zone polygons to designate the Zone V.

a. Integrate Zone V into Advisory Polygons. The final advisory Zone V polygon was unioned into the ABFE polygons. The resulting coverage was exploded and sliver polygons introduced into the ABFE coverage from the union were eliminated.

11. Simplifying (merging) Advisory Zones

This step was performed to merge polygons to create relatively simpler and larger areas of Advisory Elevation.

Guidance: Polygons were merged to create a simplified representation of advisory zones. Stillwater values, WHAFIS transect layouts for the study updates, and aerial photography were used to facilitate decision making.

- Advisory Coverage was checked against the WHAFIS modeling transect layout. Advisory areas that will not have WHAFIS modeling were mapped to the local stillwater elevation.
- Smaller polygons were merged into larger polygons to simplify linework.
- Areas were typically merged to the higher elevation; however, zones were merged within a ±1-foot range subject to analyst judgment to obtain the best representative value for the area.
- Higher elevations were merged to lower elevations when the lower elevations were more representative, for example:
    - small zones of higher elevation surrounded by lower elevation; and

    - zones of higher elevation that overlay land cover that would not allow significant wave propagation as compared to adjacent areas with lower advisory elevations (dense buildings, vegetation).
- Bounding polygons (at shoreline) were merged to a representative value. The ±1-foot range was not applied in these areas. An analyst judgment process similar to merging zones for coastal FIS mapping was applied in these areas.
- Special attention was given while merging polygons seaward of Zone V to develop the most representative value. Advisory Elevations were brought in from the seaward side of the dune to the PFD in a practice similar to FEMA coastal mapping.

12. Creation of Runup Data

The steps for runup evaluation included the following:

1. Determination of nearshore runup slope crest;
2. Determine where the 1% SWEL floodplain does not extend inland past the crest;
3. Setting the advisory elevation in these areas to be 3 feet above the crest (some averaging out of elevations along the coast would be made in order to avoid multiple changing zones along the shore); and
4. Extending the advisory floodplain 50 feet landward of crest.

The above methodology is fast and efficient, does not require modeling judgments, is a consistent method across all areas, is easy to explain, and captures any structures that may have been damaged by runup and overtopping by Sandy. It is also consistent to what would be mapped as maximum runup in an effective FIS (3 feet above crest)

A drawback is the possible mapping of runup elevations that greatly exceed what would be mapped in an FIS when the runup model or calculation does not reach the crest. However, no structures should be located seaward of the runup crest, hence mapping the higher elevation will have no impact. Landward of the crest, the approach will lead to conservative results. However, if a landward structure was not damaged by Sandy, the higher runup elevation would not affect rebuilding efforts, except to relay the risk posed by future storm events greater than Sandy. There may also be unrealistic elevations, such as an extreme runup slope crest (100 feet or more), but these can be determined and avoided by analyst judgment when mapping.

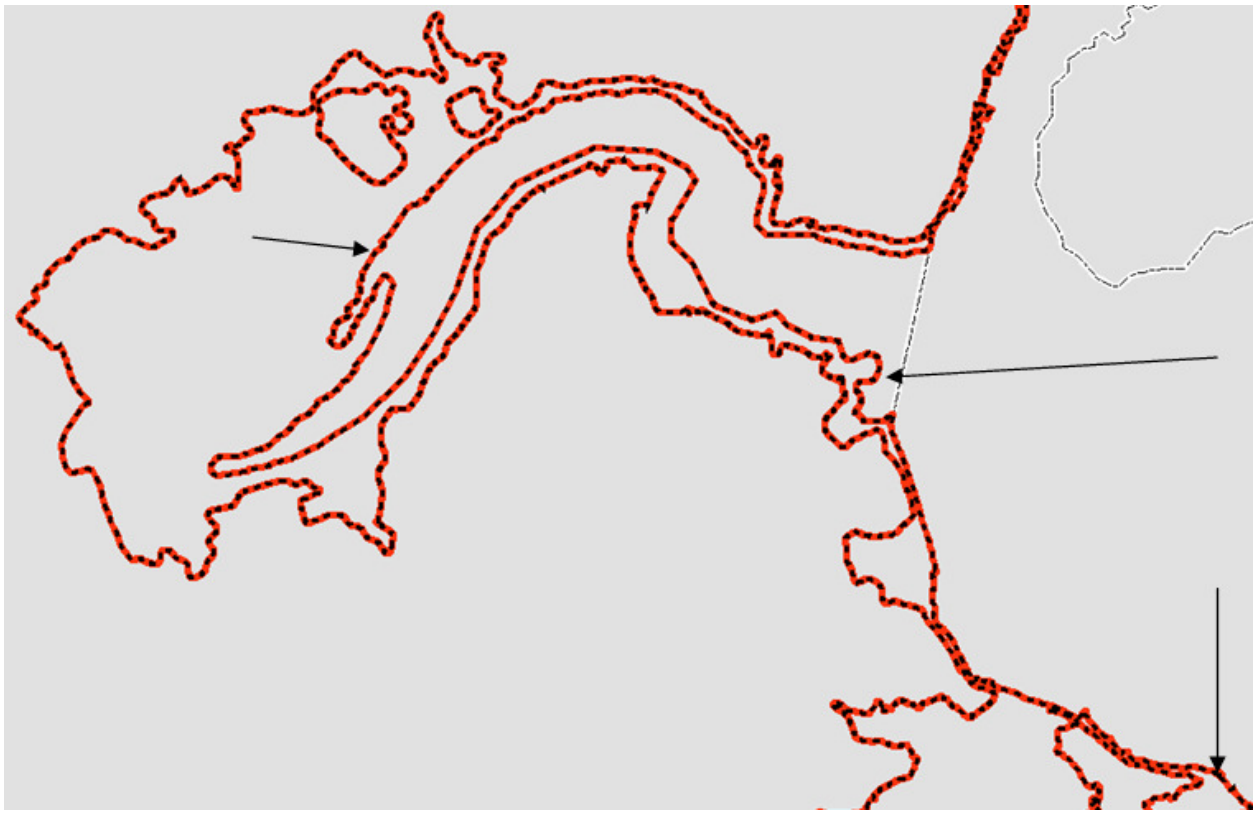
Data Finalization

1. All comments from Detailed Checks and Independent Technical Reviews were resolved

2. Final Edits of MOWA
    a. ABFE polygons were dissolved by Zone, then limited to Zone V.
    b. The spatial extent of the advisory Zone V polygon was erased from the MOWA polygon.

c. Any resultant sliver polygons, or remnant areas seaward of the Zone V polygon, were identified and removed.

3. Polyline Features were generated for Map Production:
   a. Zone V/A Boundary:
      i. The advisory Zone V polygon was converted to polyline
      ii. Resultant linework was edited to leave only the line between the V and A Zones (bounding linework, i.e., linework at the county boundary and open water boundary of the ABFE polygons was removed)



Example of linework at the open water boundary of the VE polygon that was removed to fully prepare the Zone V/A Boundary Line

   b. LiMWA
      i. The MOWA polygon was converted to polyline.
      ii. The Zone V polygon was used in an erase operation against the resultant line feature to remove linework coincident with the Zone V/A boundary.
      iii. Resultant linework was edited to leave only the line at the landward edge of the LiMWA (removing remaining bounding linework – i.e., county boundary).

   c. 1% Floodplain Boundary Line
      i. The ABFE polygons were dissolved then converted to polyline.
      ii. Resultant linework was edited to leave only the SFHA boundary (bounding linework, such as lines along the county boundaries and the open water edge of the ABFEs, were removed).

4. Shaded Zone X polygon creation for areas between 1% and 0.2% flood hazard area boundaries and merge into advisory zones
   a. 0.2% annual chance floodplains were clipped to the county boundaries.
   b. The spatial extent of the ABFE coverage, clipped to the 1% floodplain, was erased from the edited 0.2% floodplain.
   c. Narrow areas below the advisory cartographic specification were typically removed.

5. All data was reprojected into WGS_1984_Web_Mercator_Auxiliary_Sphere

6. County file geodatabase (FGDB) was prepared to receive data
   a. FGDB template was copied into county folder
   b. "_CountyTemplate" portion of the FGBD was renamed with studied county name, ie, "_EssexNJ" for Essex County, New Jersey.
   c. Layers that have a "Adv_XX_" nomenclature
      i. "XX" portion of layer was renamed with the first two letters of the county name (all upper case), i.e., "XX" portion of Essex NJ layer will be renamed as "ES"

7. Data were loaded into the County Level FGDB with Advisory Schema

8. County and State Attributes were added to all Layers

9. FGDB was provided to data manager and PM was notified.

10. Preparing Shapefiles for Geospatial Deliverable
    a. FGDB Feature Classes exported to shapefile:

Appendix B

NASSAU SUFFOLK ADVISORY GUIDANCE MEMORANDUM

A JV of Dewberry, URS, and ESP
RAMPP
Risk Assessment, Mapping, and Planning Partners

Memorandum

Date:	*January 24, 2013*
To:	*Rick Sacbibit*
From:	*Jeff Gangai*
Cc:	*Mike McGinn, Luis Rodriguez, Todd Steiner, Jonathan Westcott* *Jean Huang, Vikram Shrivastava*
Subject:	*Advisory Information for Nassau and Suffolk Counties, NY*

BACKGROUND

Given the level of reconstruction anticipated along the Atlantic coast of New Jersey and New York, FEMA would like to provide the best available data for reconstruction purposes in the form of Advisory Base Flood Elevations (ABFEs) for those communities most impacted. This data must be available as quickly as possible to best inform those reconstruction efforts.

For New Jersey and New York City, FEMA has undertaken a full scale restudy of the coastal flood hazards with the development of regulatory products which are anticipated to be delivered in mid 2013. This new coastal study data was utilized to support the advisory guidance and mapping.

For Nassau and Suffolk Counties, NY, (see Figure 1) a recent surge and coastal analysis was completed a few years ago with the FISs and FIRMs becoming effective in 2009. The initial review of available Hurricane Sandy tide gage data indicated that for some areas, the event was likely greater than a 1-percent annual chance event based on a comparison to stillwater levels taken from the 2009 FIS. No new coastal analysis and mapping projects are underway for this area; however, it is recommended that advisory elevations be provided for people wanting to rebuild stronger. The current Region II storm surge model does not provide sufficient detail to allow for a depth grid analysis as was done for New York City and the New Jersey Atlantic coast. Therefore, RAMPP conducted post-disaster flood hazard verification analyses to develop freeboard recommendations to be applied to the effective flood hazard information to use as advisory information. This analysis composed of comparing the elevations and flood extent that Hurricane Sandy achieved versus the 2009 effective information. The area of Nassau County affected by flooding from Jamaica Bay was also evaluated against the updated coastal surge analysis for New York City which includes Jamaica Bay.

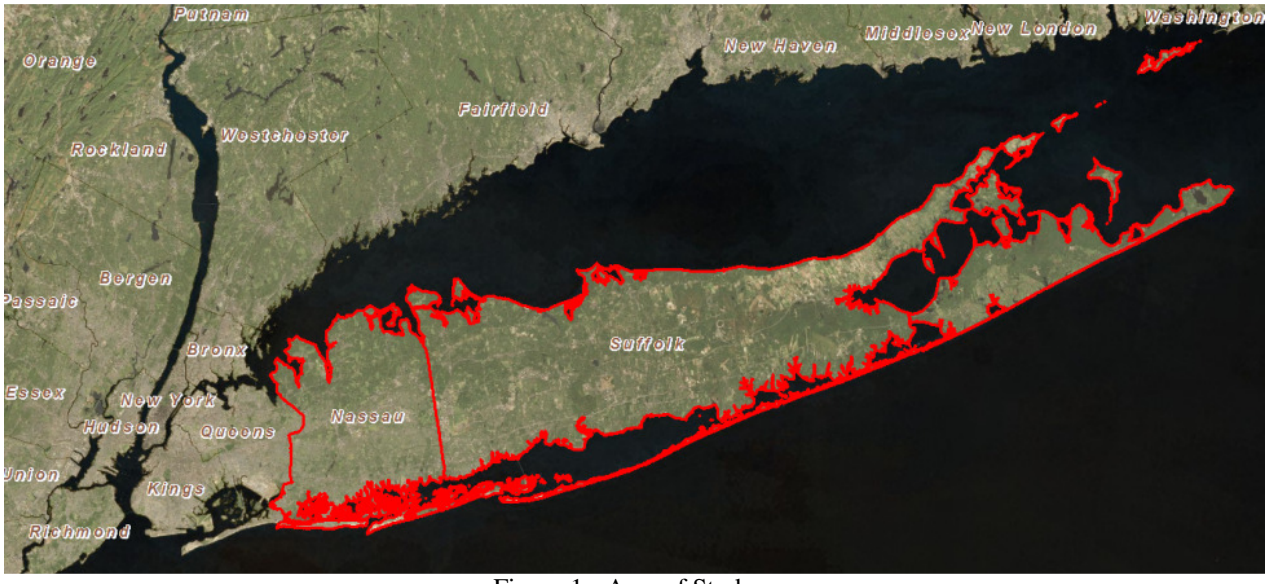


Figure 1 - Area of Study

DATA COLLECTION

The two main data sources that were used in this assessment were the effective flood mapping for Nassau and Suffolk Counties along with Sandy observed flooding extents and elevations.

For the effective information the DFIRM databases for each county were obtained and the flood hazard area polygons extracted.

The Sandy flooding extent and corresponding elevations were obtained from the FEMA Modeling Task Force (MOTF) Hurricane Sandy Impact Analysis efforts. A high resolution inundation polygon was obtained that showed the flooding extent of Sandy. Also, a raster was obtained that contained the Sandy flood elevation information that was used to produce the flooding extent boundary. These products were based on the High Water Marks (HWMs) and gage data collected by the USGS. This means that the data has the same limitations as HWMs, such as whether they represent true surge or include wave heights or wave runup. These limitations of the HWM were considered in evaluating the impacts to Nassau and Suffolk County.

ANALYSIS METHOD

As an initial assessment of the differences between Sandy inundation limits versus the effective 1-percent annual chance boundary, the two boundary limits were reviewed geospatially to see if an overall single trend could be seen. From this, it could be seen that the Sandy inundation limit is landward of the effective 1-percent boundary and greater than or very close to the 0.2-percent boundary for almost all of Nassau County's south shore but landward of only about half of Suffolk County 1-percent boundary on the County's south shore.

On the east end of Long Island, where Sandy had a lesser impact, the effective 1-percent flood extent is only slightly greater than Sandy. However, the Sandy surge levels were very close to the effective 1-percent annual chance stillwater levels but below the 0.2-percent annual chance levels.

For the north shores of both Nassau and Suffolk, the effective mapping is dominated by wave runup elevations. Due to the predominantly bluff shorelines there were limited Sandy HWMs that represent wave runup elevations. However, a few HWMs appear to represent wave runup. Figure 2 provides a comparison of the effective wave runup mapping in an area along the north shore of Nassau County. Here the effective BFE is 17 ft and the Sandy debris line HWM is 15.6 ft; differences in the topographic information used for mapping the effective versus the Sandy inundation or the accuracy of the location of the HWM may account for the discrepancy between the elevations and the effective flooding extent. The effective surge levels were based on a tidal gage analysis and interpolated between them. Areas where the inundation limit was not based on wave runup, but surge alone, the effective mapping appears landward of the Sandy flooding extent. As it is at the east end of Long Island, based on the HWMs, the north shore area saw Sandy surge levels that came very close to the effective 1-percent annual chance levels.

Figure 2 Wave Runup Comparison on North Shore of Nassau County

A series of paneled PDFs for Nassau and Suffolk Counties were prepared to show the differences in the flooding extent of Sandy versus the effective flood hazard areas.

To further investigate the comparison on the south shore of Long Island a flood area change analysis was performed similar to the changes since last FIRM product, Figures 3 and 4 below. A GIS change polygon was created that shows areas where both Sandy and the effective 1-percent annual chance flood show as flooded, where only Sandy flooded, and where only the effective 1-percent floodplain shows as flooded. From a review of this polygon, it was determined that Sandy flooding dominated for all of Nassau County's south shore over the effective. In the area of Nassau County affected by flooding from Jamaica Bay, Sandy was less than the 2009 effective levels, but more than the proposed LOMR based on the new NYC storm surge study (where the 1-percent surge elevations were reduced by approximately 2 ft below the effective).

Figure 3 Nassau County Flood Area Change

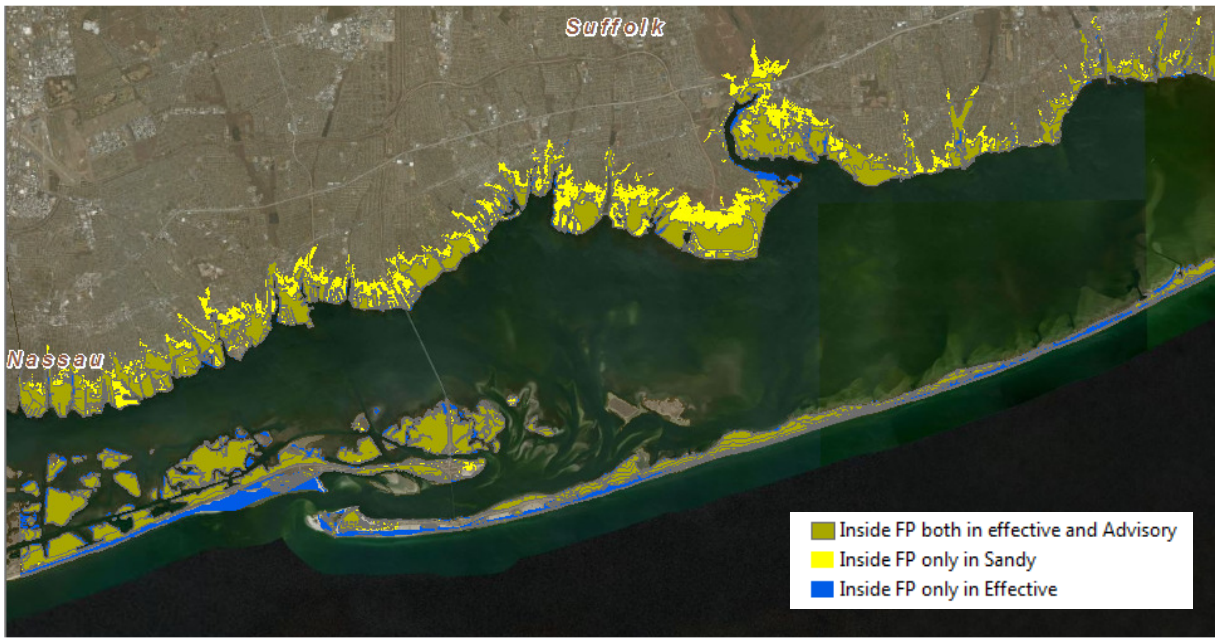


Figure 4 Suffolk County Flood Area Change

For Suffolk County, Sandy only dominated the inland flood extent over the effective until just west of Mastic Beach at William Floyd Parkway or Smith Point Park on Fire Island, as shown in Figure 5.

Figure 5 Change Point from Sandy dominance to Effective
(Blue=effective dominates, Yellow=Sandy dominates)

An initial review of the Sandy raster surface, and the USGS HWMs from which it was derived, revealed a few questionable HWMs; areas where the resulting raster and flooding limit should be ignored at these locations. The HWMs may be accurate at their specific location; however, due to the sparseness of HWMs in some areas and across transitional areas, the interpolation between the HWMs do not accurately represent the true surge profile. Figures 6 and 7 show areas in Suffolk and Nassau where a large open coast HWM is influencing the raster much further inland. This causes the Sandy elevations to be much larger on the bay side and mainland than they actually were. There also appears to be a limited amount of HWMs on the barrier islands, especially on Fire Island in Suffolk County.

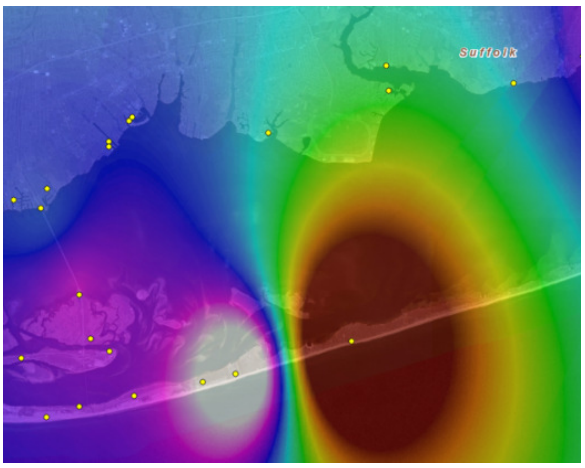


Figure 6 Suffolk: High Water Marks
Raster Interpolation

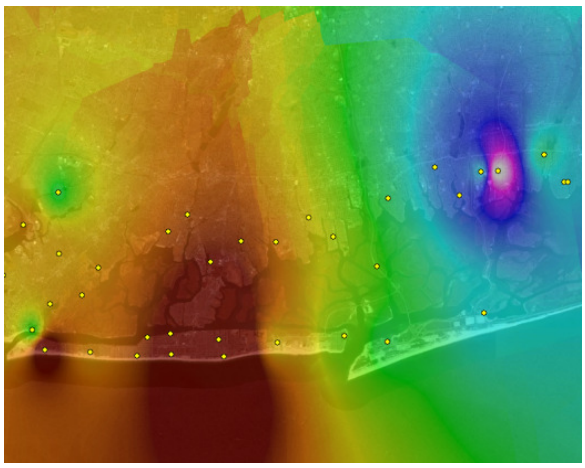


Figure 7 Nassau: High Water Marks
Raster Interpolation

In order to establish the magnitude of Sandy in comparison to the effective, the Sandy HWM raster was used to extract elevations within the change polygons for the areas where both the Sandy and effective floodplains exist. The Sandy elevations were averaged within each polygon. The Sandy elevations were than subtracted from the effective BFEs to obtain the magnitude of the difference. The most relevant data is along the inland floodplain boundary where the influence of waves is minimized.

For *Nassau County*, the elevation difference can be divided into three areas. The area affected by the flooding from Jamaica Bay showed that Sandy produced surge levels 1-2 ft greater that the proposed LOMR, as shown in Figure 8, where the differences are equal to the effective BFE minus the Sandy surge elevations. East of Jamaica Bay, the western half of Nassau County has Sandy elevations that are 1-2 ft above the effective while the eastern half has Sandy elevations 0-1 ft above the effective. The large differences in the middle of the bay on the order of 3 to 5 ft is due to the large HWM on the barrier island that is getting pulled across the bay as mentioned above and shown in Figure 7.

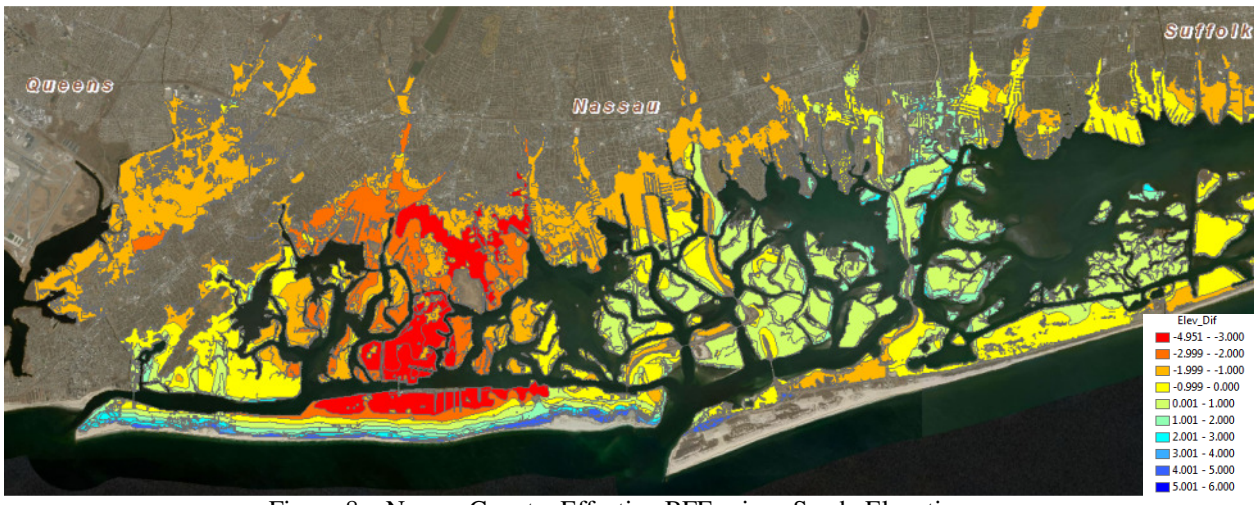


Figure 8 – Nassau County, Effective BFE minus Sandy Elevations

For *Suffolk County*, the Sandy elevations were higher than the effective ranging mostly from 1-2 feet except for the eastern end of Great South Bay where the difference was between 0-1 ft, as shown in Figures 9 and 10. In the areas where the range was 1-2 ft the majority of the differences are less than 1.5 ft. The eastern side of Figure 9, around Heckscher State Park, the darker reds indicates that Sandy was 3-

4 ft higher than the effective. This area is an artifact of the single HWM on the open coast pointed out in Figure 6 above and these large differences should be ignored in this area. East of Smith Point Park where Sandy was at or slightly less than the effective the differences were less than 1 ft.

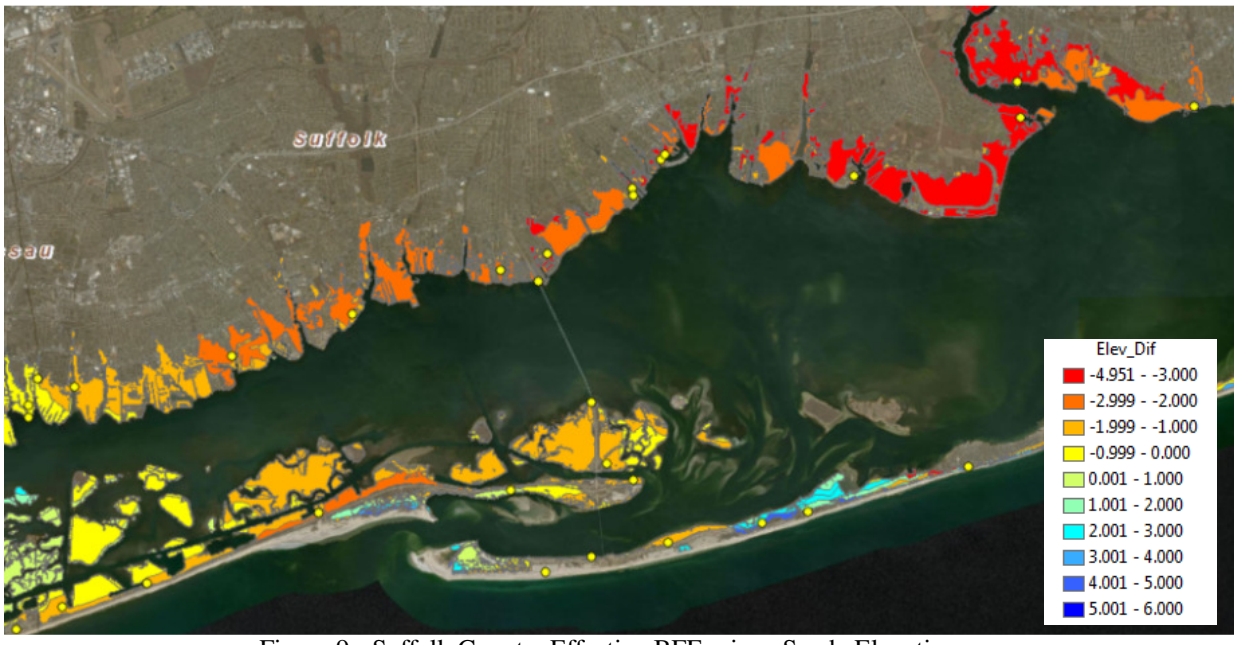


Figure 9 - Suffolk County, Effective BFE minus Sandy Elevations

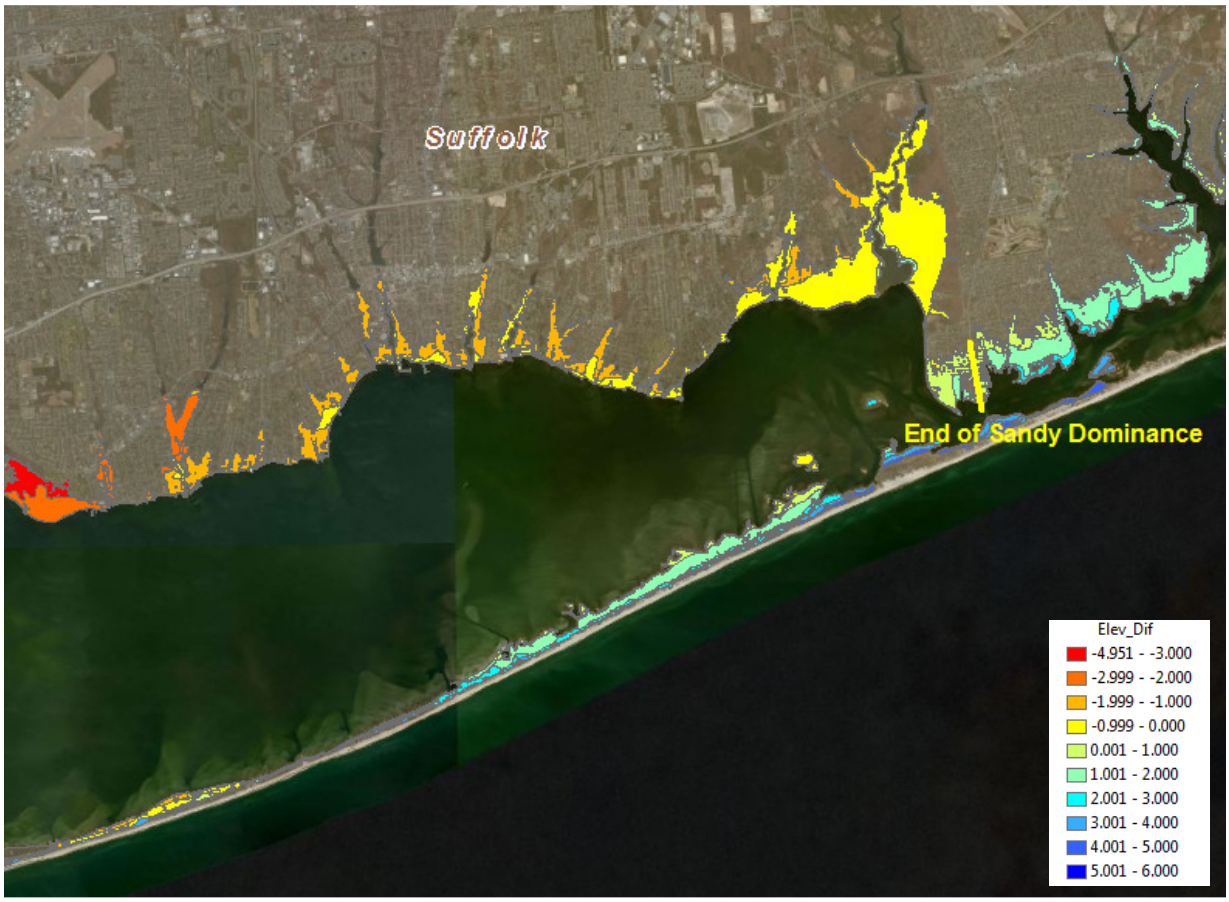


Figure 10 - Suffolk County, Effective BFE minus Sandy Elevations

RECOMMENDATIONS

For *Nassau County*, 2 ft of freeboard over the effective is recommended. For the area of Nassau affected by Jamaica Bay flooding, the 2009 effective BFEs could be used as a conservative Sandy advisory level or 2 ft of freeboard over the new surge study and LOMR could be used as a minimum.

For *Suffolk County*, where the Sandy levels were more than the effective, use of a 2 ft freeboard over the effective up to the point indicated above in Figures 3 and 8 at Mastic Beach. Anywhere on the barrier islands of the south shore of Nassau and Suffolk Counties due to the erosion potential and large surge overtopping, 3 ft of freeboard over the effective is recommended. East of Mastic Beach, between the North and South Forks of eastern Long Island and for the north shores of both Nassau and Suffolk where Sandy levels appear to be at or slightly lower than the effective, the effective plus 2 ft of freeboard is also recommended.

These recommendations are as conservative as the New York State Building Code recommendation of 2 foot freeboard. The recommendations are consistent across the counties. Finally, Sandy levels appear to be no more than 2 ft above the effective levels in these counties.

SUMMARY OF FREEBOARD RECOMMENDATIONS

Nassau County - 2 ft freeboard
Nassau Jamaica Bay – Min LOMR plus 2 ft Freeboard, Max Effective
Suffolk County – 2 ft freeboard
Barrier Islands of the south shore of Nassau and Suffolk Counties – 3 ft freeboard.

FEMA

Coastal Mapping in New Jersey
Preliminary Work Map Release

Hudson County, New Jersey

June 14, 2013

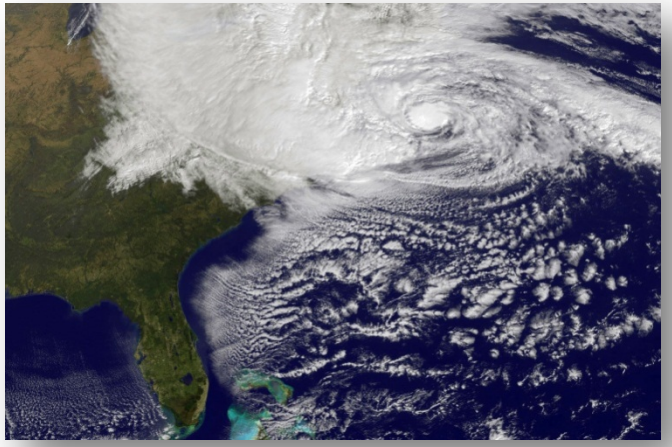
RiskMAP
Increasing Resilience Together

Agenda

- Introduction and Purpose of Briefing
- Hurricane Sandy
  - Advisory Base Flood Elevations
- Transitioning to Preliminary Work Maps
  - Flood hazard mapping changes
- Partnerships
- Next Steps
- Questions and Answers

Hurricane Sandy

- Hurricane Sandy made landfall in New Jersey on October 29, 2012
- Advisory Base Flood Elevations (ABFEs) were released after Hurricane Sandy to provide communities and property owners with the best available flood hazard data *at the time* for rebuilding and recovery
- The ABFEs were an interim step in the flood risk mapping process and used data that FEMA and New Jersey gathered up to October 2012



Preliminary Work Maps

- ABFEs represented the best available flood hazard data *at the time* of Hurricane Sandy
- As of June 17, 2013, the Preliminary Work Maps supersede the ABFE data to show a more accurate reflection of flood risk
  - Incorporates more precise calculation of wave hazards

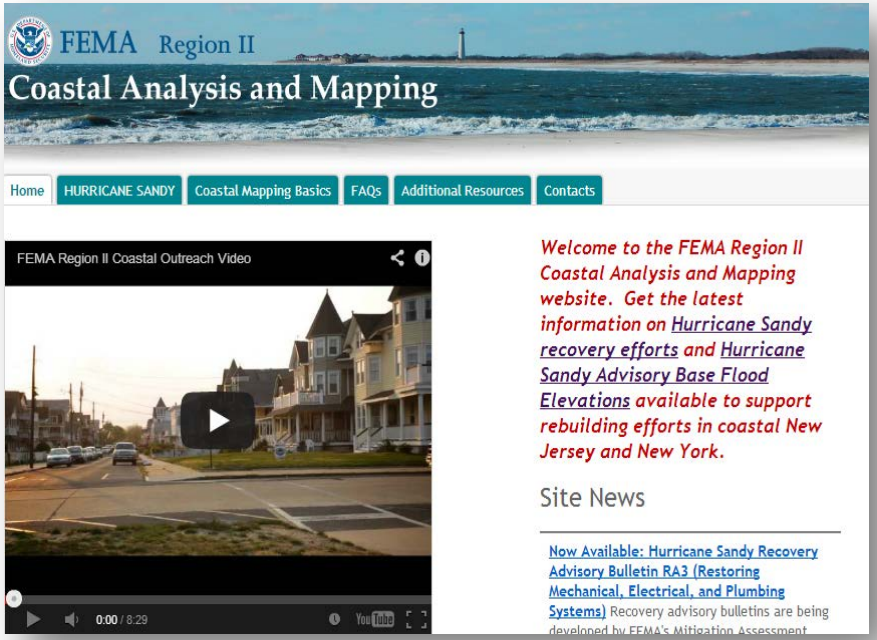
- Preliminary Work Maps are being shared in advance of the preliminary Flood Insurance Study and Flood Insurance Rate Maps (FIS & FIRMs) to provide property owners and communities with updated flood hazard information as quickly as possible to continue rebuilding and recovery
- Preliminary work maps will reflect the same coastal flood hazard as the Preliminary FIRMs, but the Preliminary FIRMS will also include riverine flood hazards

Preliminary Work Maps:
Benefits for New Jersey?

- Preliminary Work Map will:
  - Assist community officials and property owners in understanding the current flood risk
  - Inform rebuilding and recovery actions at the state and local level
  - Inform decisions to reduce loss of life and property through appropriate mitigation actions
  - Inform public investment process
- Preliminary Work Map will not immediately impact flood insurance rates or Federal flood insurance requirements
  - Depiction of likely flood insurance requirements in the near future

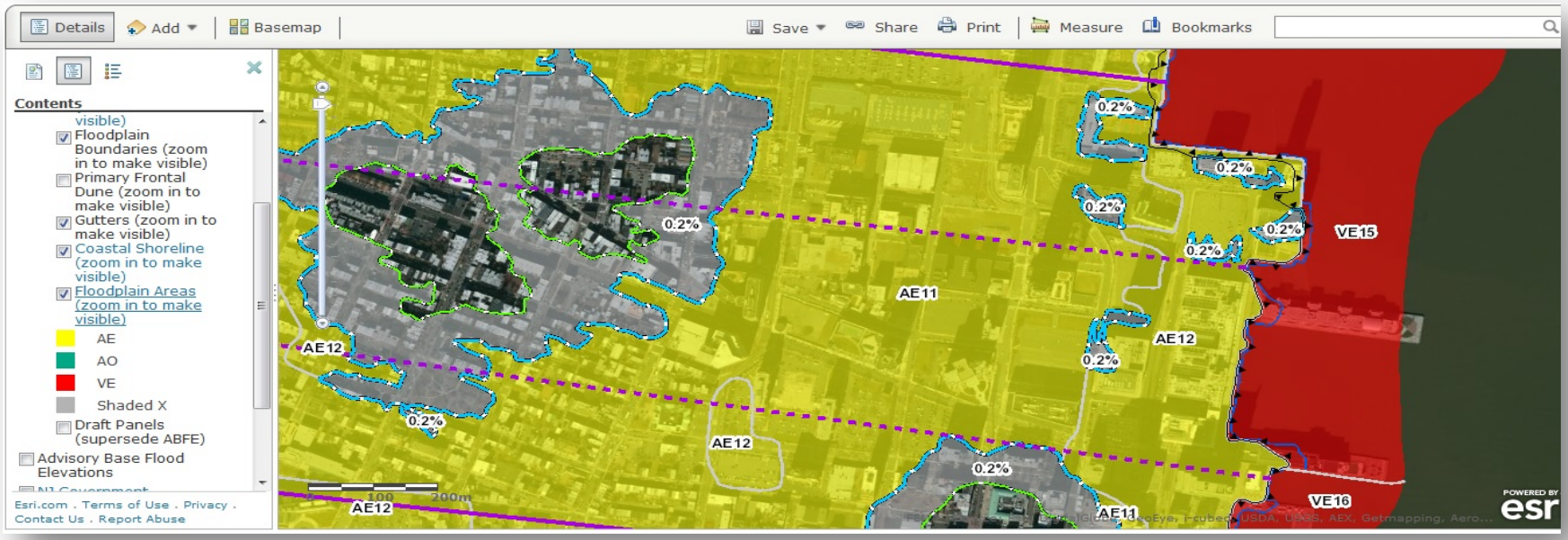
Preliminary Work Maps:
When and Where Can I Find this Information?

- June 17, 2013:
  - Preliminary Work Map information is being released on the FEMA Region 2 Coastal Website: www.Region2Coastal.com
  - The online Tool, "What is my Base Flood Elevation (BFE)?" is also available on www.Region2Coastal.com for residents and property owners



What You Will See in the Preliminary Work Maps?

- Special Flood Hazard Areas
  - Zone VE
  - Zone AE
  - Shaded Zone X
- Base Flood Elevations for 1% annual chance flood
- Estimated area and limit of structurally damaging wave action
- Preliminary Hurricane Sandy high water marks

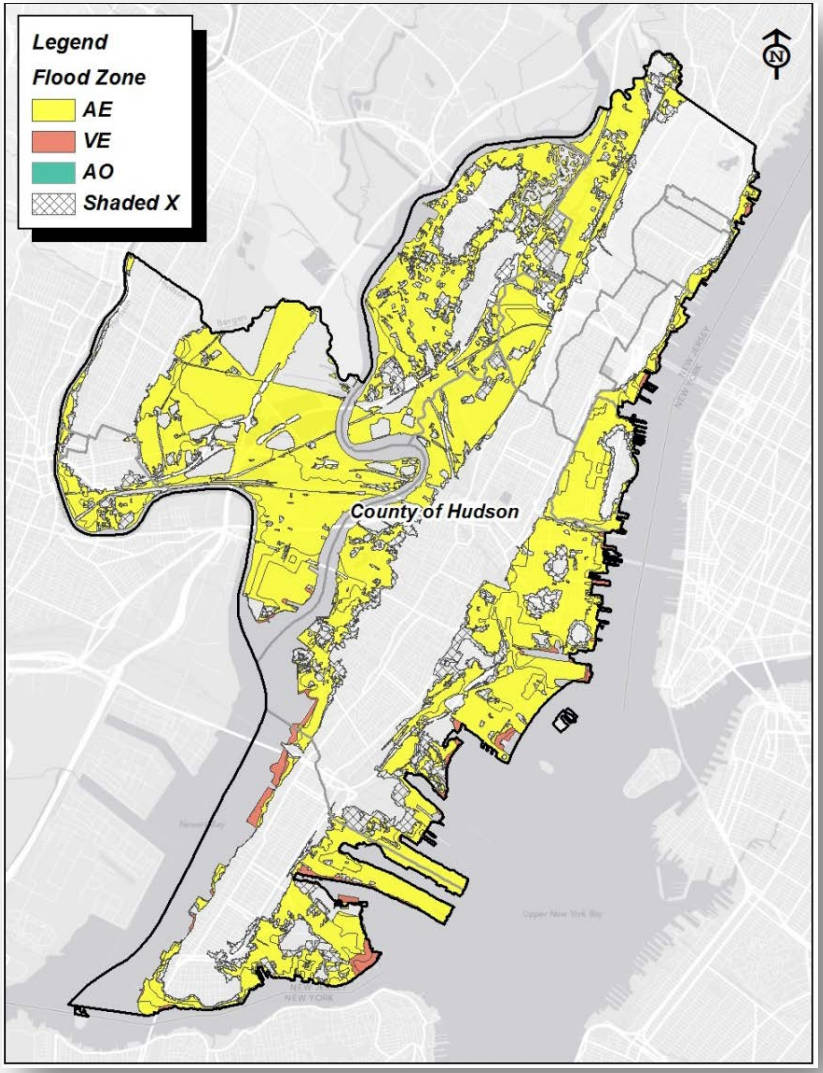


Preliminary Work Maps:
What are the High-Level Changes?

New Jersey:

- Indications are that the risk to coastal floods will increase in the future and communities and the public should plan accordingly
- Increases in the overall size of the coastal high hazard area (or V Zone) from the current effective maps
- Limited increases in the overall size of the A zone from the current maps of record are also now identified

Hudson Preliminary Work Map:



Access to Information:
www.region2coastal.com

People with accessibility needs may call 1-800-427-4661 or use our online form to request and receive assistance in identifying and interpreting the flood information for their property.

Enter an address to view effective and updated coastal flood risk information for that location:

Newark Airport | Get Details | Clear Details

Approximate Address Identified: *Newark Liberty International Airport (EWR), 3 Brewster Road, Newark, NJ 07114, USA*

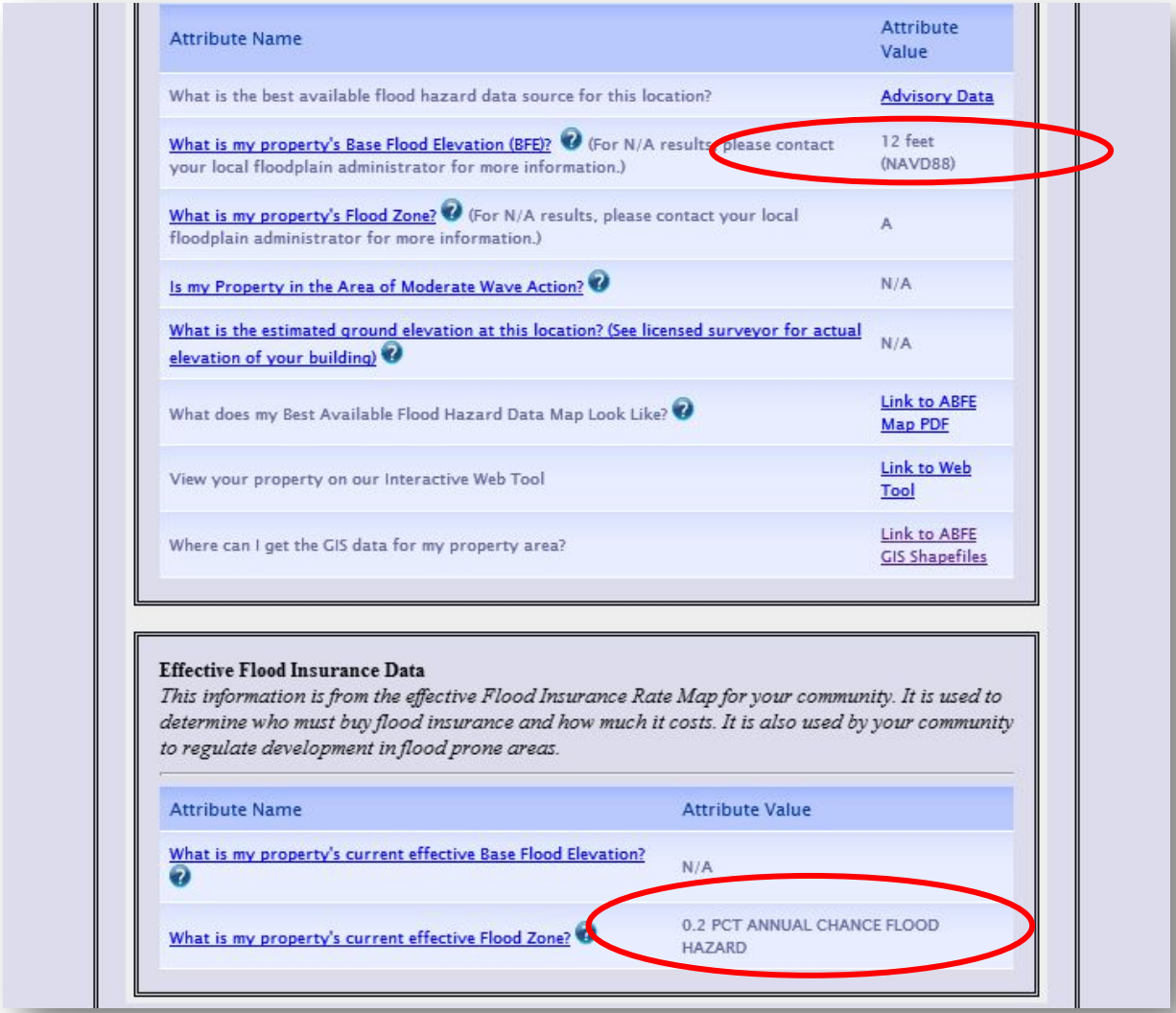
Best Available Flood Hazard Data

The best available flood hazard data for coastal areas of New York and New Jersey is provided below to help you understand the current flood risk to your property and to guide Sandy recovery and rebuilding efforts.

*Please be advised that in most communities, only **coastal** flood risk information is provided below. **Riverine** flood risk information will **not** be shown in most locations. Please contact your local floodplain administrator for more information about those areas.*

Attribute Name	Attribute Value
What is the best available flood hazard data source for this location?	Advisory Data
What is my property's Base Flood Elevation (BFE)? (For N/A results, please contact your local floodplain administrator for more information.)	12 feet (NAVD88)
What is my property's Flood Zone? (For N/A results, please contact your local floodplain administrator for more information.)	A

www.region2coastal.com



Attribute Name	Attribute Value
What is the best available flood hazard data source for this location?	Advisory Data
What is my property's Base Flood Elevation (BFE)? (For N/A results, please contact your local floodplain administrator for more information.)	12 feet (NAVD88)
What is my property's Flood Zone? (For N/A results, please contact your local floodplain administrator for more information.)	A
Is my Property in the Area of Moderate Wave Action?	N/A
What is the estimated ground elevation at this location? (See licensed surveyor for actual elevation of your building)	N/A
What does my Best Available Flood Hazard Data Map Look Like?	Link to ABFE Map PDF
View your property on our Interactive Web Tool	Link to Web Tool
Where can I get the GIS data for my property area?	Link to ABFE GIS Shapefiles

Effective Flood Insurance Data

This information is from the effective Flood Insurance Rate Map for your community. It is used to determine who must buy flood insurance and how much it costs. It is also used by your community to regulate development in flood prone areas.

Attribute Name	Attribute Value
What is my property's current effective Base Flood Elevation?	N/A
What is my property's current effective Flood Zone?	0.2 PCT ANNUAL CHANCE FLOOD HAZARD

Project Partners

- Local Communities
  - Provide technical information that best characterizes local flood risk
  - Communicate flood risk information to their constituents
- New Jersey Governor's Office
  - GAR/GORR responsible for oversight of all recovery and rebuilding
  - Facilitate outreach to local elected officials
- New Jersey Department of Environmental Protection
  - In charge of multiple NJ coastal flood risk study updates
  - Produce non-regulatory products for the entire NJ coastal communities

Project Partners *(continued)*

- Coastal Outreach Advisory Team (COAT)
  - State and local governments; academic organizations; other federal agencies
  - Support New Jersey coastal flooding outreach and education program
- Technical Advisory Panel (TAP)
  - New Jersey floodplain management and coastal engineering experts from diverse backgrounds
  - Review and provide feedback on the on-going coastal flood risk study

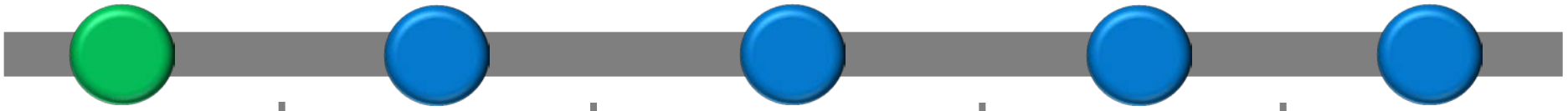
Project Partners *(continued)*

- Academics and Non Government Organizations
  - Jacques Cousteau National Estuarine Research Reserve
  - Richard Stockton College Coastal Research Center
  - Monmouth University Urban Coast Institute
  - Sea Grant Administration
  - Stevens Institute of Technology
  - Liberty Science Center
  - New Jersey Association for Floodplain Managers
- *Co-host workshops/trainings to local officials and information dissemination*

Public Outreach & Support

- Preliminary Work Maps and Datasets are being provided to communities in advance of the preliminary FIRMs:
  - Transect Data and Field Reconnaissance
  - Storm Surge Geographic Information System (GIS) Data
  - Coastal Hazard Analysis Modeling Program (CHAMP) Database
  - Preliminary Work Maps
- Each Community receives an FTP link for download
- Preliminary Work Maps will be available through the GeoPortal at www.Region2Coastal.com
- For technical questions about the Preliminary Work Maps and datasets provided, submit your questions:
  - *Community Officials and General Public* online at www.region2coastal.com/contacts

Timeline of Events



Preliminary Work Map Release

Preliminary Work Maps are released on Region 2 Coastal Website

WE ARE HERE

Preliminary FIRM Release

Preliminary Flood Insurance Rate Maps are released to the communities and the general public

Post-Release of Preliminary FIRMS

Regulatory and formal 90 days appeals and comments period will be determined

Post-Appeals

FEMA will issue Letter of Final Determination (LFD) that initiates the 6 month adoption period before the new maps become effective – all appeals will be resolved prior to LFD

Post-LFD

Effective FIRMs become the basis for flood insurance rates, community floodplain management regulations, and determining which structures require flood insurance

Providing Input

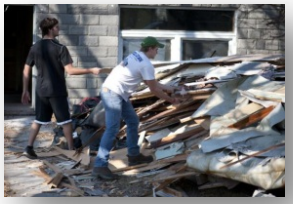
- FEMA is encouraging communities and property owners to submit technical information to Local FPA's for review and submittal to FEMA
- Validated appeals may result in revisions to FIRMs through the regulatory process
- Data submitted needs to be comprehensive, detailed and consistent with the process for developing preliminary FIRMs
- Coastal analysis and mapping information must follow FEMA Guidelines & Specifications for Flood Hazard Mapping Partners
- Technical information should be submitted to:
  - Robert J. Schaefer, P.E. FEMA Region II: Robert.Schaefer@fema.dhs.gov

Next Steps

- Review the technical and preliminary work map data
  - State agencies, property owners, general public
- Communicate the improved flood risk information to your residents and property owners
- Continue engagement in the ongoing flood risk analysis and flood insurance study update by:
  - Attending Flood Risk Review Meetings
  - Attending Resilience Meetings
  - Attending Community Coordination Officer Meetings
  - Informing residents and property owners of upcoming Public Open House Meetings

Conclusion: Community Resilience

Risk Changes Over Time → FEMA Provides Best Available Data → Community Officials Adopt Higher Standards → Property Owners Build to Higher Standards → More Resilient Communities Created



Together, we all can create stronger and safer communities

Resources

- Region 2 Coastal Flood Study Information: www.Region2Coastal.com
- FEMA: www.fema.gov
- FloodSmart (official site of NFIP): www.floodsmart.gov
- Risk Assessment, Mapping and Planning Partners (RAMPP): www.RAMPP-team.com/nj.htm
- New Jersey GORR: http://www.state.nj.us/gorr/
- New Jersey DEP: http://www.nj.gov/dep/ec/

Local Communities – *Data Gathering*

- Areas of Mitigation Interest Questionnaire
- To be sent to community officials early next week
  - This information will:
    - Help document the flood risk and will be used in Non-Regulatory Products development
    - Aid in identifying areas that may be affecting flood risk that would benefit from a raised local awareness
    - Provide input to local mitigation plans
    - We will provide the draft products and go over it with you during the Flood Risk Review meeting

Q&A

Contacts

FEMA

Bill McDonnell | William.McDonnell@fema.dhs.gov
Andy Read | Andrew.L.Read@URS.com

Interim Report

Redefinition of the Coastal Flood Hazard Zones in FEMA Region II: Analysis of the Coastal Storm Surge Flood Frequencies

Summary and Background of Restudy

August 2011

FEMA

Federal Emergency Management Agency
Department of Homeland Security
500 C Street, SW
Washington, DC 20472

This document was prepared by

Risk Assessment, Mapping, and Planning Partners.
840 Arlington Boulevard
Fairfax, VA 22031

Contract No. HSFEHQ-09-D-0369
Task Order HSFE01-09-J-0001

Acknowledgements

TABLE OF CONTENTS

Figures

Tables

Appendices

ADCIRC	Advanced Circulation Hydrodynamic Surge Model
BFE	Base Flood Elevations
CISL	Computational and Information Systems Laboratory
DEM	Digital Elevation Models
DTM	Digital Terrain Model
ESRI	Environmental Systems Research Institute
FEMA	Federal Emergency Management Agency
FIRM	FEMA Flood Insurance Rate Map
FGDC	Federal Geographic Data Committee
GAP	Gap Analysis Program
HWM	high water mark
ICOADS	International Comprehensive Ocean Atmosphere Data Set
IPET	Interagency Performance Evaluation Task Force
ISH	Integrated Surface Hourly
ITR	Independent Technical Review
JPM	Joint Probability Method
JPM – OSQ	Joint Probability Method – Optimum Sampling – Quadrature
LiDAR	Light Detection and Ranging
MSL	Mean Sea Level
NAV88	North American Vertical Datum of 1988
NCAR	National Center for Atmospheric Research
NDBC	National Data Buoy Center
NHC/HRD	National Hurricane Center / Hurricane Research Division
NHC/TPC	National Hurricane Center / Tropical Prediction Center
NJLU	New Jersey Land Use/Land Cover
NLCD	National Land Cover Dataset
NOAA	National Oceanic and Atmospheric Administration
NOS	Natioanl Ocean Survey
NTDE	National Tidal Datum Epoch
OWI	Oceanweather, Inc.
PBL	Planetary Boundary Layer
QA/QC	Quality Assurance /Quality Control
QMP	Quality Management Plan

RAMPP	Risk Assessment, Mapping, and Planning Partners
RMS	Root Mean Square
SMS	Surface Water Modeling System
SSST	Storm Surge Study Team
SWAN	Simulating Waves Nearshore
2-D	Two-dimensional
UnSWAN	Unstructured Simulating Waves Nearshore
USACE	U.S. Army Corps of Engineers
WHAFIS	Wave Height Analysis for Flood Insurance Study

SECTION ONE INTRODUCTION

A study is being conducted by Risk Assessment, Mapping, and Planning Partners (RAMPP) on behalf of Federal Emergency Management Agency (FEMA) Region II to result in a redefinition of the coastal flood insurance rate zones. This study requires: 1) a complete analysis of the coastal storm surge flood frequencies; 2) the addition of the wave crest elevations to the 0.01 annual exceedence still water flood elevation; and 3) production of digital flood insurance rate maps.

As this study has progressed there have been two technical presentations to an invited audience of engineers, planners, and coastal managers to describe the study methods and track progress. This brief document is a summary of the work tasks that have been completed to date. It is intended to supplement the presentations on April 14, 2011. It is also intended to be an evolving document, adding sections as future project tasks are completed. Only tasks related to the analysis of the coastal storm surge flood frequencies have been completed at this time.

SECTION TWO FEMA REGION II COASTAL FLOOD STUDY OVERVIEW

2.1 PURPOSE

The purpose of the Coastal Flood Study is to redefine the coastal flood hazard zones based on the complete restudy of the storm surge flood frequencies. The components of coastal flood study are: 1) a complete analysis of the coastal storm surge flood frequencies; 2) the addition of the wave crest elevations to the 0.01 annual exceedence still water flood elevation; and 3) production of digital flood insurance rate maps.

2.2 PROJECT SCHEDULE

Work commenced on September 24, 2009, and the coastal flood analysis is expected to be completed by October 13, 2011. The results will then be made available to the coastal mapping component of the overall project.

2.3 PROJECT TEAM

The major technical work for this project is being conduct by RAMPP, a study contractor, and the project is based on Task Order HSFE02-09-J-001 under contract HSFEHQ-09-D-0369 with FEMA. RAMPP is a Joint Venture whose individual members include URS Corporation, Dewberry Corporation, and ESP. With support from personnel from DHI Corporation, personnel from the FEMA Region II office in Manhattan administer the project and monitor its technical approach and work progress.

The companies and individual professionals carrying out this work have considerable experience with coastal flood hazard studies including similar recent studies in Mississippi, Florida, South Carolina, North Carolina, Virginia, Maryland, Delaware, and eastern Long Island.

2.4 PROJECT AREA

In order to provide spatial consistency, FEMA has elected to include a large area in this study. The coastal study project area includes New Jersey, New York City, Westchester County, NY, and the banks of the tidal portion of the Hudson River. Although all three components of the study are being carried out for most of this area, the work in the two New Jersey counties facing Delaware Bay is organized differently. The analysis of the coastal storm surge flood frequencies is determined as part of the FEMA Region III study so that there will be common results for all of the shores of the bay. RAMPP will carry out the remaining two components of the study as these results become available. The portion of the study area where all three components will be completed by RAMPP is shown on Figure 2-1.

Figure 2-1: Coastal Flood Study Project Area

The study area includes a zone from the shoreline to the 25-foot elevation contour. This inland elevation was deliberately selected to be above any expected coastal storm surge inundation level to assure that none of the simulations with numerical models could encounter an inland grid boundary. The offshore extent of the study area extends well out into the Atlantic Ocean as described in a following section (see Section 3).

The results of this project will interface with the results of several other recent and existing coastal flood studies, including the borders with: Delaware; Nassau County, NY, and Connecticut.

2.5 THE COASTAL STORM SURGE ANALYSIS

There is no standard set of methods for coastal flood studies at this time. Therefore, the RAMPP Team is combining methods used in recent FEMA coastal flood studies specifically created to address issues relevant to the New Jersey/New York City region. The sections to follow provide brief descriptions of these methods and procedures. In this section, we present a brief overview of the entire process.

Coastal flood studies to determine federally subsidized flood hazard insurance have been conducted in the United States since the late 1970s. This predates the establishment of FEMA in 1979. These studies consist of comprehensive examination of the storm climate in the region combined with the use of numerical models to convert the storm climatology to statistical measures of storm surge elevations. These detailed studies were conducted for all U.S. coasts in the 1980s. Since that time, there have been various revisions to portions of these studies and modifications to the mapped coastal flood zones. However, in 2005, FEMA initiated a new round of comprehensive coastal flood studies beginning with a project in Louisiana. After the landfall of Hurricane Katrina, the number of these studies increased dramatically. Although the methods used in this recent round of studies largely parallel the earlier work, there have been

significant advances in the quality of storm data and increases in the resolution of meteorological and hydrodynamic numerical models. There have also been many storms during the past 20 years allowing a more complete climatological summary. The FEMA Region II Coastal Flood Study has been enhanced from the experience and the techniques developed in similar recent studies, and these provided the definition of the methods of analysis that are herein summarized.

Before describing the methods of analysis, a word about the numerical models used in this study is in order. It is necessary to overcome the dearth of direct storm surge measurements. There are few places in the entire study area where long-term accurate measurements of past storm surge heights are available. Not only are these spaced widely, they are located at the shoreline. Therefore, places between and inland of these scattered gages have no direct measurements. Accordingly, it is necessary to utilize the more common meteorological measurements of large storms to characterize the region's exposure to the coastal surge flooding. The meteorological parameters derived from these measurements are used with a numerical model that represents the wind and atmospheric pressure fields of storms. When such a numerical model is used in conjunction with other models representing coastal surge hydrodynamics and waves, the time-histories and maximum elevations of the storm surge corresponding to any particular storm can be computed. This results in a detailed and complete spatial coverage of these parameters for each simulated event.

In the FEMA Region II Coastal Flood Study, two different methods are used to represent tropical and extra-tropical storms. For the overall class designated as tropical events, which include hurricanes, and lesser event also called tropical storms, the meteorological model developed by Dr. Vince Cardone of Ocean Weather, Inc. (Cardone and Cox 2009)was used. This is parametric model wherein time series of a limited number of parameters (usually central pressure; storm radius; radial wind and pressure distributions; forward speed; track orientation; and landfall location) are input to an algorithm that results in a series of outputs representing a moving field of wind and pressure. For extra-tropical storms, which are generally designated as Nor'easters on the North Atlantic coast, there is no agreed upon set of controlling parameters, and each storm must be laboriously analyzed. This starts with the general representation of the regional North Atlantic atmospheric conditions from an analysis provided by National Oceanic and Atmospheric Administration (NOAA). A number of data sources are used to create the database for an analyst to craft individual detailed representations of the wind and pressure fields at 3-hour intervals within the context of the regional weather conditions over the duration of the storm. A moving center computer algorithm interpolates between these individual hand-crafted 3-hour patterns to produce a set of output files representing the moving wind and pressure fields for each storm.

The data files representing the moving wind and pressure fields of either tropical or extra-tropical storms are used with another numerical model that computes the time varying coastal water levels and wave conditions. This model combines the hydrodynamics of the ADCIRC model with the wave generation and propagations dynamics of the SWAN model. ADCIRC is a coastal hydrodynamics finite element model (Leutich et al. 1992) that represents the depth-average response of water levels and circulation to input wind and atmospheric pressure fields. It operates on an open mesh grid (also referred to as an unstructured grid) with triangular elements of topographic and bathymetric features with a minimum resolution of about 250 ft. The SWAN model uses the same wind and pressure field files and operates on the same open-mesh grid as the ADCIRC model to represent the time varying storm wave generation and

propagation. Although developed separately, these models have recently been combined to operate in unison on the same unstructured grid. This combined model is called the ADCIRC-UNSWAN model.

All of the numerical models used in the FEMA Region II Coastal Flood Study have been independently developed, extensively tested, and frequently used in other studies. These models have undergone specific verifications for storm conditions in the project area.

The overall approach consists of work tasks to:

- Acquire map data and field reconnaissance
- Characterize the local storm climate (tropicals and extra-tropicals)
- Develop input for a set of numerical models
- Develop method of forward projection of the storm climate
- Compute surge heights with the numerical models
- Analyze surge height with wave crests annual recurrence statistics
- Develop 0.2%,1.0%,2.0% and 10.0% annual exceedence coastal flood elevations
- Conduct Wave Height Analysis for Flood Insurance Studies (WHAFIS) overland wave conditions and Base Flood Elevations (BFEs)

Each of these tasks that have been completed at the time of this summary report is described in detail in the following report sections. These sections, with the above topics designed within the parentheses, include:

- Section 3 - Summary of the Grid Development (1,3)
- Section 4 - Storm Climate Characterization (2)
- Section 5 - Storm Statistics and Tracks (3,4)
- Section 6 - Storm Model Verifications (5)
- Section 7 - Coastal Storm Surge Modeling (6)

Task subjects 6, 7, and 8 are underway at this time. Summaries describing their methods and results will be included in a follow-up summary report that will be issued later in this project.

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Cardone, V.J., and A.T. Cox, 2009. ***Tropical cyclone wind field forcing for surge models: critical issues and sensitivities.*** Natural Hazards: Volume 51, Issue 1 (2009), Page 29.

Leuttich, R.A.,Westerink,J.I. and N.W. Scheffer, 1992, ADCIRC an advanced three-dimensional circuilation model for shelves, Coasts and Estuaries, I:Theory and Methodology, Tech. Rept. 1, U.S. Army Corps of Engieneers, Waterways Experiment Station, MS.

SECTION THREE DEVELOPMENT OF STORM SURGE MODEL MESH FOR FEMA REGION II STORM SURGE STUDY, COASTAL HAZARD ANALYSIS AND MAPPING

3.1 PURPOSE

As part of the model system setup for the Region II Storm Surge Study, an unstructured model mesh was developed to conduct storm simulations using the coupled SWAN+ADCIRC storm surge model. The mesh development process involved the development and incorporation of seamless Digital Elevation Models (DEMs), field reconnaissance, and detailed mesh generation.

3.2 METHODOLOGY

3.2.1 Terrain Development

Seamless DEMs were developed from the best topographic and bathymetric data available at the time of this study. DEMs having a 10-meter horizontal resolution were developed to serve as the base elevation dataset from which the SWAN+ADCIRC storm surge model mesh was developed. Higher-resolution DEMs (2-meter horizontal) were developed for the purpose of overland wave analysis and coastal floodplain mapping.

The seamless DEMs were developed using a multi-step process. The DEMs were first produced at the resolution necessary for floodplain analysis and then resampled to a coarser resolution more suitable for the ADCIRC storm surge model. The overall process for the development of the DEMs involved five major sequential steps:

3.2.1.1 Data Acquisition

In total, the coastal study required topographic data for 29 counties, either in part or whole. The specific counties in New Jersey, New York, and Connecticut include:

- New Jersey: Salem, Cumberland, Cape May, Atlantic, Burlington, Ocean, Monmouth, Middlesex, Union, Essex, Hudson, and Bergen.
- New York: Richmond, Kings, Queens, Bronx, New York, Westchester

  Partial: Nassau, Rockland, Orange, Putnam, Dutchess, Ulster, Columbia, Greene, Albany, and Rensselaer
- Connecticut: Fairfield (*Partial*)

Detailed bathymetric data were also required for the open ocean from Cape Henlopen, DE to Martha's Vineyard, MA, including Long Island Sound, the East River, the Hudson River to Kingston, NY, along with all estuaries and embayments within coastal counties.

Given the size of the study area, data were acquired from a variety of sources. Topographic and bathymetric data were collected from the following entities:

Topography Sources:

U.S. Geologic Survey Earth Resources Observation and Science Center, National Geospatial-Intelligence Agency, FEMA, and the New York City Department of Information Technology and Telecommunications.

Bathymetry Sources:

NOAA, National Geophysical Data Center, NOAA Office of Coast Survey, U.S. Army Corps of Engineers (USACE), New York and Philadelphia Districts, New York State GIS Clearinghouse, and the New Jersey Department of Environmental Conservation.

3.2.1.2 Topography

The goal was to obtain a topographic dataset for each county that met or exceeded FEMA Guidelines and Specifications for 2-foot mapping contours, as outlined in Appendix A of the Guidelines and Specifications for Flood Hazard Mapping Partners. Topographic datasets were available in the form of Light Detection and Ranging (LiDAR) mass-points, tiled LiDAR-derived high resolution (1m) DEMs, low-resolution (10m) DEMs and vector contour data. Each type of data was processed by a slightly different methodology due to associated technological constraints. All data were treated on a county-by-county basis. Final topographic DEMs had a minimum and maximum cell size of 6.56ft (2m) and 32.8ft (10m), respectively. All data were provided with a vertical reference to North American Vertical Datum of 1988 (NAVD88).

A horizontal datum conversion was applied, where necessary, to bring the data into the project datum. Independent quality control of the data was conducted, including documentation and disclosure of identified problems. Identified problems were resolved and Federal Geographic Data Committee (FGDC) compliant metadata were created.

3.2.1.3 Shoreline

The shoreline feature was extracted from the topographic data set for each county and edited, as needed, to remove artifacts. This feature serves four purposes for the Region II Coastal Flood Study: 1) to facilitate a clean transition from the bathymetric to topographic dataset in the seamless DEM, 2) to provide a boundary and guiding arc for ADCIRC mesh generation; 3) to provide an accurate reference location of the zero-elevation contour for the WHAFIS overland wave model; and 4) to provide accurate cartographic representation of the shoreline on the final cartographic product, a FEMA Flood Insurance Rate Map (FIRM).

To provide an accurate and up-to-date representation of the coastal shoreline, the study team extracted the zero-foot contour (NAVD88) from each topographic DEM. A review was conducted and hand-edits were made to remove erroneous or non-representative data. The extracted shoreline was supplemented, as necessary, with NOAA, State, or other available data. The vector line was then put through a quality-control process that checked for potential artifacts and ensured that the location was consistent with the most recent aerial photography.

3.2.1.4 Bathymetry

The completed bathymetric surface serves two purposes: 1) provide base depths for the ADCIRC/UNSWAN storm surge model for ocean and inland water features; and 2) provide base depths for the overland wave analysis.

Bathymetric data from varying sources were compiled into a single Environmental Systems Research Institute (ESRI) Terrain dataset. Terrain datasets are an efficient way to manage large point based data in a geodatabase and produce high quality accurate surfaces on the fly. Digital

Terrain Models (DTMs) can also be generated from the terrain dataset at a variety of resolutions. An example of the combined bathymetry data is shown in Figure 3-1 below.

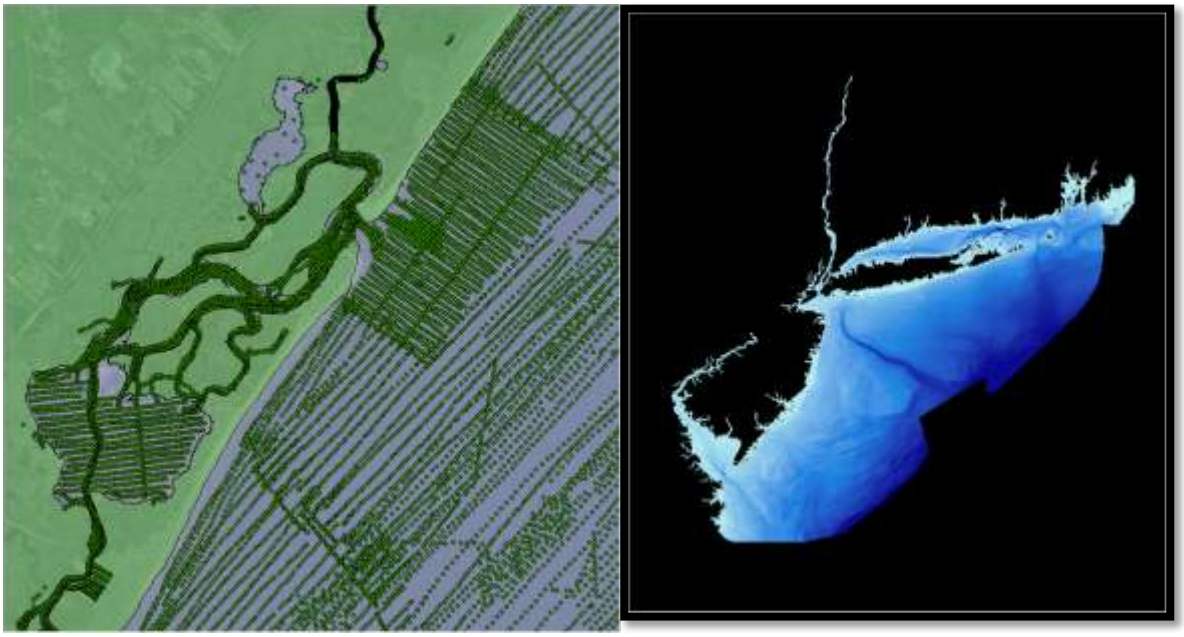

Figure 3-1: Example Bathymetry

Once all the bathymetric datasets were obtained, the XYZ data points were processed into a DTM. All soundings were converted into a common horizontal datum and into the NAVD88 vertical project datum using the NOAA National Geodetic Survey VDatum software. All files were then imported into ArcGIS for visual inspection. Priority was given to the USACE data where there was overlap with the NOAA data, as the USACE data was more recent. Additionally, the NOAA data included many overlapping surveys. These overlapping areas were inspected on a case-by-case basis, examining both the age and coverage of the surveys, to determine which should be retained.

The ESRI terrain was converted to an ESRI raster that was then clipped to over-water areas. Again, an independent quality control of the data was conducted, problems were identified, comments were addressed, and metadata were created.

3.2.1.5 Seamless DEM

The final step in the terrain development task was to process the discreet topographic and bathymetric DEMs into continuous "seamless" DEMs that provide coverage of both land and water surface elevations as shown in Figure 3-2. The shoreline facilitates a clean transition from the bathymetric to topographic dataset in the seamless DEM. As such, the shoreline serves as the landward bound of the bathymetry and the seaward bound of the topography, allowing for a common continuous feature to facilitate interpolation between the two disparate datasets.

Seamless DEM generation was conducted on a county-by-county basis. To facilitate this process, a mask was created for each county from the shoreline for both the topographic and bathymetric datasets. The topographic mask extended from the shoreline boundary to an identified upper limit (+25 ft NAVD88 with a 2,000 ft buffer applied), and included the spatial

boundaries of the dataset. In a similar fashion, the bathymetric mask extended from the shoreline boundary to the pre-identified lower depth limit (-60 ft NAVD88) or the seaward limit of the bathymetric dataset. An ESRI Terrain was generated, incorporating both the bathymetry points and the shoreline as a hard line feature. The topographic dataset was then extracted to the topographic mask, and the two sections (topography and bathymetry) were merged by raster mosaicing. Any remaining gaps between the two sections were then filled using an algorithm that identifies voids within the dataset and fills them with a nearest neighbor interpolation.

Independent quality assurance /quality control (QA/QC) was conducted, evaluating the seam transition from topography to bathymetry and identifying problem areas or data voids. Any identified problems were documented and the problem areas were revisited with an appropriate method of resolution.

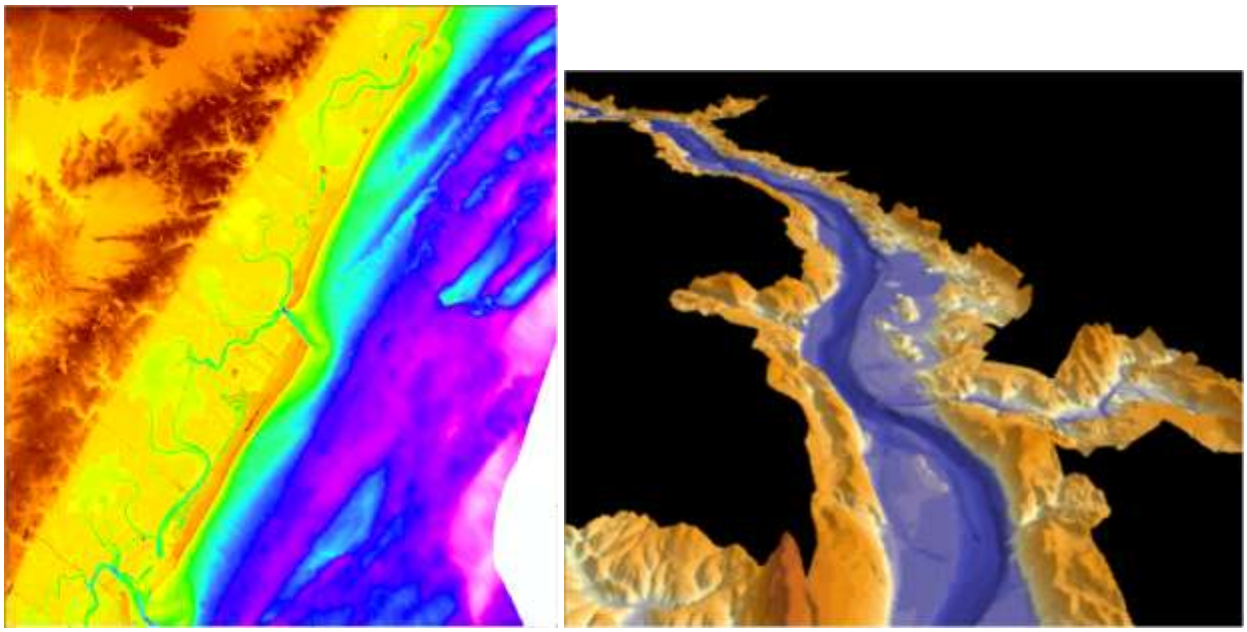

Figure 3-2: Example Seamless DEM

Field Reconnaissance

To support the storm surge modeling effort, field reconnaissance was conducted along select portions of the New Jersey and New York shorelines. As part of this field program, 27 locations of interest were visited and evaluated, and they aided in the development of the ADCIRC grid to be used for the surge modeling (see Figure 3-3). These locations were in Bergen and Hudson counties in New Jersey on the west side of the Hudson River and Hudson Bay, and on the east side of the Hudson River in New York County, New York. Additional points were located in New York and Queens Counties along the East River, and the east side of Hudson Bay in Kings County and western shore of Hudson Bay in Richmond County New York. Other locations that were visited are along the shores of Middlesex, Monmouth, Ocean, Atlantic and Cape May Counties in New Jersey. At each location, digital photography and field notes were collected to document natural and manmade features and to assist in the storm surge model mesh development.

Figure 3-3: Field Reconnaissance Locations

Mesh Generation

The ADCIRC model uses an unstructured, triangulated mesh that allows for detailed representation of narrow flow features and major obstructions. With recent model developments, a fully coupled version of the SWAN and ADCIRC models to operate on the same mesh and the SWAN+ADCIRC model was selected for use in the Region II Storm Surge Study.

As part of the mesh development process, the Region II Storm Surge Study Team (SSST) developed a detailed guidance document and an extensive QA/QC procedure with the goal to design a robust SWAN+ADCIRC mesh that would 1) have consistent mesh design throughout the model domain, and 2) ensure proper mesh design to limit extensive mesh revisions once storm simulations were being conducted.

Most regional-scale ADCIRC storm surge projects begin the mesh development process with one of the Western North Atlantic Tidal Database ADCIRC meshes – Eastcoast 1995 (Westerink et al., 1994) or Eastcoast 2001 (Mukai et al., 2002). The domain is identical for these two meshes and includes the U.S. Atlantic coast, the Gulf of Mexico, and the Caribbean Sea, with the boundary extending to the 60 degree West meridian. The main difference between the meshes is the resolution. The Eastcoast 1995 mesh has approximately 30,000 nodes or locations where model computations are made, while the Eastcoast 2001 mesh has approximately 250,000 nodes. Typically, one of these meshes is selected as the base and then additional resolution and overland areas are added in the region of interest. The Region II SSST followed this approach beginning with the Eastcoast 1995 base mesh. The mesh was extended overland, increasing the resolution along the New Jersey and New York shorelines for the study area.

In developing the storm surge model mesh, an overall goal is to provide sufficient horizontal resolution to adequately capture the major waterways and barriers to flow, while limiting the number of nodes to maximize computational efficiency. For the Region II mesh, in areas far inland, further offshore, or far from the project area (such as the Caribbean Sea), the node-to-

node spacing was increased. The largest elements in the deep ocean are approximately 5 miles wide. In the project area, the maximum spacing inland was set at 1650 feet (approximately 500 meters) and the minimum spacing was set at 260 feet (approximately 80 meters).

The Surface Water Modeling System (SMS) program version 10.1 was utilized in generating the mesh. Features that may inhibit or contribute to flow were first identified and series of lines or feature arcs were created with nodes distributed along these arcs at a prescribed density. The node density could vary along the feature arcs, depending on the type of feature and location within the model domain. The SMS program was then utilized to generate the mesh, creating additional nodes in the domain interior and connecting the nodes to develop the mesh elements. The seamless DEM data was then interpolated to the mesh to specify the vertical elevations at each node and represent the underlying terrain.

For the mesh development activity, the team followed the quality management plan (QMP) standards and conducted extensive checks of the mesh. After an initial review by the mesh developers, a detail check was conducted on each section of the mesh. The detail check involved identification of any mesh quality issues and verification that the mesh development guidelines were followed, as well as a check of the interpolated bathy/topo elevation data at the mesh nodes. Two independent technical reviews (ITR) were conducted. A first check was done to compare the mesh for Monmouth and Ocean counties because the mesh sections were being developed by people in different locations. After the mesh sections were merged, another ITR was conducted on the complete mesh. A final audit was conducted of the completed mesh and of the QA files.

The final SWAN+ADCIRC mesh has 604,790 nodes and 1,188,640 elements. The high resolution portion of the mesh includes Delaware Bay, New Jersey, the Hudson River valley up to Troy, New York, New York City, Long Island Sound, and Long Island. Rough county boundaries and the detailed portion of the mesh are shown in the Figure 3-4 below. The final mesh is referenced to mean sea level (MSL) vertical datum and the Geographic Coordinate System (i.e. longitude and latitude).

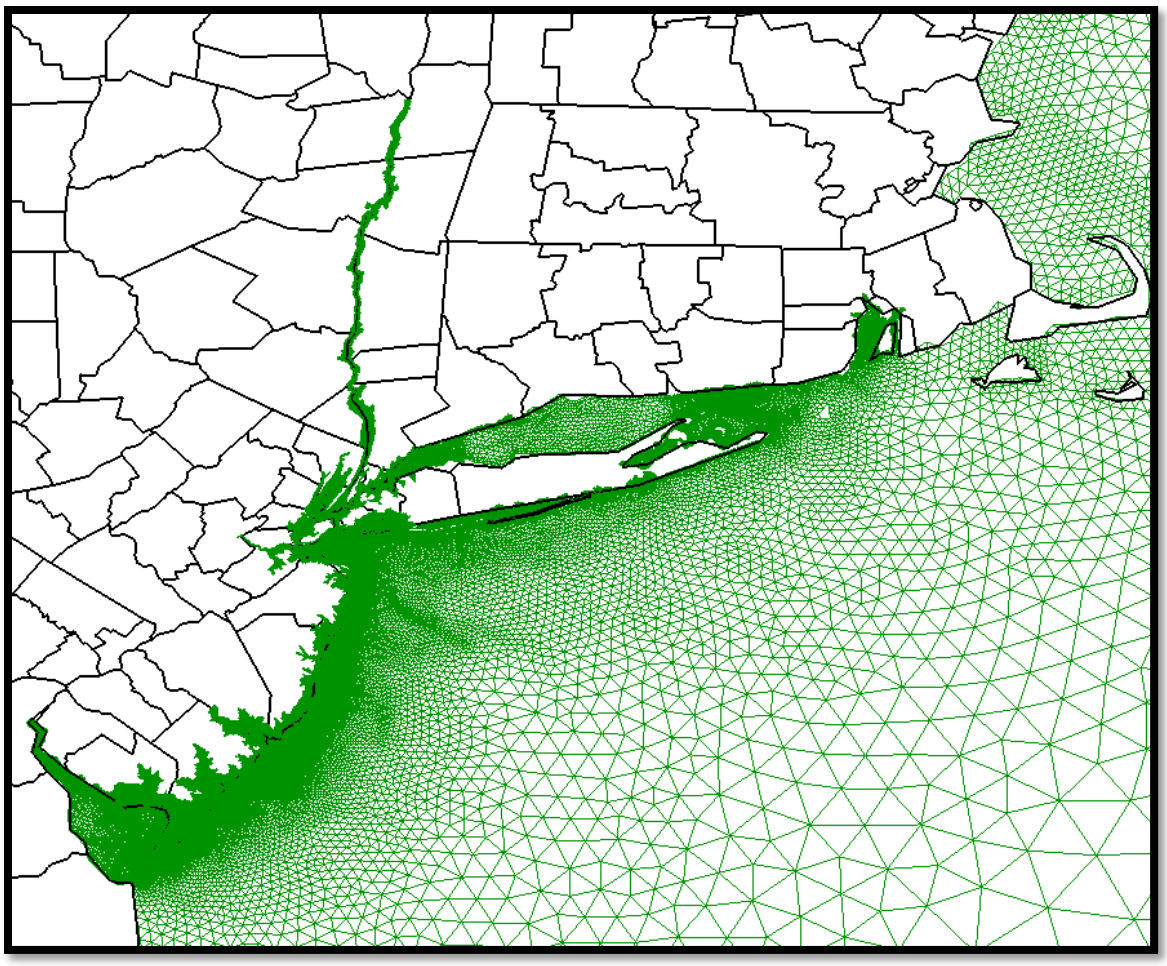

Figure 3-4: ADCIRC/SWAN Mesh

The ADCIRC model allows the incorporation of an additional input file called the nodal attributes file (or fort.13 file). This input file lets the user specify model parameters on a node-by-node basis allowing spatial variation in the parameter values. The parameters that will be used for the Region II Storm Surge Study are the *surface directional effective roughness length*, the *surface canopy coefficient*, and the *Manning's n at the sea floor*. These parameters are mainly defined based on currently available land use data and an evaluation of current aerial imagery. For this study area there were three main data sources available: National Land Cover Dataset (NLCD), the New Jersey Land Use/Land Cover (NJLU), and the Gap Analysis Program (GAP). Each of the data sources were evaluated to determine the most appropriate one to apply for each parameter. For the surface directional effective roughness length, the NJLU data is used in NJ and the NLCD is used in the NY area. For both the surface canopy coefficient and the manning's n coefficient, the NJLU data is used in NJ and the GAP data is used in NY.

SECTION FOUR STORM SELECTION & CHARACTERIZATION

4.1 PURPOSE

The purpose of storm selection and characterization is to obtain appropriate meteorological and storm surge data for past storms in, or affecting, the project area as the basis of providing a quantitative characterization of the present storm climatology that is efficient and optimized to support storm surge analyses with meteorological and a computationally demanding hydrodynamic numerical models.

4.2 METHODOLOGY

The FEMA Region II Coastal Flood Study determines the annual flood frequency distribution along the open New Jersey coastal, the coastal areas of New York City and Westchester County, NY, and along the banks of the tidal section of the Hudson River. Both tropical cyclones (e.g. hurricanes) and extra-tropical storms (e.g. nor'easters) are capable of producing significant coastal storm surge flooding. Tropical cyclones are normally represented by a limited number of meteorological parameters, each with a statistical frequency distribution. Because this cannot be done for extra-tropical storms, non-parametric representation consisting of a catalog of major historic storms is used.

CYCLONIC STORMS - The steps to characterize these past events include:

Historical data sources - Offshore: NOAA Marine Environmental Buoy Database – ocean data buoys and International Comprehensive Ocean Atmosphere Data Set (ICOADS)- ship bourn observations. Coastal and Inland: C-MAN (Manned coastal stations); NOAA National Climatic Data Center (land-based Integrated Surface Hourly (ISH) database). Satellite: TOPEX and JASON-1; ENVISTA; ERS-1; ERS-2; NSCAT; QUIKSCAT. Aircraft: National Hurricane Center Tropical Prediction Center (NHC/TPC); NHC Hurricane Research Division (NHC/HRD). Far-field conditions: National Center for Atmospheric Research (NCAR) Computational and Information Systems Laboratory (CISL). Compiled tracks and parameters: NOAA HURDAT; NWS Reports; NHC Post-storm reports; Monthly Annual Review annual summaries; published papers.

Search/Capture Area – Three zones bounded by 38 N – 42 N and 64 W- 72 W, 72 W – 76 W, and 76 W -82 W.

Period of record - Initial search: 1900 – 2009 (235 events), final period of record is post-WW 2 with 1938 and 1944 storm added (30 events and 420 'snapshots').

Tropical System Parameters –

Initial parameters: total central pressure deviations; Holland B, and pressure drop associated with up to two pressure radii; storm landfall; storm track azimuth at landfall, landfall tide phase (eight parameters).

> An initial study of the radial structure of the wind and pressure fields showed that about half of the storms within the period of record were best represented with a double exponential function, which would call for two Holland B values and a parameter (pressure deficit associated with each radii) representing the distribution of the total storm energy between these two radial distributions. Subsequent sensitivity tests with the

hydrodynamic model (ADCIRC) operating on the simplified topo/bathy grid showed that the computed coastal surge heights were not sensitive to this refinement in the definition of the wind and pressure fields. Accordingly, a new evaluation of all of the storms within the period of record was carried out so that the best single exponential fits could be obtained.

Final parameters - central pressure deviations; storm pressure radius; Holland B; storm landfall; storm track azimuth at landfall (five parameters). Note – special sensitivity tests made with ADCIRC and a small bathy grid to confirm at double vortex representation of hurricanes in not necessary for this surge study.

Storms for Hurricane Characterization -

Table 4-1 shows the hurricanes selected for inclusion in statistical characterization of the five parameters:

Year	Name	Max Wind Speed (kts)	Minimum Central Pressure (mb)	Track Type
1938	Not Named	120	937.0	Ocean Direct
1944	Not Named	105	952.7	Ocean Direct
1948	Not Named	80	979.5	Offshore
1952	Baker	100	961.5	Offshore
1953	Barbara	90	970.0	Coastal/Offshore
1953	Carol	90	971.0	Offshore
1954	Carol	100	962.3	Ocean Direct
1954	Edna	110	947.0	Ocean Direct
1954	Hazel	75	984.0	Inland
1955	Connie	85	976.4	Inland
1958	Daisy	90	969.3	Offshore
1960	Donna	95	962.5	Coastal Direct
1961	Esther	90	968.7	Recurving/Loop
1967	Doria	85	976.0	Recurving/Loop
1969	Gerda	85	975.0	Offshore
1972	Agnes	80	977.0	Coastal Direct
1976	Belle	85	974.7	Ocean Direct
1978	Ella	100	961.2	Offshore
1985	Gloria	110	951.0	Coastal Direct
1990	Bertha	85	973.4	Offshore
1991	Bob	105	952.0	Ocean Direct
1993	Emily	95	966.1	Offshore
1996	Edouard	100	961.8	Offshore
1996	Hortense	100	959.7	Offshore
1999	Floyd	75	982.0	Coastal Direct
2002	Gustav	95	965.2	Coastal Offshore
2003	Isabel	75	984.4	Inland
2004	Alex	105	957.0	Coastal Offshore
2007	Noel	95	967.0	Offshore
2009	Bill	100	961.5	Offshore

Table 4-1: Storms for Hurricane Characterization

Characterization of Hurricane Climate -

The data for each of the hurricanes shown in the table were passed to RAMPP Team Member Dr. G. Toro at Fugro/W. Lettis for statistical analyses (see summary titled Storm Statistics and Tracks).

EXTRA-TROPICAL STORMS - Thirty storms were selected to represent major extra-tropical events affecting the study area.

Selection criteria – Base on storm surge levels at NOAA tide gages. Events above 99th percentile measured residual water level taken from time series at six long-term tide stations in the project area (Willets Point, The Battery, Sandy Hook, Atlantic City, Cape May, Lewes) and three peripheral locations (New London, Montauk, Chesapeake Bay Bridge). Surge levels corresponding to dates of tropical events were eliminated. Storms were selected to adequately characterize the major events that have affected the whole study region.

Period of record - 1 January 1950 through 30 November 2009

Selected Major Extra-tropical Storms –

Start Date(s)*	Start Date(s)
November 11, 1950	December 11-12, 1992
April 13, 1961	March 13 - 14, 1993
March 6 - 7, 1962	March 3, 1994
January 9 - 13, 1964	December 24, 1994
January 23, 1966	February 4, 1995
November 12, 1968	November 14 -15, 1995
December 17, 1970	January 8, 1996
February 8, 1971	October 19 - 20, 1996
November 25, 1971	December 6 - 8, 1996
February 19, 1972	January 28, 1998
December 2, 1974	February 5, 1998
January 25, 1979	October 25, 2005
March 29, 1984	April 16, 2007
January 22 - 23, 1987	May 12-13, 2008
Oct 31- Nov 1, 1991	November 13-14, 2009

Table 4-2: Nor'easters for Extra-tropical Storm Characterization

Note - in some cases, the start date is not the same across the study region and is shown with multiple dates.

Characterization of the Extra-tropical Storm Climate –

Unlike hurricanes, there is no accepted list of meteorological parameters that adequately define extra-tropical storms. Instead, the 30 extra-tropical storms listed above are taken to represent the present and future storm climate. The storm surge characteristics of each of these events are estimated by simulating the storm meteorology and surge propagation with numerical models. The computed maximum surge heights, adjusted for the effects of the astronomical tide, are then directly used to statistically characterize the flood levels at points densely distributed over the entire study region.

SECTION FIVE STORM STATISTICS AND TRACKS

5.1 PURPOSE

The purpose of Storm Statistics and Tracks task is to develop a procedure, specific to the New Jersey/New York City project area, to generate a set of synthetic storms, and associated annual rates, that are representative of the statistical characterization of the hurricane climate in the region. These synthetic storms will be used as inputs to the numerical models that calculate the hurricane-induced winds, coastal surge, and waves. Results from these numerical models, together with the storm annual rates, will be used to compute the annual coastal flood frequencies over the entire study area.

5.2 METHODS

Because hurricane storm surge events are relatively rare occurrences, characterized by flood levels that vary both inland from, and along the shoreline, it is advantageous to use numerical models to compute surge behaviors for a large number of representative synthetic storms. This allows the calculation of the surge elevation recurrence frequencies with uniform statistical precision over the whole study region. In order to apply this modeling approach, it is first necessary to develop a statistical characterization of the storm climate, generating a set of synthetic storms that represent the full range of storms that could occur and affect the project area and their associated frequencies, and then compute the effects from these storms using numerical models.

Methods to accomplish these tasks have been long developed but are changing rapidly owing to the new round of studies by FEMA and the USACE following the major storms of 2004 and 2005. In this summary the methods developed for, or applied in the New Jersey/New York City coastal flood study are described.

5.2.1 Statistical Characterization of the Hurricane Climate

Data – The needs of the Storm Statistics Task were integrated into the preceding Storm Selection and Characterization Task through a series of meetings, telephone discussions, and e-mail communications. Accordingly, the data from the 30 hurricanes that are representative of the range of hurricanes that affect the project area produced by this preceding task were adequate.

Probabilistic representation of storm frequency and characteristics – A complete representation is obtained with the determination of the following parameters: the storm rate (i.e., how frequent hurricane landfalls are in the area), and probability distributions for the intensity, size (radius), heading, and forward speed of the hurricane as it approaches land.

Storm rate – The storm rate was determined using the method of Chouinard and Liu (1997; see also Chouinard, 1992)that uses a distance weighted average of storm tracks that enter the search area (see the Storm Selection and Characterization summary for the definition of the capture area). Hurricanes since 1948 with central pressure deviation greater than 33 mb were considered. The distances, for this and all other parameters, are taken from a line perpendicular to each track that intersects each of the reference points. To account for spatial variability, a total of seven reference sites were distributed along the coast from Cape May (Point 1) to Montauk Point (Point 7). Where the results were uniform, a blended characterization was used.

The storm rate was shown to vary smoothly along the coast, with the lowest values occurring in the vicinity of New York City and the highest values offshore to the east. This rate varied from 0.035 to 0.060 storms/degree/year, increasing with offshore distance. A degree (or more precisely, an equatorial degree) is approximately 60 nautical miles or 69 statute miles.

Heading (Azimuth)- Found to have a very narrow normal distribution with tracks generally parallel to the New Jersey coast. Mean of 22^o (NJ sites) and 23^o (LI sites) both with standard deviations of only 10^0.

Central Pressure Deviation – Fitted with a three-parameter (or truncated) Weibull distribution. A single distribution adequately represents the entire study region.

Pressure Radius – The pressure radius is generally very similar to the radius from the storm center to the zone of maximum winds (or radius of maximum winds). Here it is best fit with a log-normal distribution, which is correlated with the central pressure deviation according to a relationship developed by Vickery and Wadhera (2008) based on hurricanes over a large part of the Atlantic Ocean.

Holland B - Found to have a normal distribution with a mean of 1.1 and a standard deviation of 0.2 (no units) and independent of both the central pressure deviation and the pressure radius.

Forward Speed - Normally distributed and correlated with the central pressure deviation (larger storms go faster). These speeds are considerably greater than values typical of the well-studied Gulf of Mexico, and it shows a marked tendency to increase along the length of the storm track.

5.2.2 Application of the JPM-OS-Q Procedure and Development of the Synthetic Storm Set

Application of the JPM-OS-Q - - The Joint Probability Method (JPM) was developed for coastal storm surge studies by Myers (Myers, 1975; Ho and Meyers, 1975). JPM provides a mathematical framework for the calculation of the probabilities of storm surge elevations that could be equaled or exceeded in any given year in terms of the hurricane climatology and hurricane surge effects.

Although the conventional JPM approach has been used in earlier FEMA coastal flood studies the evaluation of the JPM function using conventional numerical-integration approaches is impractical in this study for the following two reasons: (1) each evaluation involves computationally intensive numerical calculations of wind, waves, surge, wave setup, etc.; and (2) numerical evaluation of the 4-dimensional function by conventional approaches requires an evaluation for each of the possible combination of parameter values. Typically this can translate to a requirement for carrying out thousands of storm surge simulations (the so-called curse of dimensionality). When a computational resource demanding hydrodynamic model such as ADCIRC is to be used, this becomes prohibitive with respect to schedule and costs.

A sophisticated method, named the Joint Probability Method – Optimum Sampling – Quadrature (abbreviated as JPM-OSQ; see Toro et al. 2010) was developed to optimize the number and distribution of discrete value-classes of five of the parameters (central pressure deviation, pressure radius, Holland B, forward speed, and track azimuth at landfall) such that a relatively small number (35) of individual parameter combinations, together with their associated probabilities, can sufficiently represent the entire joint probability distribution hurricane parameters that can occur in the project area given a continuation of the present storm climate. We refer to this as the basis storm set.

Each storm in the basis storm set is replicated multiple times along the coast, using a perpendicular spacing of Rp (1/2 Rp along the NJ coast because the coast is nearly parallel to the storm direction), resulting in 159 storms The rate (in units of year^{-1}) assigned to each resulting storm is equal to the probability of that parameter combination within the basis storm set, multiplied by the rate per unit length of coast at the landfall location, and ten multiplied by the perpendicular spacing.

Depending on the landfall location and heading, each storm is associated with a given master track (based on a historical storm), and the geometry of the master track is then modified so it conforms to the desired landfall location and heading. For storms making landfall in New Jersey and as far East as Islip, NY (denoted as NJ storms), two master tracks were used, depending on the heading. For storms making landfall to the East of Islip (denoted as LI storms), one master track was used. This scheme resulted in three families of tracks.

It was found that tracks for past events with central pressure deviations greater than 33 mb do not include exiting storms. There is also a good physical reason for this: storms that have traveled any significant distance over land are weaker and are not expected to contribute to flooding hazard. An unusual feature of this study is that the presence of Long Island Sound causes storms moving on tracks east of Long Island can funnel a significant surge into the western portion of the sound. Overall tracks between eastern Rhode Island and the Delaware Bay are significant and are well represented by the three families as shown in Figure 5-1.

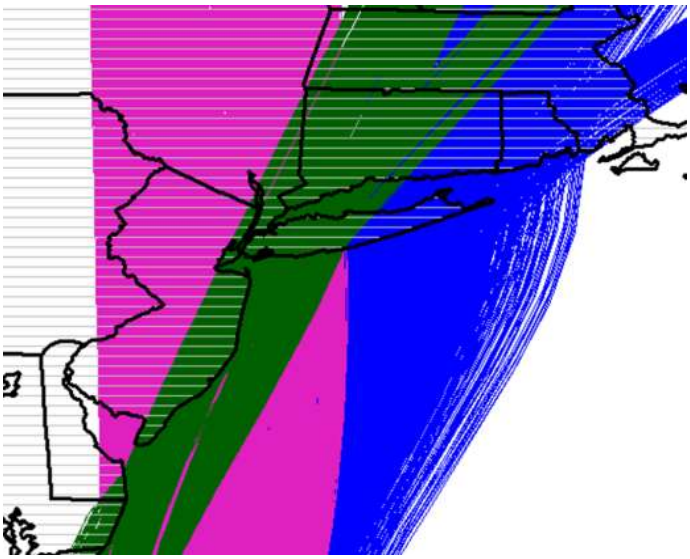

Figure 5-1: Three Hurricane Track Families

Sensitivity tests in previous FEMA coastal flood studies showed that the best balance between avoiding uneven computed storm surge heights due to a track spacing that is too large and reducing the total number of synthetic storm tracks to a practical set is obtained by spacing the tracks according to the pressure radius of the individual storm magnitude being modeled (Niedoroda et. al. 2010). Because of the shallow angle between the general coastline of southern New Jersey and the storm track azimuths, this perpendicular spacing between tracks was reduced to one half of the pressure radius for synthetic storms making landfall in this part of the study area.

Verification of the JMP-OS-Q Synthetic Storm Set

Because the JPM-OS-Q optimization methodology makes use of some simplifying assumptions in order to determine the basis storm set, it is necessary to demonstrate that the 159 JPM-OS-Q synthetic storms can adequately match the results of the more comprehensive and detailed application of the full JPM approach.

The verification procedure consisted of carrying out a full JPM analysis of the storm surge heights across the project area with the same hurricane, Planetary Boundary Layer (PBL) Hurricane Model, and hydrodynamic,ADCIRC, numerical models as the main study. Two simplifications made the verification work much faster than that required for the full study: the effects of wave set-up were neglected and a relatively simple bathymetry grid was input for the ADCIRC model. The first of these simplifications is based on the concept that a comparison of the JPM-OS-Q method and the full JPM is equally valid without the relatively small contribution of wave set-up. This saved applying the numerical wave model and allowed the use of a grid with considerably large minimum element sizes. The use of the simplified ADCIRC bathymetry grid greatly speeds the model execution time, allowing the 4108 storm simulations required for the full JPM analysis to be carried out in a few days.

The JPM analysis was rigorously developed using one-dimensional quadratures (e.g., Miller and Rice, 1983) for each storm characteristic, following the same general approach described earlier for replicating landfalls and assigning master tracks. The resulting 4108 synthetic storms were simulated using a modified version of the North Atlantic ADCIRC bathymetry grid. The modifications included making better and more realistic representations of the tidal waterways in the New York City area. This grid does not extend overland so that the computed storm surge elevations were taken at the shoreline. A total of 49 output points were arranged over the portion of the model grid within and near the project area. Upon completion of the ADCIRC simulations the statistical behavior of the surge heights at each of these output points was analyzed to determine the flood elevations associated with the 0.01 and 0.002 annual probabilities.

Similar calculations were performed with the 159 JPM-OS-Q storms, and the index coastal flood elevations at the same 49 output points were determined. A comparison of the results for the 0.01 probability level from the JPM and JPM-OS-Q procedures at the 49 output points resulted in a mean difference of 0.1 ft, a maximum individual difference of 1.3 ft, and a standard deviation of 0.5 ft. The corresponding values for the 0.005 probability level were -0.4 ft, 1.3 ft, and 0.4 ft, respectively. These demonstrate that the JMP-OS-Q set of 159 storms can be used to adequately match the results of the full JPM analysis.

The experience of our team with similar problems on other projects lends additional confidence regarding the adequacy of the JPM-OS-Q storm set.

Inclusion of Astronomical Tide

The astronomical tide in the New Jersey/New York City project area is dominantly semi-diurnal with a significant variation in the tide range over the fortnightly cycle between spring and neap phases. Tide ranges are on the order of 3 ½ ft to 8 ft across the area. This range is a significant fraction of the storm surge heights as determined in an earlier FEMA coastal flood study. This, in turn, means that the approach for including the effect of storms making landfall at random phases of the astronomical tide that was developed and used in other recent FEMA coastal flood studies such as in the West Florida, Louisiana, and Mississippi examples (see Toro et al. 2010,

Niedoroda et al. 2010) would not be valid. These Gulf of Mexico areas have small tide ranges compared to the surge heights of interest, and the tide is dominantly diurnal.

A new approach to FEMA studies has recently been implemented for the project in South Carolina. This method is derived from an approach developed and applied by Walton and Dean for storm surge studies along the coasts of Florida. It consists of including the random phase of the astronomical tide directly into the hydrodynamic model simulations. These Florida studies follow a Monte Carlo analysis method that involves thousands of modeling simulations. To determine whether this could be used in the New Jersey/New York City project, it was necessary to validate an application that is consistent with the 159 simulations of the JPM-OS-Q method.

To verify that the use of only one realization of the random tide phase for each of the 159 JPM-OS-Q synthetic storms provides stable results, the project team performed a test using the results from the ADCIRC runs that had been previously used for comparison against the full JPM storm set. These ADCIRC runs were made at a mean tide level and the outputs were at 49 locations along the shoreline. To introduce the effect of tide, the hydrograph of the computed surge was combined with the National Ocean Survey (NOS) hydrograph of predicted tide during the days preceding and following the randomly picked landfall time of each storm, and the peak combined water elevation was identified. This was done for the 159 synthetic storms and at the 59 locations, and the results were then used to calculate the combined water elevations for the 0.01 and 0.002 recurrence probability at each location. This process was repeated 500 times, picking new random landfall times for the 159 storms each time.

The variation of the 0.01 and 0.002 water elevations during these 500 realizations of the experiment yields information about the stability of the procedure. The average values at each location indicate the exact values of the 0.01 and 0.002 water elevations. The standard deviations indicate how much the results from one realization are likely to deviate from these exact values. These standard deviations vary slightly across the 49 locations, with values near 0.2 ft for the 0.01 recurrences and 0.4 ft for the 0.002 recurrence. Because these standard deviations are small, this test confirms that it is sufficient to use only one realization of the random tide phase for each JPM-OS-Q storm.

It is worth noting that the purpose of the above test is only to verify the probabilistic stability of the approach. Therefore, the test is not invalidated by the fact that this superposition of the two hydrographs is somewhat simplistic (and clearly not applicable to sites on land). In the production ADCIRC calculations, all hydrodynamic interactions between surge and tide are automatically included.

Inclusion of Secondary Parameters

Secondary parameters have been used with JPM analysis in fields such as earthquake engineering for many years (for example see SSHAC, 1997) and have been introduced into coastal storm surge frequency analyses during the post-Katrina Interagency Performance Evaluation Task Force Studies (IPET). These parameters include effects that affect the surge heights and are relatively small in comparison with the magnitude of the surge elevations at the return frequency of interest. Unlike the major parameters (e.g. central pressure deviation, pressure radius, etc.), the secondary parameters are not represented within the JPM integral, which saves having to increase the number of storm surge model simulations and thus side steps

the curse of dimensionality. More complete explanations can be found in Toro et al. (2010b), Niedoroda et al. (2010) and Resio (2007).

The secondary parameters of interest in the New Jersey/New York City Coastal Flood Study include: the effects on storm surge elevations due to the departure of real wind and pressure fields from the idealized representations used in the numerical model simulations and the limitations of the software used to compute storm surge elevations (including the wave and surge components).

One quantifies these secondary parameters by specifying their associated standard deviations. Secondary parameters were first evaluated in the Mississippi and Louisianastudies, and their values provided a useful starting point. Following the approach utilized in these studies, these standard deviations will be quantified using a combination of modeling and comparisons to data such as historical high-water-marks and tide-gage records.

The effect of the secondary terms is introduced in the surge-frequency calculations, after all the modeling runs have been performed. Details of this approach are described in Niedoroda et al. (2010).

5.3 EXTRA-TROPICAL STORMS

In order to extend the analysis of the coastal flood recurrence frequencies to the annual probability of 0.1 (the so-called 10-year level), it is necessary to include the effects of strong extra-tropical storms. These are dominantly of the variety commonly referred to as Nor'easters. Screening calculations have shown that the frequency of surge elevations around the 0.1 level is controlled by these events; therefore hurricanes and tropical storms with central pressure deviations less than 33 mb can be neglected.

Our attempts to find a systematic set of meteorological parameters that can define the behavior of these storms were not successful as other previous attempts. Consequently, these events are included in the overall analysis in a non-parametric procedure wherein the 30 dominant storms that have impacted the study area over the past 30 years are to be replicated by the numerical models to assess the resulting maximum surge elevations in a uniform manner over the entire study area. The methods for selecting these storm events have been discussed in the summary, entitled "Storm Climate Characterization," which is included in this document. The use of the resulting computed storm surge elevations is described in another summary chapter, entitled "Coastal Storm Surge Return Period Analyses."

Including the Astronomical Tide

It is important to include the effect of the astronomical tide level variations on the surge elevations computed for the extra-tropical storms. The sample population of 30 real storms is associated with only one realization of this interaction. It is necessary to generalize these effects over a range of possible interactions between tide levels and surge levels. A method for including astronomical tide effects into the analysis of surge level frequencies for hurricanes similar to that described above for including has been adopted.

The set of 30 selected extra-topical events was simulated on the same simplified AdCIRC model grid as used previously with no tide variations so that all model runs were made at mean tide level. As with the corresponding hurricane-related issues the hydrographs of these 30 events

were combined with random selections of the predicted tide level time series for durations identical to the duration of each storm surge hydrograph. This was carried out for all 49 output point results and repeated 500 times. In each of the 500 individual analyses the surge elevations associated with the 0.1 annual occurrence probabilities (the so-called 10-yr events) were determined. The combined results had standard deviations of 0.2 ft. These values mean that the probable error associated with any one set of 30 storm simulations with a start time randomly assigned with respect to tide phase would be 0.2 ft.

5.4 REFERENCES

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SECTION SIX MODEL VALIDATION FOR FEMA REGION II STORM SURGE STUDY

6.1 PURPOSE

Storm surge modeling is being conducted for the Region II Coastal Flood Study area using the two-dimensional (2-D) ADCIRC Model for Oceanic, Coastal and Estuarine Waters , which is dynamically coupled with the unstructured version of the wave field model Simulating Waves Nearshore (UnSWAN). The model validation process verifies the model's performance and ability to predict storm surge levels based on a tidal simulation and hindcasts of historical storm events.

6.2 METHODOLOGY

The storm surge model validation process consisted of a tidal calibration followed by simulations of both tropical and extra-tropical historical storm events.

6.2.1 Tidal Calibration

To ensure the ADCIRC model is capable of predicting water levels and coastal hydrodynamics during typical weather conditions, the model was utilized to predict tidal conditions within the study region for a period of 45 days. The model was forced with tidal constituents at the open ocean boundary in order to simulate water levels which were then compared with known tidal conditions at seven NOAA stations.

The seven NOAA stations listed in Table 6-1 were selected for tidal comparisons based on their relevance to the current study and the availability of tidal harmonic data from the NOAA CO-OPS Web site.

Table 6-1: Tide Gage Data Sources

Montauk, NY	8510560
Cape May, NJ	8536110
Atlantic City, NJ	8534720
Sandy Hook, NJ	8531680
Bergen Point West Reach, NY	8519483
The Battery, NY	8518750
Bridgeport, CT	8467150

The ADCIRC tidal simulations consisted of a 15-day ramping period, allowing the model to enter a steady state, followed by a 30-day period. During this tidal simulation, no additional input conditions, such as river discharges, were specified. Tidal harmonic analyses were performed using the 30-day modeled data output at the NOAA station locations. Modeled amplitudes and phases for eight predominant tidal constituents (M2, S2, N2, K2, K1, O1, P1, Q1) were compared with the values reported at each of the stations by NOAA.

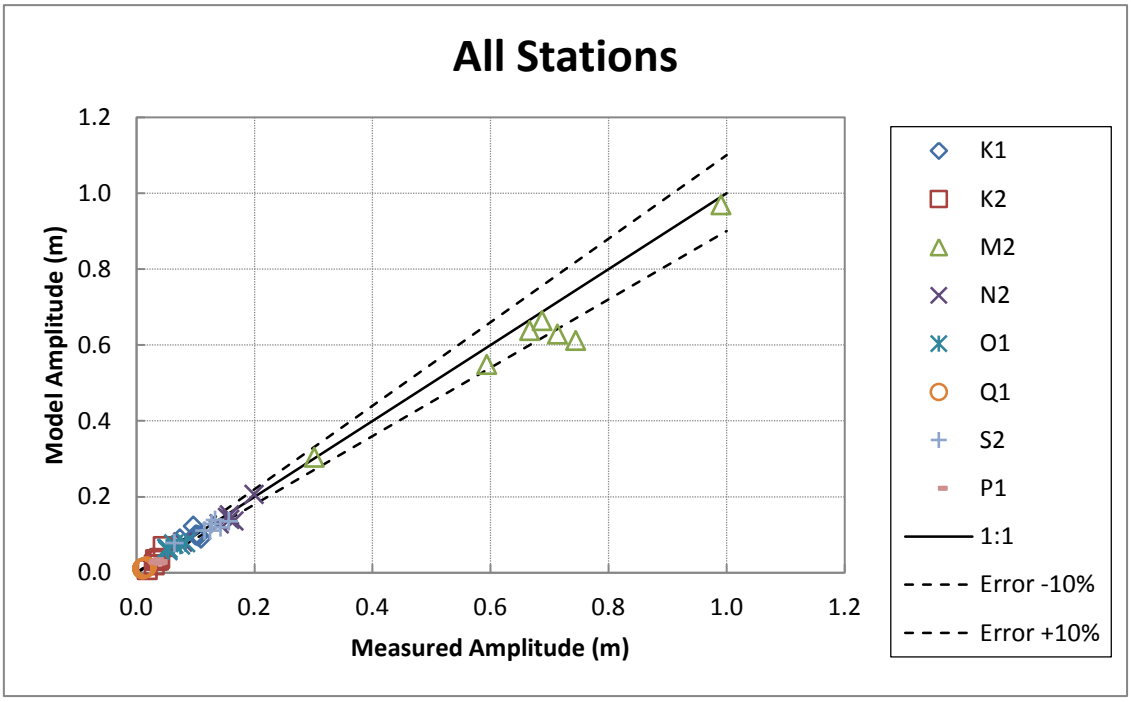
Table 6-2 lists the modeled and measured constituent parameters. The tidal constituents listed for each NOAA station are sorted by amplitude (largest to smallest) and the cumulative percentage of the overall tidal amplitude is shown indicating the contribution of these eights constituents to the tidal signal at each location. Figure 6-1 shows scatter plots comparing modeled and measured amplitudes and phases for all of the NOAA stations.

Overall, there is good agreement between modeled and measured data with differences in amplitude being less than 20% for all significant constituents having amplitude greater than 0.1 meters. Larger amplitude and phase differences exist for stations outside of the detailed study area, such as Montauk, NY and Bridgeport, CT, where the mesh resolution is not sufficient to capture the complex harbor inlets and hydrodynamics.

Table 6-2: Tidal Calibration Constituent Comparisons

Station Name, ID	Constituent	Cumulative % of Tide	NOAA Amplitude (m)	Model Amplitude (m)	Amplitude Difference (%)	NOAA Phase (deg.)	Model Phase (deg.)	Phase Difference (min.)
Montauk NY, 8510560	M2	34%	0.302	0.304	0.7%	46.8	45.8	-2
	N2	43%	0.079	0.080	1.6%	22.2	25.9	8
	K1	51%	0.074	0.089	20.3%	178.7	181.4	11
	S2	58%	0.065	0.078	19.8%	56.6	37.5	-38
	O1	64%	0.054	0.058	7.2%	209.8	207.6	-9
	P1	67%	0.023	0.028	23.5%	193.7	189.8	-16
	K2	69%	0.019	0.008	57.4%	61.6	209	294
	Q1	71%	0.015	0.012	19.3%	192.6	198.8	28
Cape May NJ, 8536110	M2	46%	0.714	0.629	12.0%	28.6	19.3	-19
	N2	56%	0.159	0.140	11.7%	9.7	5.3	-9
	S2	65%	0.125	0.110	11.8%	55.3	42.5	-26
	K1	71%	0.105	0.097	8.1%	200.4	186.4	-56
	O1	77%	0.084	0.079	6.4%	185.6	196.7	48
	P1	79%	0.036	0.028	22.8%	199.2	187.7	-46
	K2	81%	0.033	0.034	3.0%	54.5	52.2	-5
	Q1	82%	0.013	0.013	0.8%	184.1	178	-27
Atlantic City NJ, 8534720	M2	43%	0.594	0.548	7.7%	355.4	352.5	-6
	N2	54%	0.141	0.128	9.0%	335.9	337.7	4
	S2	62%	0.116	0.111	4.7%	17.8	9.6	-16
	K1	70%	0.110	0.090	17.9%	183.2	176.8	-26
	O1	76%	0.075	0.073	2.8%	166.1	180.6	62
	P1	78%	0.033	0.027	17.0%	178.5	167.5	-44
	K2	80%	0.031	0.021	32.9%	18.7	20	3
	Q1	81%	0.012	0.011	6.7%	168.7	164.1	-21

Station Name, ID	Constituent	Cumulative % of Tide	NOAA Amplitude (m)	Model Amplitude (m)	Amplitude Difference (%)	NOAA Phase (deg.)	Model Phase (deg.)	Phase Difference (min.)
Sandy Hook NJ, 8531680	M2	44%	0.688	0.664	3.5%	6	1.5	-9
	N2	55%	0.158	0.152	3.8%	348.6	348.9	1
	S2	63%	0.134	0.139	3.5%	32.6	24.9	-15
	K1	70%	0.103	0.099	4.1%	175.7	177.7	8
	O1	73%	0.054	0.064	18.1%	172.5	184.7	53
	K2	76%	0.038	0.033	12.9%	31.5	20.5	-22
	P1	78%	0.031	0.028	11.0%	180.2	181.7	6
	Q1	79%	0.011	0.010	7.3%	183.1	181.2	-9
Bergen Point West Reach NY, 8519483	M2	44%	0.745	0.612	17.9%	21.2	32.4	23
	N2	53%	0.166	0.136	17.9%	5.1	20.7	33
	S2	62%	0.143	0.119	16.6%	51.2	61.6	21
	K1	68%	0.106	0.097	8.1%	182.9	194.9	48
	O1	71%	0.053	0.062	17.7%	179.3	203.2	103
	K2	73%	0.040	0.037	7.0%	47.9	54.5	13
	P1	75%	0.033	0.027	19.4%	181.8	205.1	93
	Q1	76%	0.011	0.010	7.3%	191.3	202.6	51
The Battery NY, 8518750	M2	43%	0.667	0.638	4.3%	19	11.8	-15
	N2	53%	0.155	0.145	6.6%	360	358.6	-3
	S2	62%	0.128	0.129	0.4%	43.3	34	-19
	K1	68%	0.101	0.099	2.0%	179.6	182.1	10
	O1	72%	0.052	0.064	22.5%	176.3	189.3	56
	K2	74%	0.035	0.032	8.3%	43.9	36.8	-14
	P1	76%	0.031	0.027	14.2%	183.9	187.5	14
	Q1	77%	0.011	0.010	6.4%	190.7	186.2	-20
Bridgeport CT, 8467150	M2	51%	0.991	0.969	2.2%	109.6	101.6	-17
	N2	62%	0.200	0.206	2.8%	87.6	83.8	-8
	S2	70%	0.157	0.135	13.9%	135.9	122.2	-27
	K1	75%	0.097	0.122	26.2%	191.6	196.1	18
	O1	78%	0.064	0.076	18.1%	219.5	218.4	-5
	K2	81%	0.046	0.069	49.8%	134.7	153.4	37
	P1	82%	0.030	0.033	9.3%	204.1	210	24
	Q1	83%	0.018	0.015	15.0%	205.7	214.3	39



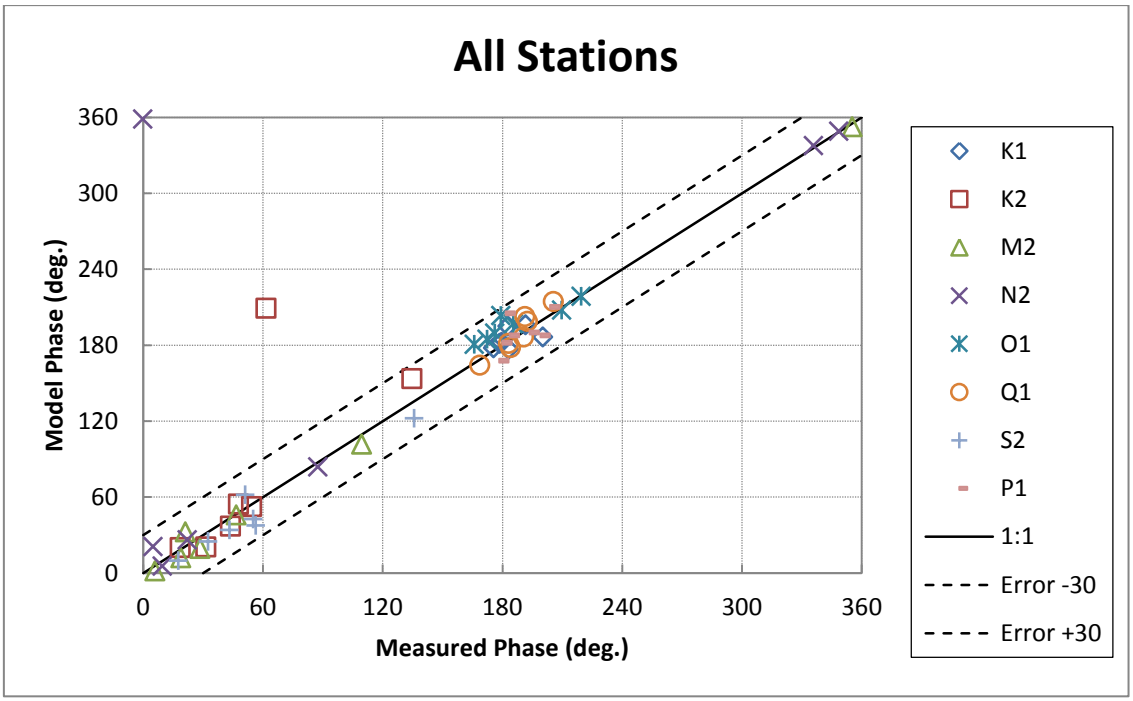


Figure 6-1: Comparison of Tidal Constituents from Tidal Calibration

6.2.2 Storm Validation

The combined ADCIRC and UNSWAN model was validated against measured data for both maximum storm surge levels and wave heights.

The historical storms selected for validation included both tropical and extra-tropical events. The tropical storm events included:

- H1938 – Hurricane of 1938 ("Long Island Express")
- H1944 – Great Atlantic Hurricane of 1944
- H1960 – Hurricane Donna
- H1985 – Hurricane Gloria

The extra-tropical events included Nor'easter storms that impacted the region:

- N1984 – March 28-29, 1984 Nor'easter
- N1991 – October 30-31, 1991 Nor'easter ("Perfect Storm" or 'Halloween Storm")
- N1992 – December 11-14, 1992 Nor'easter

These storms were selected for validation as they are well-documented major storm events affecting the region with sufficient measured water level and high water mark (HWM) data.

Measured Storm Surge Data

For each storm, the modeled water levels were compared with verified water level data obtained at NOAA tidal stations (see Figure 6-3)located throughout the study area.

Table 6-3: Selected NOAA Stations With Surge Measurements

					Availability of Verified Data						
Station	Station Name	State	Lat (dd)	Long (dd)	1992 Nor'easter	1991 Nor'easter	1985 Hurricane Gloria	1984 Nor'easter	1960 Hurricane Donna	1944 Hurricane	1938 Hurricane
8467150	Bridgeport	CT	41.1733	-73.1817	Monthly	Monthly	Monthly	Monthly	No data exists		
8518750	The Battery	NY	40.7000	-74.0133	Hourly WL	Hourly WL	Hourly WL	Hourly WL	Hourly WL	Monthly	Monthly
8519483	Bergen Point West Reach	NY	40.6367	-74.1417	Monthly	Ver hourly from 10/29/91 onwards, ver H/L for entire	Hourly WL	Hourly WL	No data exists		
8510560	Montauk	NY	41.0483	-71.9600	Hourly WL	Hourly WL	Hourly WL	Hourly WL	Hourly WL	No data exists	
8531680	Sandy Hook	NJ	40.4667	-74.0083	Hourly WL	Hourly WL	Hourly WL	Hourly WL	Hourly WL	Hourly WL	Hourly WL
8534720	Atlantic City	NJ	39.3550	-74.4183	Monthly	Hourly WL	Hourly WL	Monthly	Hourly WL	Monthly	Monthly
8533615	Barnegat Inlet	NJ	39.7617	-74.1117	Hourly WL	Hourly WL	Hourly WL	No data exists			
8536110	Cape May	NJ	38.9683	-74.9600	Hourly WL	Hourly WL	Hourly WL	Hourly WL	No data exists		

In addition to the data from tide gages, HWM data were available for six of the validation storms with the exception of the 1991 Nor'easter. The USACE was the primary source for the HWM

data. For the 1938 and 1960 hurricanes, many of the HWM points were digitized from maps obtained from the 1976 NY Sea Grant publication[1].

A filtering of the HWM data was then conducted prior to making comparisons with the modeled storm output in order to exclude data where: 1) the HWM was located outside of the detailed overland ADCIRC mesh, 2) the HWM was located in an exposed area where water elevation would include contribution of waves, or 3) the HWM was an apparent outlier compared to other HWMs.

The HWM data were converted to the NAVD88 vertical datum using NOAA's VDATUM software. For the older storms (H1938, H1944, and H1960), it was first necessary to account for the sea level rise that occurred from the time the HWM data was collected to the present National Tidal Datum Epoch (NTDE). For those HWMs that were referenced to the older NTDE, the rates of sea level rise for the nearest NOAA tidal station were applied so that all were adjusted to the current (1983-2001) NTDE. For comparison with the ADCIRC model output, all HWMs were finally adjusted to the NAVD88 elevation datum.

Measured Storm Wave Data

In addition to validation of ADCIRC modeled water levels, modeled wave heights from UnSWAN were also compared with wave height measurements obtained at NOAA's National Data Buoy Center (NDBC) stations within the study area (see Table 6-4). Observed wave data were available for the more recent extra-tropical storms: N1984, N1991 and N1992.

Table 6-4: Selected NDBC Buoys

Station	Lon (dd)	Lat (dd)	Data Availability		
			N1984	N1991	N1992
44004	-70.4330	38.4840	X	X	X
44008	-69.2470	40.5020	X		
44012	-74.6000	38.8000		X	
44025	-73.1660	40.2500		X	X
44009	-74.7020	38.4640		X	
ALSN6	-73.8000	40.4500			X

Model Verifications

In conducting the validation storm hindcasts, modeled peak water levels and time series of water elevations were extracted at selected locations and compared with measured data collected during the storm events. The UnSWAN wave model was also validated by comparing the modeled wave heights with available collected wave data. The steps involved in the model validation process included:

[1] Pore and Barrientos, 1976. Storm Surge: MESA New York Bight Atlas Monograph 6, New York Sea Grant, Albany NY

1. The gathering of historical HWM and NOAA gauge data for the validation storms
2. Hindcasts of the storms utilizing ADCIRC/UnSWAN together with wind and pressure fields reconstructed for each storm
3. A quantitative comparison of modeled and measured peak water levels and waves to assess the overall model performance.

A summary of the peak water level comparison is shown in Table 6-5, and the percentages of comparisons within defined difference ranges are listed. Seventy percent or more of the peak water level comparisons being less than 1.5 feet is a level that has been used in past and ongoing FEMA surge studies as an accepted criterion to evaluate model performance.

The combined surge and wave model for the H1938 storm was initially over-predicting surge values within Raritan Bay while under-predicting within Long Island Sound. After consultation with the developers of the wind and pressure fields, Oceanweather, Inc. (OWI), it was determined that there was some uncertainty in the storm track and intensity due to the lack of data and reliability of the data for this older storm. A reanalysis conducted by Landsea et al. (2008)[2] indicated adjustments to the storm were warranted, and the wind and pressure fields were adjusted based on this reanalysis.

Less than 70% of the comparisons are within 1.5 feet for H1960 Hurricane Donna and H1985 Hurricane Gloria storms. For Hurricane Donna, there was the most measured peak water level data available for comparison purposes, while there were limited data available for Hurricane Gloria. For the other four validation storms, H1938, H1944, N1984 and N1992, greater than 75% of the modeled surge levels are within 1.5 feet of the measured peaks.

Table 6-5: Difference Ranges For Peak Water Level Comparisons

Storm	Number of Comparisons	Difference between Maximum Simulated and Measured Surge				
		< 1 ft	< 1.5 ft	< 2 ft	< 2.5 ft	< 3 ft
H1938	45	71.1%	80.0%	93.3%	97.8%	97.8%
H1944	34	58.8%	76.5%	91.2%	97.1%	100.0%
H1960	88	48.9%	61.4%	69.3%	79.5%	89.8%
H1985	14	40.0%	60.0%	80.0%	100.0%	-
N1984	10	50.0%	92.9%	92.9%	92.9%	92.9%
N1992	27	70.4%	81.5%	88.9%	88.9%	-

[2] Landsea, C., M. Dickinson, and D. Strahan, 2008. *Reanalysis of Ten U.S. Landfalling Hurricanes.* Final report submitted to the Risk Prediction Initiative, 120 pp.

To assist in assessing the model performance related to the prediction of the maximum surge values, Table 6-6 lists the average difference and the absolute average difference of the peak water level comparisons made for each storm, as well as for all validation storms collectively.

Table 6-6: Model Performance For Peak Water Levels

Validation Storm	Number of Comparisons	Avg. Difference (ft)	Abs. Avg. Difference (ft)
H1938	45	-0.20	0.81
H1944	34	0.59	0.94
H1960	88	-0.15	1.28
H1985	14	1.12	1.23
N1984	10	0.72	0.86
N1992	27	0.58	0.93
All Storms	**218**	**0.15**	**1.06**

Given the many sources of uncertainty in hindcasting these storms, including the data collection, meteorology, wave model, surge model, and topographic data, and given there were no general trends observed in looking at the peak water level comparisons collectively for all of the storms, the model validation results compare reasonably well with the available data. An average difference of 0.15 feet and an average absolute difference of just over 1 foot indicate the model is capable at simulating both tropical and extratropical storm events for the purposes of this study.

For each validation storm simulation, significant wave heights and the peak wave period were output from the SWAN model, and time series were extracted to compare with the available measured wave data. Time series comparisons of simulated and NDBC buoy measured wave heights indicate the model performs well at capturing the general wave height trends during the Nor'easter storm events. The model is in line with the measured data with respect to the phase or timing of the peak wave heights, and the simulated wave heights are generally within 20% of the measured values. In order to better quantify the model performance, Table 6-7 lists the root mean square (RMS) error and the bias for each wave height time series comparison, along with the correlation coefficient describing how the modeled waves correlate with the measured waves.

Table 6-7: Error Statistics For Wave Height Comparisons

NDBC Buoy	N1984			N1991			N1992		
	RMSE (m)	Bias (m)	Correlation Coef.	RMSE (m)	Bias (m)	Correlation Coef.	RMSE (m)	Bias (m)	Correlation Coef.
44004	0.67	-0.01	0.94	-	-	-	0.75	-0.15	0.96
44008	0.61	-0.03	0.96	0.85	0.14	0.97	-	-	-
44009	-	-	-	0.51	-0.04	0.94	-	-	-
44012	-	-	-	0.63	0.12	0.91	-	-	-

NDBC Buoy	N1984			N1991			N1992		
	RMSE (m)	Bias (m)	Correlation Coef.	RMSE (m)	Bias (m)	Correlation Coef.	RMSE (m)	Bias (m)	Correlation Coef.
44025	-	-	-	0.54	0.03	0.95	0.55	0.07	0.98
ALSN6	-	-	-	-	-	-	0.39	0.06	0.99

The results from the N1984 comparisons at the offshore 44004 and 44008 buoys indicate the model is slightly negatively biased (under-prediction of waves). The model is shown to be positively biased (over-prediction of waves) at three of the four NDBC buoys having data during the N1991 storm. However, the time series data indicate the modeled and measured maximum wave heights are in good agreement (within 1-2 feet) offshore (44008) and moving closer to shore. The RMS error is shown to be lower at the buoys located closer to shore (44009, 440012, and 440025) when compared to the offshore location. The N1992 Nor'easter wave height comparisons show there is good agreement between the modeled and measured data. The model under-predicts the maximum wave height at the offshore buoy (44004), but shows better performance moving closer to shore at the 44025 and ALSN6 buoys. This is also indicated in the RMS error values.

The results indicate that there is good correlation between the simulated and measured wave heights for the extratropical storm runs (> 90%) at all NDBC buoy locations and that the model is capable of simulating the propagation of storm-generated swell.

SECTION SEVEN PRODUCTION MODEL RUNS FOR FEMA REGION II STORM SURGE STUDY

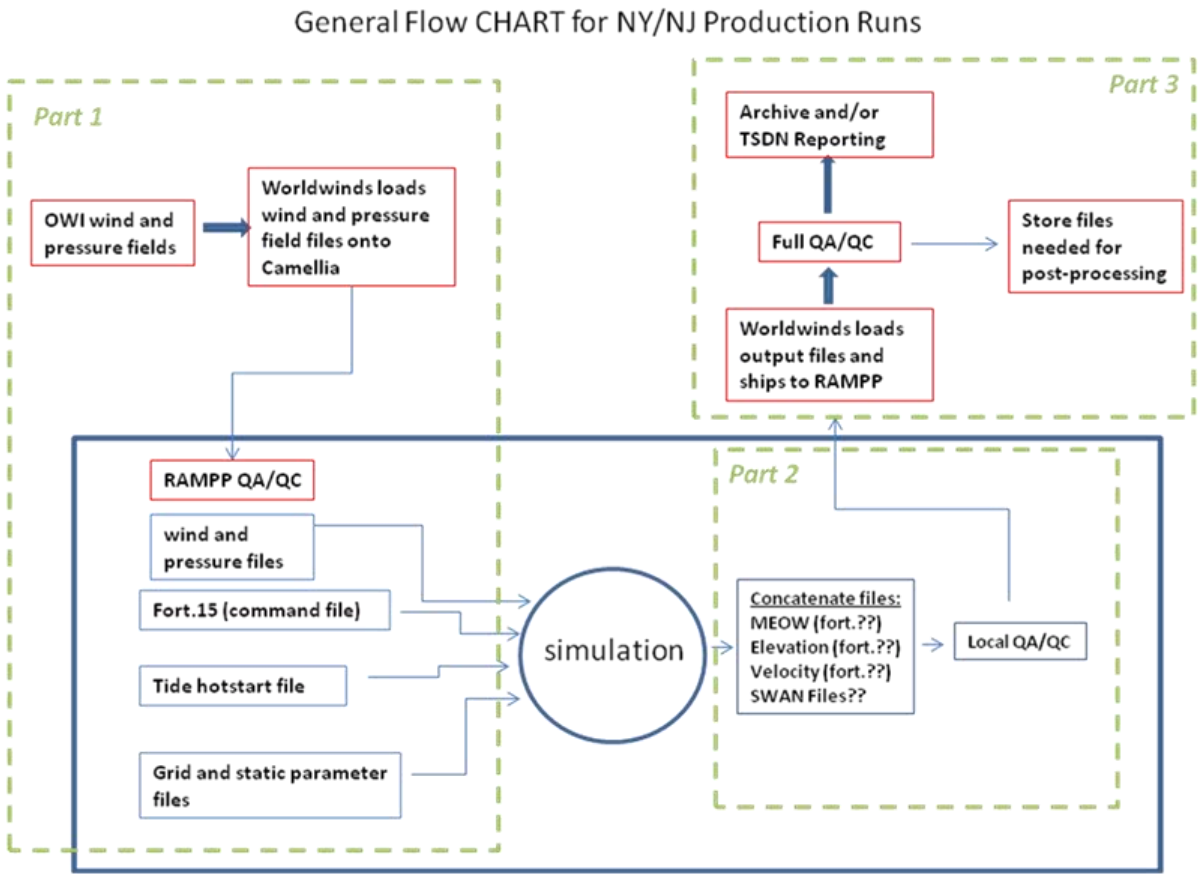
7.1 PURPOSE

Storm surge modeling for the Region II Coastal Flood Study used the 2-D ADCIRC Model for Oceanic, Coastal and Estuarine Waters, which is dynamically coupled with the field model UnSWAN. In order to develop the extreme annual chance surge and wave conditions, ADCIRC-UnSWAN simulations were conducted for the set of synthetic storms that are representative of the full range that are known to occur in the project area (see Chapter 5). These are designated as the "production model runs."

7.2 METHODOLOGY

The production model runs were inclusive of both synthetic tropical and historical extra-tropical storm events. A total of 30 extra-tropical storms were simulated along with 160 tropical storms.

The general process for completing each of the production run simulations is depicted in the flow diagram shown in the figure below. The process contains three basic parts: (1) loading input files and launching the run, (2) post-processing the files and conducting a local QA/QC, and (3) downloading the output files, conducting a detailed QA/QC, and archiving of the input and output files.



The production started with the development of wind and pressure fields for all 190 storms. OWI was responsible for producing the wind and pressure fields. Each storm that was defined by the storm statistical task was run with OWI's PBL in order to produce wind and pressure field files for each production storm. These files were sent to the cluster production center at Worldwinds, Inc.

The production storm environment was setup on a high-performance 144-node cluster (multi-processor computer) at Worldwinds, Inc. The ADCIRC+SWAN input files were loaded onto the cluster for each storm and were organized into folder directories defined for each storm run. Input files included the ADCIC/SWAN mesh and associated input parameter files discussed in previous sections. Tides were included in the production storms by randomly selecting the tidal phase time to start with each storm as described in Section 5. Despite the computation power available, typical storm simulations required 5 to 8 hours to execute.

The storm simulations were setup to provide output at every node in the model domain for the parameters listed in Table 7-1. Upon completion of the storm runs, a local QA/QC of the model output was conducted on the cluster.

Table 7-1: Production Storm Model Output

Maximum water surface elevation
Maximum radiation stress
Maximum water velocity
Maximum wind velocity
Minimum atmospheric pressure
Maximum wave heights Hs (with associated wave direction, mean period, and peak period)
Time series of water surface elevation
Time series of wind speed, direction
Time series of atmospheric pressure
Time series of radiation stress
Time series of wave heights Hs (with associated wave direction, mean period, and peak period)

The local QA/QC process involved an initial check of the completeness of the model run, as well as model output files. This initial QA/QC check determined the following:

1. If the model ran to completion without instabilities
2. If the appropriate output files were created
3. If anomalies were present in the maximum water surface elevation and significant wave height output files, and associated wave period files

Once the production storm had passed the initial QA/QC, the model input and output files were transferred to an external hard drive for delivery to the QA/QC team for a more detailed review. The in-depth detailed QA/QC involved the visualization of model output and generation of contours for the following global output files:

- Peak pressure
- Maximum wind velocity
- Maximum water surface elevation
- Maximum current velocity
- Maximum radiation stress
- Maximum significant wave height

Each contour plot of the model output was reviewed to determine if any anomalies existed and comments were provided when a problem was identified. Where possible, further investigation was conducted by examining the time series output files and creating animations of the model output. Storm hydrographs were also generated from the model output at locations throughout the Region II NY/NJ area. The hydrographs were reviewed to ensure there were no identifiable problems with the model run, and that the peak surge was captured. Particular attention was paid to the maximum water surface elevation output files as this data will provide the water levels for the return period analysis.

If any comments required a response and resolution by the production team, the resolution was back-checked and verified once the final production storm run was complete.

FEMA

Rebuilding after Hurricane Sandy

Building Safer and Stronger Pays Off

(Coastal High Hazard Area: Zone VE)

Flood risk changes over time as conditions in the community change. Sometimes risk goes down, but more often it goes up. Recent analysis shows that flood risk has increased along the New Jersey and New York coast. Advisory Base Flood Elevations (ABFEs) for Hurricane Sandy-affected coastal areas of New Jersey and New York can serve as a guide to understanding current coastal flood hazard risk and the higher elevations that communities should build to in order to reduce their vulnerability to flooding. ABFEs are being developed using updated coastal flood hazard study methodologies and topographic data. They leverage work already underway prior to Hurricane Sandy to update Flood Insurance Rate Maps (FIRMs) planned for preliminary release mid-2013.

ABFEs can help communities and property owners make informed decisions about rebuilding their homes and businesses to reduce their vulnerability to flooding. They provide an indication of how flood elevations and risk zones are likely to change in the near future. Ultimately, new maps will be released that incorporate this advisory data, which may result in new, higher flood elevations or a new, higher flood risk zone designation. Once adopted by communities, flood elevations and flood risk zones affect minimum building requirements and flood insurance premiums. ABFEs represent the most up-to-date assessment of the current flood risk. Over time, it is possible that flood risk will continue to rise, so property owners may want to consider adding an additional factor of safety on to the advisory information.

For more information on updated flood mapping, visit:
www.Region2Coastal.com

Key Points

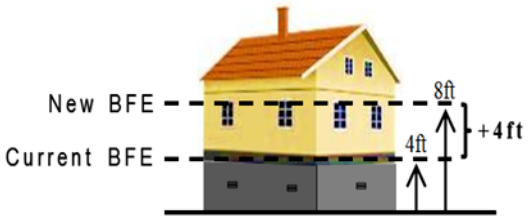
- Flood insurance premiums are based on flood risk. Communities and property owners can save money by reducing their vulnerability to flooding.
- Under new Federal law, flood insurance premium rates on many properties in special flood hazard areas will increase.
- Build correctly and higher to reduce vulnerability to flooding.
- Long-term insurance savings can far exceed initial construction costs.
- ABFEs will be available to communities in the following areas:

  New Jersey Counties Atlantic, Bergen, Burlington, Cape May, Essex, Hudson, Middlesex, Monmouth, Ocean, Union

  New York Counties Bronx, Kings, New York, Richmond, Queens, Westchester

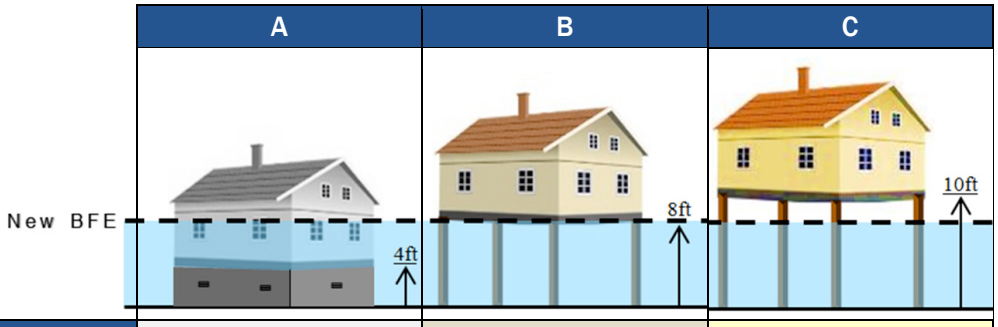
Example Rebuilding Scenarios

Assume that your home has been substantially damaged or destroyed and you are now faced with a rebuilding decision. Under the current rules you can rebuild at 4 feet above grade on a conventional foundation. However, in the future, the minimum National Flood Insurance Program building requirements will increase an additional 4 feet and the risk zone changes to a coastal high hazard zone (Zone VE, which requires specific foundation types). This will result in higher insurance costs for buildings constructed to today's minimum standard.



Now consider these rebuilding scenarios, based on the assumptions listed previously: rebuild to A) the current community BFE standard, B) 4 feet higher than the current BFE, or C) 6 feet higher than the current BFE:

Coastal High Hazard Area: Zone VE



	A	B	C
Home Elevation	4ft	8ft	10ft
Total Cost of Foundation	$18,000	$29,000	$30,000
Increase in Monthly Mortgage Payment	n/a	$49*	$54*
Annual Flood Insurance Premium (Coastal High Hazard Area: Zone VE)	$31,500	$7,000	$3,500
Monthly Cost (Mortgage Increase + Flood Insurance)	$2,625	$632	$346
Months to Recover Foundation Cost	n/a	14	13
Savings Over 10 Years	n/a	$239,160**	$273,480**
Peace of Mind	☹	😮	🙂

$2,279 per month savings compared to the current BFE

*Based on the additional expense, compared to Scenario A, of elevating a home from the current BFE to the new BFE.
**Based on a lower flood insurance premium, compared to Scenario A, minus an increase in monthly mortgage payment.

Additional assumptions for illustrative purposes only include:

- Foundation costs are averages - for scenario A they are based on an average of costs for several common foundation types including Slab-on-grade, crawl space, perimeter and pier foundations. Scenarios B and C are based on wood pile foundations
- Home value is $250,000
- Flood Insurance policy covers $250,000 building coverage
- Rebuilding requires a new foundation
- The costs and savings numbers provided above are based on best-practice estimates and assumptions for foundation costs and flood insurance premiums. Actual costs and premiums may vary by structure, policy types, and specific home values, locations, and sizes
- Monthly mortgage payments are based on a 30-year fixed rate loan at 3.5% interest,
- Flood insurance premiums are based on 2012 insurance rates represent the premiums after the new BFEs are official and the phase-in of the new rates is completed. Flood insurance premiums are based on 2012 rates and represent premiums after new BFEs are official and the phase-in of new rates is completed.

What's Next

Property owners should contact their local floodplain manager or building official to find out what permits will be required. Additionally, they should consider implementing flood risk mitigation measures, such as elevating a home or flood proofing a business, which may be covered under flood insurance by Increased Cost of Compliance (ICC). Property owners are encouraged to contact their insurance agent to file their flood insurance claim and ask if ICC applies. They can also visit FloodSmart.gov for more information about flood insurance. In addition, property owners can visit the Hazard Mitigation desk at a local Disaster Recovery Center for more information.

FEMA

www.Region2Coastal.com

Rebuilding After Hurricane Sandy

Stronger. Safer. Smarter.

Know Your Updated Flood Risk

- ☐ Visit www.Region2Coastal.com information about Advisory Base Flood Elevations, to find answers to frequently asked questions, and learn tips to rebuild better and safer.
- ☐ Under the Hurricane Sandy tab, click "What is my ABFE?"
- ☐ Enter your address to determine your property's advisory flood zone and elevation for rebuilding.

Take Action

- ☐ Contact your local floodplain manager or building official for information about local building codes and permit requirements.
- ☐ Discuss with your builder or contractor the options for elevating your home.
- ☐ Discuss with your insurance agent the options for flood insurance coverage and ways to maximize the discounts on your flood insurance premium.

Before constructing, property owners should consult their local government officials to determine mandatory elevations for their home or building.

For More Information…

- ☐ To learn more about the National Flood Insurance Program or find an insurance agent, visit: www.FloodSmart.gov or call 1-888-229-0437.
- ☐ To learn how to build safer and stronger and potentially decrease your flood insurance premiums, download the ***FEMA Building Science Resources to Assist with Reconstruction After Hurricane Sandy*** factsheet by visiting www.fema.gov/library/viewRecord.do?id=6651.
- ☐ To see if you are eligible for Hazard Mitigation grants and loans, visit: www.fema.gov/hazard-mitigation-assistance.

***Remember:* generally the higher you build, the lower your flood insurance premium.**

FEMA

Hurricane Sandy Advisory Base Flood Elevations (ABFEs)

As communities begin to recover from the devastating effects of Hurricane Sandy, it is important to recognize lessons being learned and to employ mitigation actions that ensure structures are rebuilt stronger, safer, and less vulnerable to future flooding events.

Prior to Hurricane Sandy, the Federal Emergency Management Agency (FEMA), as administrator of the National Flood Insurance Program (NFIP), was restudying areas of the New Jersey and New York coastlines to update Flood Insurance Rate Maps (FIRMs). These updated maps were set to be delivered to state and local officials in mid-2013. Since existing FIRMs for these areas were developed more than 25 years ago, and because updated FIRMs are yet to be finalized, it is vital to provide near-term Advisory Base Flood Elevations (ABFEs) to support reconstruction efforts.

The ABFEs are based on sound science and engineering, and are derived from more recent data and improved study methodologies compared to existing FIRMs. Based on an assessment following recent storm events, including Hurricane Sandy, FEMA has determined that the base flood elevations shown on some existing FIRMs do not adequately reflect the current coastal flood hazard risk. In most cases, ABFEs reflect a higher flood elevation than the current regulatory FIRMs. Property and business owners should check with their local building official to fully understand any requirements for using ABFEs in rebuilding efforts.

ABFEs will be available to communities in the following areas:

- New Jersey Counties: Atlantic, Bergen, Burlington, Cape May, Essex, Hudson, Middlesex, Monmouth, Ocean, and Union.
- New York Counties: Bronx, Kings, New York, Richmond, Queens, and Westchester.

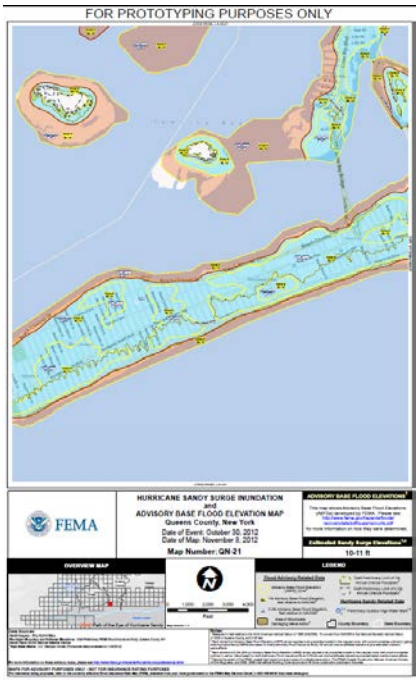
Available Resources

- For information about Hurricane Sandy Recovery, visit: www.fema.gov/sandy
- To apply for Disaster Assistance, visit: http://www.disasterassistance.gov/
- Additional information on Advisory Base Flood Elevations will be available in December 2012 on FEMA Region II's Coastal Website, visit: www.Region2Coastal.com
- To ask questions and get information about flood insurance and general information about Advisory Base Flood Elevations, call the National Flood Insurance Program Help Center at 1-800-427-4661
- To learn how to build safer and stronger and potentially decrease your flood insurance premiums download the ***FEMA Building Science Resources to Assist with Reconstruction After Hurricane Sandy*** factsheet by visiting http://www.fema.gov/library/viewRecord.do?id=6651
- To see if you are eligible for Hazard Mitigation grants and loans, visit: www.fema.gov/hazard-mitigation-assistance
- To learn more about the National Flood Insurance Program or find an insurance agent, visit: www.FloodSmart.gov or call 1-888-229-0437
- For information about local building code and permit requirements, contact your community officials

Geospatial data layers and maps for these areas will be available via FEMA Region II's Coastal Website, www.Region2Coastal.com, in December 2012. This information will be accompanied by guidance to inform Federal, state, and local officials and to assist them in making informed decisions about rebuilding.

ABFEs were successfully used in rebuilding efforts after Hurricane Katrina (2005). Many communities in Louisiana and Mississippi adopted ABFEs, which led home and business owners to rebuild higher and safer, and in some cases resulted in flood insurance premium discounts for policy holders in high-risk areas.

In New Jersey and New York, Federal, state and local officials, builders, architects, insurance professionals, property and business owners should use ABFEs to make informed decisions about rebuilding, and to mitigate the impact of future flood events. Those opting not to use ABFEs will miss a significant opportunity to mitigate their future flood risk. Additionally, communities participating in the NFIP's Community Rating System can receive credit for adopting standards higher than NFIP minimum requirements, resulting in premium discounts for policyholders in high-risk areas.



ABFEs prototype for illustrative use only

NFIP policyholders should also be aware of recent legislation that could affect their future insurance rates. The Biggert-Waters Flood Insurance Reform Act of 2012 calls for the NFIP to eliminate flood insurance subsidies and discounts and to increase rates to reflect actual flood risk. These provisions may have a significant future impact on rates for properties not compliant with NFIP requirements, and properties that are not compliant with future base flood elevations will see significant premium increases.

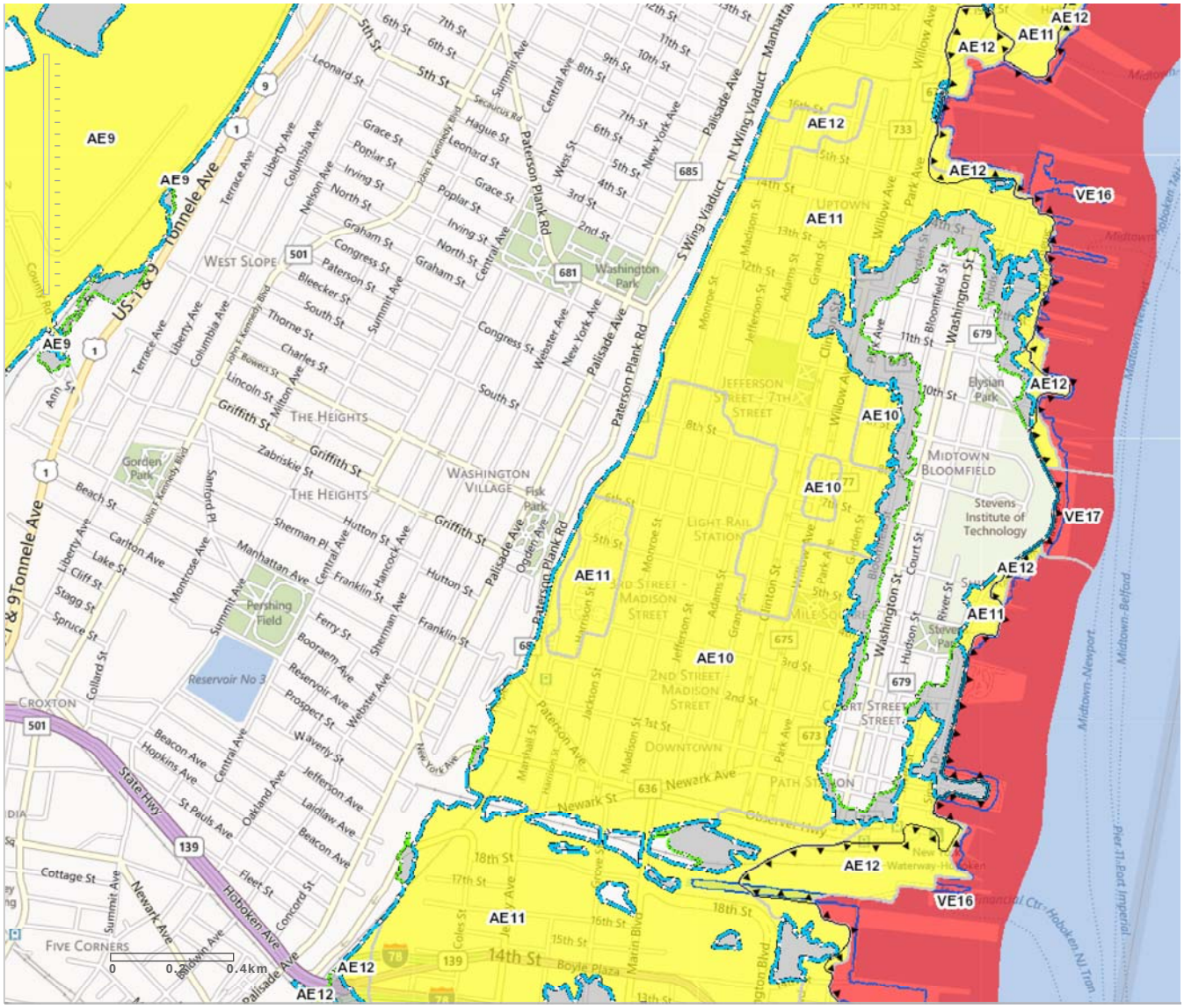
The information used to develop the ABFEs will be part of what is used to update FIRMs. Insurance premium rates will not rise, and the mandatory purchase requirements will not apply until the revised base flood elevations have been subject to review, comment, and adoption by local governments. Communities are strongly encouraged to use ABFEs to rebuild stronger, safer, and with reduced vulnerability to future flooding events. Providing reliable and timely flood hazard data is just one way FEMA is helping decision makers ensure that New York and New Jersey coastal communities recover smarter and stronger in the wake of this devastating event.

For additional information regarding ABFEs information please visit www.Region2Coastal.com in December 2012. In addition, it will be important for property and business owners to work with their local officials to fully understand any requirements for using ABFEs in rebuilding. Decisions property and business owners make now can help provide a safer, stronger future for their family or business.

Before building, property and business owners should consult their local government officials to determine the mandatory elevations for their home or building.

Best Available Flood Hazard Data

Efubjt Bee | Cbtfn bq |



The '*What is My Advisory Base Flood Elevation (ABFE)*' - Address Lookup Tool: -

A Quick and Easy Way to Get the ABFE for Your Property -

The Federal Emergency Management Agency (FEMA) has created Advisory Base Flood Elevations (ABFEs) to show a more current picture of flood risk for certain communities in New Jersey and New York affected by Hurricane Sandy. Community officials, property owners, and others can use the ABFE information to understand where flood risk exists and to decide whether to build to higher elevations based on what has been learned from Sandy.

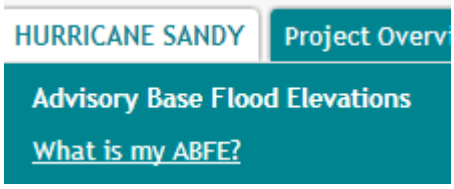
Additional information about ABFEs, including answers to Frequently Asked Questions is available through FEMA's Region 2 Coastal Outreach website at www.region2coastal.com.

The '*What is My ABFE*' address lookup tool, available through FEMA's Region 2 Coastal Outreach website (www.region2coastal.com) is a simple way to get a customized report showing the current and advisory flood risk for your property.

Getting Started with the 'What is My ABFE' Tool

To find out what information is available for your property, follow these easy steps:

1. Navigate to the webpage labeled "What is my ABFE?" through the Hurricane Sandy tab on http://www.region2coastal.com/.



2. Once you are on the 'What is My ABFE' page, scroll down until you see the 'Enter your address here' field (Figure 1 below). Enter your address and click the "Get Details" button. (See browser limitations in the box to the right.)

Internet Explorer users: This message will appear when the 'Get Details' button is clicked on: "Do you want to view only the webpage content that was delivered securely?" In order to view your report, click the 'No' button.

Google Chrome users: The 'Get Details' button will need to be clicked on twice in order for the report to be generated (due to browser limitations).

3. A "flag" () will be added to the map banner below the address field indicating the location of information provided by the tool. Find your home on the map and click on your house.

4. - The data fields below the map banner will provide you with an overview of ABFE and related information at the location you placed the flag (graphic). Print the report (using your browser's printing capabilities) and take it to your local building and permitting authority to understand the building requirements for your property.

After you have generated a report using the steps above, you can also click on any other location on the locator map. The report will automatically update and include information for the new location, and the new address will be shown in the address bar field.

To enter a different address after generating a report, first click the '***Clear Details***' button.

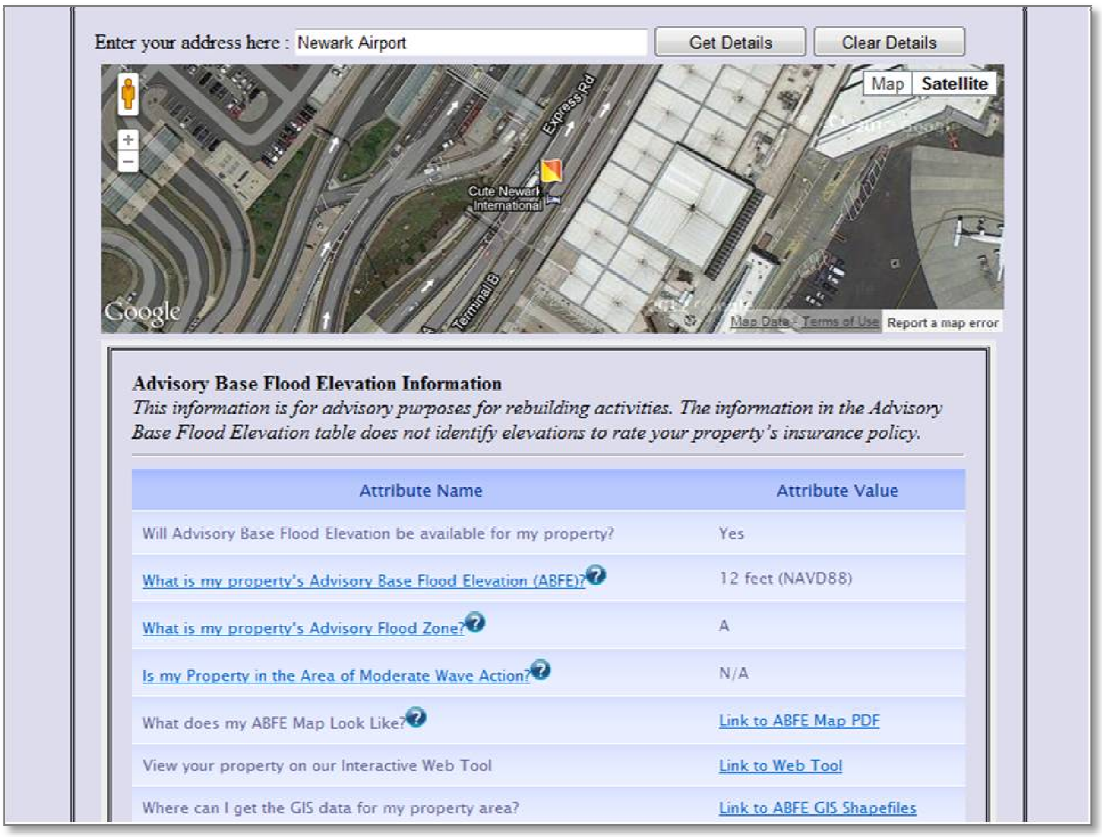


Figure 1

DISCLAIMER: The information generated on each 'What is My ABFE' report is dependent on the location of the point location of the flag (graphic). The flood information included in the report tables is not a regulatory determination. Results from the 'What is My ABFE Tool' are not intended for insurance rating purposes and is for information only. The positional accuracy may

be compromised in some areas. The address locator is not 100% accurate in identifying your address. Property owners should contact their local floodplain administrator for more information or to view an official copy of their community's Flood Insurance Rate Map and discuss the ABFEs in the vicinity of their property prior to starting any reconstruction activity.

Reading the 'What is My ABFE' report

The report generated by the 'What is My ABFE' tool is divided into two sections (Figure 2). The first section of the report contains the advisory flood hazard information for your property. This information is intended to be used for rebuilding activities. The information in this table does not identify elevations to rate your property's insurance policy. The second section of the report contains information from the effective Flood Insurance Rate Map (FIRM) for your community. This information is used to rate your property's insurance policy and is also used by your community to regulate development in floodprone areas.

To get more information about a question in the report, scroll your mouse over the question mark icon to the right of the question, or click on the hyperlinked question in the left column. The report also contains hyperlinks to view the .pdf map panel your property is located on or to view your property on FEMA's interactive ABFE map. For GIS software users, data layers for the entire county the property is located in are also available for download in ESRI shapefile format.

Advisory Base Flood Elevation Information

This information is for advisory purposes for rebuilding activities. The information in the Advisory Base Flood Elevation table does not identify elevations to rate your property's insurance policy.

Attribute Name	Attribute Value
Will Advisory Base Flood Elevation be available for my property?	Yes
What is my property's Advisory Base Flood Elevation (ABFE)?	12 feet (NAVD88)
What is my property's Advisory Flood Zone?	A
Is my Property in the Area of Moderate Wave Action?	N/A
What does my ABFE Map Look Like?	Link to ABFE Map PDF
View your property on our Interactive Web Tool	Link to Web Tool
Where can I get the GIS data for my property area?	Link to ABFE GIS Shapefiles

Effective Flood Insurance Data

This information is from the effective Flood Insurance Rate Map for your community. It is used to determine who must buy flood insurance and how much it costs. It is also used by your community to regulate development in flood prone areas.

Attribute Name	Attribute Value
What is my property's current effective Base Flood Elevation?	N/A
What is my property's current effective Flood Zone?	0.2 PCT ANNUAL CHANCE FLOOD HAZARD

Figure 2

How Should I Use the Information in the Report?

As you make decisions for rebuilding and reconstruction, the information provided by the 'What is My ABFE' tool will provide you with an understanding of the possibility of flooding and coastal wave actions that affect your property. Investigations conducted by FEMA and other organizations after major coastal disasters have consistently shown that properly sited, well-designed, and well-constructed coastal residential buildings generally perform well. This information can assist you in your rebuilding efforts and provides a centralized point of risk information for you to discuss permitting requirements with your local building and permitting staff.

- Local building and permitting varies by community. This information will allow you to meet with your local building and permitting authority to discuss your individual property building requirements.

- Before building, property and business owners should consult their local government officials to determine the mandatory elevations and any construction requirements for their home or building.

- Consider elevating your home's lowest floor above the Base Flood Elevation (BFE) or ABFE, whichever is higher. Elevating your structure is a good way to reduce your risk of flooding even if your property is not currently subject to flooding.

- Elevating your home above the BFE or ABFE (whichever is higher) will also provide a future reduction in flood insurance premiums.

- If your property is subject to coastal wave action, consider breakaway walls and other structural building measures that will allow the building to remain after a storm event.

- Consider relocating your structure (if possible) to minimize the hazards your home or business may encounter.

What Does it Mean if the Report shows 'N/A' for All Fields?

The 'What is my ABFE' tool will return 'N/A' results in 2 situations: 1) in cases where ABFE data is not yet available for a location and 2) in cases where the location is not in an Advisory flood zone. Check the Region 2 Coastal Outreach website ABFE webpage (http://www.region2coastal.com/sandy/abfe) to see a list of counties that ABFE information is available for. If your property is located in one of these counties and you receive 'N/A' results, it is most likely you are not located in an Advisory flood zone.

If you click on the 'Link to Web Tool' in the "What is my ABFE?" report, it will bring up the ABFE map for your location – this is an easy way that you can see your location on the map and any flood zones in the vicinity. Even if you are not actually located in an Advisory flood zone, you should still consider purchasing flood insurance if you are close to an Advisory flood zone to reduce the chance of financial impacts in case a flood does occur in the future.

The '*What is My Base Flood Elevation (BFE)*' Address Lookup Tool:

A Quick and Easy Way to Get Coastal Flood Risk Information for Your Property

The interactive 'What is My BFE?' address lookup tool can help you compare the current effective and the best available flood hazard data for your property. You can access the What is My BFE? tool through the FEMA Region II Coastal Outreach website at http://www.region2coastal.com/sandy/table.

Get information for your property in three easy steps:

1. **Enter your address into the field at the top of the tool screen (Figure 1) and click the "Get Details" button.** (*Internet Explorer users: You must click 'No' if a security warning pop up window appears on your screen in order for the report to display correctly after clicking the "Get Details" button.*)

After you enter your information, you will see an address appear in red below the address field. This is the address located by the program based on the information you entered. The report displays the flood hazard information at this location.

2. A "flag" graphic will be added to the map banner indicating the location for which the tool retrieved information. **If the "flag" on the map is not directly on your house, click on the location of your house as shown on the map to reposition the flag.** The report will be refreshed automatically with information for the repositioned location.

3. The data fields below the map banner will provide you with data from both the effective Flood Insurance Rate Map (FIRM) and the best available flood hazard data for the address entered.

FEMA is in the process of issuing preliminary work maps which will supersede previously issued Advisory Base Flood Elevation (ABFE) maps as the best available flood hazard data in certain areas of New Jersey and New York. When available, the preliminary work maps will be the source of the updated flood hazard data provided in the What is My BFE? report. If not yet available, ABFE data will be the source of the updated information listed in the report if released for the area. If neither preliminary work map nor

Additional information about best available flood hazard data, preliminary work maps, and ABFE maps is available through FEMA's Region 2 Coastal Outreach website at www.region2coastal.com.

ABFE map information is available, only information from the effective FIRM will be shown.

In most communities, only updated **coastal** flood risk information is provided in the report. **Riverine** flood risk information will not be shown in most locations. Please contact your local floodplain manager for more information about those areas.

After you have generated a report using the steps above, you can also click on any other location on the locator map. The report will automatically update and include information for the new location, and the new address will be shown in the address bar field.

To enter a different address after generating a report, first click the '***Clear Details***' button.

Figure 1

DISCLAIMER: *The information generated on each report is dependent on the point location of the flag graphic. The flood information included in the report tables is not a determination. Results from this tool are not intended for flood insurance rating purposes and is for information only. The positional accuracy may be compromised in some areas. The address locator is not 100% accurate in identifying your address. Property owners should contact their local floodplain administrator for more information or to view an official copy of the FIRM and discuss the flood elevations and zones in the vicinity of their property prior to starting any reconstruction activity.*

Reading the 'What is My BFE' report

The report generated by the 'What is My BFE' tool is divided into two sections (Figure 2). The first section of the report contains the best available flood hazard data for your property. The first field of this section will indicate the source of the best available flood hazard data (e.g., Advisory, Preliminary Work Map, or Effective information). The second section of the report contains information from the effective FIRM for your community.

To get more information about a question in the report, scroll your mouse over the question mark icon to the right of the question, or click on the hyperlinked question in the left column. The report also contains hyperlinks to view the .pdf map panel your property is located on or to view your property on FEMA's interactive Best Available Flood Hazard Data map. For GIS software users, data layers for the entire community or county the property is located in are also available for download in multiple formats.

Best Available Flood Hazard Data

The best available flood hazard data for coastal areas of New York and New Jersey is provided below to help you understand the current flood risk to your property and to guide Sandy recovery and rebuilding efforts.

Please be advised that in most communities, only ***coastal*** *flood risk information is provided below.* ***Riverine*** *flood risk information will* ***not*** *be shown in most locations. Please contact your local floodplain administrator for more information about those areas.*

Attribute Name	Attribute Value
What is the best available flood hazard data source for this location?	Advisory Data
What is my property's Base Flood Elevation (BFE)? (For N/A results, please contact your local floodplain administrator for more information.)	16 feet (NAVD88)
What is my property's Flood Zone? (For N/A results, please contact your local floodplain administrator for more information.)	V
Is my Property in the Area of Moderate Wave Action?	N/A
What is the estimated ground elevation at this location? (See licensed surveyor for actual elevation of your building)	N/A
What does my Best Available Flood Hazard Data Map Look Like?	Link to ABFE Map PDF
View your property on our Interactive Web Tool	Link to Web Tool
Where can I get the GIS data for my property area?	Link to ABFE GIS Shapefiles

Effective Flood Insurance Data

This information is from the effective Flood Insurance Rate Map for your community. It is used to determine who must buy flood insurance and how much it costs. It is also used by your community to regulate development in flood prone areas.

Attribute Name	Attribute Value
What is my property's current effective Base Flood Elevation?	8.9 feet (NAVD88)
What is my property's current effective Flood Zone?	AE

Figure 2

Estimated Ground Elevations for Properties in Certain Locations

For certain locations, the What is My BFE? Tool report includes an estimated ground elevation for buildings. This estimated elevation is determined from available topographic data for the location, which is the same data used to create revised coastal flood hazard information. **You will need to consult with a licensed surveyor to determine the actual elevation of your home.**

In areas where the estimated ground elevation is available, you will need to click directly on top of your building shown in the locator map in the 'What is My BFE?' report in order for the estimated elevation to appear in the report. Otherwise, 'N/A' will appear in the report in place of an estimated ground elevation.

Estimated ground elevation information is currently only available for locations in New York City, Monmouth County, New Jersey, and portions of Essex and Hudson Counties in New Jersey.

What Does it Mean if the Report shows 'N/A' for All Fields?

The 'What is my BFE' tool will return 'N/A' results in 2 situations: 1) in cases where ABFE or preliminary work map data has not been developed for a county/community and 2) in cases where ABFE or preliminary work map data has been released for a particular county/community but the specific location within the county/community is not actually in an updated coastal flood zone. (For most communities, riverine flood information is not supported by the What is my BFE? tool.) ABFE data has been released for the following counties/communities: (New Jersey) Atlantic, Bergen, Burlington, Cape May, Essex, Hudson, Middlesex, Monmouth, Ocean, and Union; (New York) Westchester County. Preliminary work maps have been released for New York City. If your property is located in one of these communities and you receive 'N/A' results, it is most likely that your property is not located in an updated coastal flood zone. However, it is recommended that you consult with your community's floodplain administrator for additional details.

If you click on 'Link to Web Tool' in the report, it will bring up the location on the FEMA Best Available Flood Hazard Data map for your location – this is an easy way that you can see your location on the map and any coastal flood zones in the vicinity. Even if you are not actually located in a flood zone, you should still consider purchasing flood insurance if you are in the

vicinity of a flood zone to reduce the chance of financial impacts in case a flood does occur in the future.

What Should I Do With The Flood Hazard Information in the Report?

As you make decisions for rebuilding and reconstruction, the information provided by the 'What is My BFE?' Tool will provide you with an understanding of the possibility of coastal flooding that can affect your property. Investigations conducted by FEMA and other organizations after major coastal disasters have consistently shown that properly sited, well-designed, and well-constructed coastal residential buildings generally fair well in floods. This information can assist you in your rebuilding efforts and provides a centralized point of risk information for you to discuss permitting requirements with your local building and permitting staff.

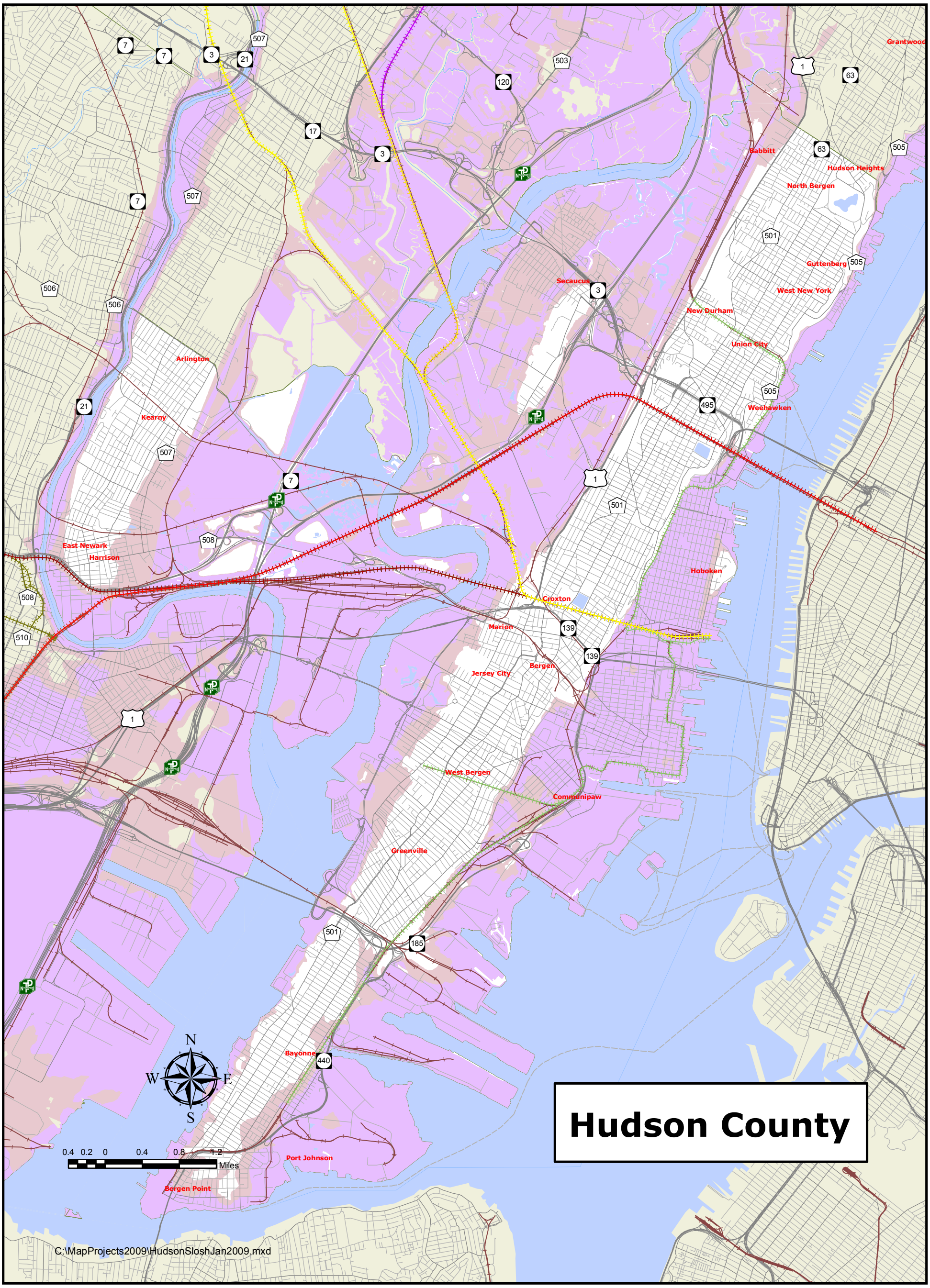
- Local building and permitting varies by community. This information will allow you to meet with your local building and permitting authority to discuss your individual property building requirements.

- Consider elevating your home's lowest floor above the best available flood hazard elevation or the Base Flood Elevation (BFE) shown on your community's effective FIRM, whichever is higher. Elevating your structure is a good way to reduce your risk of flooding even if your property is not currently subject to flooding. Elevating your home can also provide a future reduction in flood insurance premiums.

- If your property is subject to coastal wave action, consider breakaway walls and other structural building measures that will allow the building to remain after a storm event.

- Consider relocating your structure (if possible) to minimize the hazards your home or business may encounter.

Before building, property and business owners should consult their local government officials to determine the mandatory elevations and any construction requirements for their home or building.



The U.S. Army Corps of Engineers storm surge data/maps are to be used in combination with other GIS data or satellite imagery to enable managers to plan for major hazards events, and the analysis would only evaluate the vulnerability of an area to hurricane storm surge. This type of analysis would not evaluate the vulnerability of an area to high winds or fresh water flooding. Therefore, the surge data/maps alone should not be used as a tool for determining which areas are susceptible to hurricane hazards. Emergency management personnel may take factors other than storm surge into consideration when they define evacuation zones. Coastal residents should heed evacuation orders and recommendations of emergency management officials when storms threaten.

Storm Surge/ Hurricane Categories

- Category 1 and 2
- Category 3 and 4

Interpreting New Jersey Preliminary Work Maps

Overview

FEMA is committed to continuing the recovery process in New Jersey by providing the best available flood risk assessments. This will help guide communities in their efforts to reduce the impact of flood events and protect lives and property from future damages. To accomplish this, FEMA is implementing a comprehensive outreach initiative to share data and to ensure that affected communities are fully engaged and informed throughout the Flood Insurance Rate Map (FIRM) development process.

FEMA has prepared this fact sheet to provide important information regarding the specific types of data that communities will receive. In addition to describing the data, it provides guidance on how communities can use the data to better understand their own flood risk, use as a tool in the decision making process, and to plan for mitigation activities.

Release of Preliminary Work Maps

The FEMA preliminary work maps are an interim product created during the process of developing preliminary FIRMs. This information will replace the Advisory Base Flood Elevation (ABFE) maps that were made available to impacted communities as the best available flood hazard data for rebuilding and recovery efforts in the aftermath of Hurricane Sandy. FEMA strongly encourages communities to reasonably use this information in instances where Base Flood Elevations (BFEs) increase, floodways are revised, and/or new Special Flood Hazard Areas (SFHAs) are shown on the on the preliminary work maps. This will help community members make decisions to reduce their flood risk until the preliminary FIRMs become effective.

Preliminary Work Map Data

The coastal hazard analysis and mapping process involves a series of steps to produce preliminary work maps and ultimately the effective FIRMs, which become the regulatory basis of flood insurance ratings and floodplain management requirements. These steps include:

- Defining a base topographic data set to be used for analysis and mapping
- Defining shoreline transects to represent terrain and variability of shoreline features
- Conducting analyses to characterize 1% storm-induced erosion
- Conducting overland wave modeling to define coastal hazard areas and establish BFEs
- Creating preliminary work maps of coastal hazard areas utilizing the results of modeling and analysis
- Producing FIRMs and Flood Insurance Study (FIS) reports

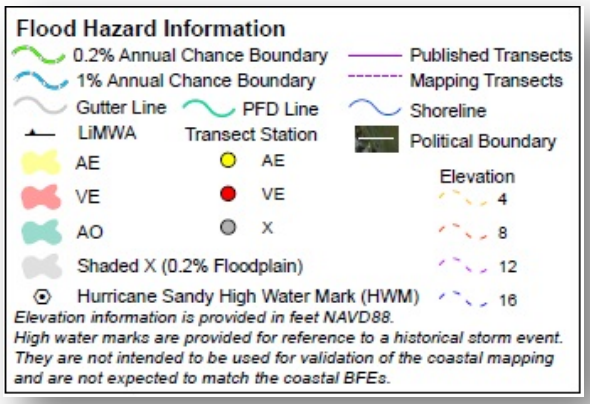
The preliminary work maps have been refined from the information shown on the ABFE maps. Community officials should review them to identify any areas of concern with the mapping of the proposed SFHAs (the area inundated by a flooding event having a 1% chance of occurring in any given year). The flood hazard information contained on the preliminary work maps is shown in the legend and the most pertinent items are described in more detail below.

Interpreting the Preliminary Work Map Data

To appropriately interpret the preliminary work map data there must be an understanding of the information shown on the preliminary work maps. The most pertinent flood hazard features are defined below along with an image showing how the preliminary work maps will look.

Zone AE - A yellow shaded area of high flood risk subject to inundation by the 1% annual-chance flood event determined by detailed methods. Base Flood Elevations are shown and mandatory flood insurance purchase requirements and floodplain management standards apply within AE zones included on effective FIRMs.

Zone AO - A blue shaded area of high flood risk subject to inundation by 1% annual-chance shallow flooding where average depths are between one and three feet. Average flood depths derived from detailed hydraulic analyses are shown in this zone. Mandatory flood insurance purchase requirements and floodplain management standards apply within AO zones included on effective FIRMs.



Zone VE - A light-red shaded area of high flood risk subject to inundation by the 1% annual-chance flood event with additional hazards due to storm-induced velocity wave action (a 3-foot or higher breaking wave). BFEs derived from detailed hydraulic analyses are shown. Mandatory flood insurance purchase requirements, specific construction requirements, and floodplain management standards apply within VE zones included on effective FIRMs.

Shaded Zone X - A gray shaded area of moderate flood risk subject to inundation by the 0.2% annual-chance flood event. Although mandatory purchase of flood insurance doesn't apply in Shaded Zone X, property owners are encouraged to do so to reduce their flood risk.

LiMWA - The black line denoting the Limit of Moderate Wave Action (LiMWA) is the landward limit of the area where base flood wave heights are between 1.5 and 3 feet and where wave characteristics are deemed sufficient to damage many structures on shallow or solid wall foundations. Triangular marks point toward the deeper flooding section of the area.

AE 10 (example) - Zone AE having a Base Flood Elevation of 10 feet as referenced to North American Vertical Datum of 1988 (NAVD 88).

VE 11 (example) - Zone VE having a Base Flood Elevation of 11 feet as referenced to NAVD 88.

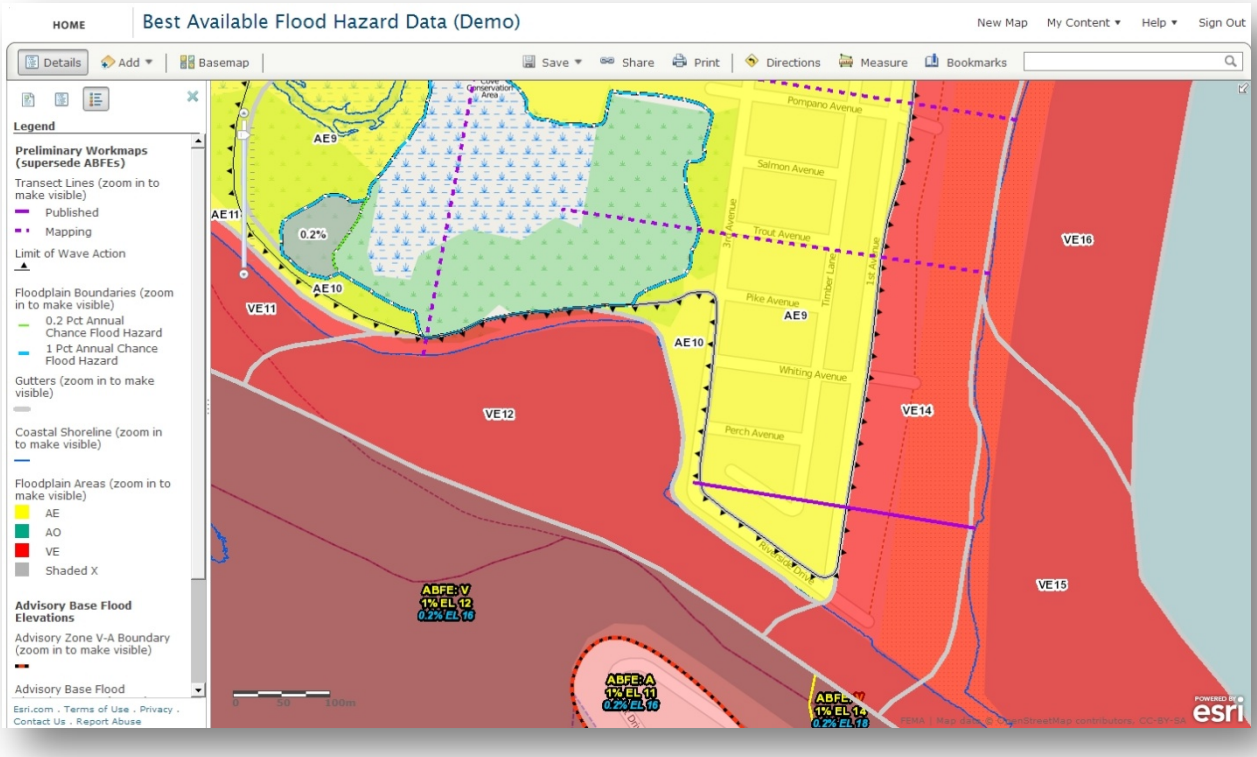
Gutter Line - A gray colored line dividing two different flood zones (AE, AO, or VE) or dividing the same zone when there is more than one BFE. In the example image there is a gutter line dividing VE15 and VE16.

PFD Line - A teal colored line denoting the location of the Primary Frontal Dune. The PFD is used to delineate the limit of the coastal high hazard area.

Transect - A purple line depicting a surveyed cross section taken perpendicular to the shoreline to represent the coastal and overland characteristics present in the area. Transect data is used when performing overland wave modeling and mapping for a coastal flood study.

Transect Station - The distance along a profile (transect) in reference to a common starting point. Transect stations define the points where information is being provided for the modeling and define the location of the BFE and zone changes along a transect.

Hurricane Sandy High Water Mark (HWM) data - The Hurricane Sandy HWM is based on data collected by the U.S. Geologic Survey (USGS). These data are shown for informational purposes and are not intended to be used to validate the coastal mapping or the coastal BFEs.



Where the Preliminary Work Maps Can Be Viewed

The preliminary work maps, including tutorials, user guides, and other learning resources, are available through the FEMA Region II Coastal Analysis and Mapping website at www.region2coastal.com.

How the Data can be Used

Community officials will have the opportunity to comment on the preliminary work maps at any point in time once they are issued and during meetings that are planned to review the maps. It is important for community officials to identify areas in their community where they believe the risk is inappropriately mapped (understated or overstated) and to be prepared to discuss those concerns at the meeting. Hard data is encouraged, if available. Additionally, if more detailed local information is available such as terrain data, corrected street names, building features, and land features, this information is requested to be provided to FEMA for review.

Following this review, FEMA may incorporate this information into the regulatory products. By actively engaging in the mapping process, officials can help to ensure more precise effective FIRMs. Community officials are also encouraged to proactively communicate this information to ensure residents and property owners fully understand the changes in the maps and have an opportunity to discuss potential mitigation options.

Next Steps

Preliminary FIRMs will be released mid-to-late summer 2013. After their release, there will be a statutory 90-day appeal period during which FEMA will accept technical information submitted by the community that better characterizes local conditions and flood risk. Data submitted for potential refinement of the preliminary FIRMs must be comprehensive and detailed enough to be consistent with the process for developing the preliminary FIRMs.

Following the end of the appeal period and the resolution of any submitted concerns, FEMA will finalize the maps and initiate a six-month compliance period for formal map adoption. It will be after that six-month period when the revised FIRMs will become effective and once this occurs, they will become the basis for flood insurance requirements and insurance premiums. It typically takes 18 to 24 months from release of the preliminary FIRMs for the maps to complete the regulatory process and become effective.

Where to Go for More Information

The New Jersey Department of Environmental Protection (NJDEP), in coordination with FEMA, will be hosting webinars and community meetings to further explain the data that is received and answer questions about next steps. Please visit www.Region2Coastal.com for more information on FEMA's data sharing initiative with New Jersey.

FEMA

Coastal Mapping in New Jersey
Preliminary Work Map Release

Hudson County, New Jersey

June 14, 2013

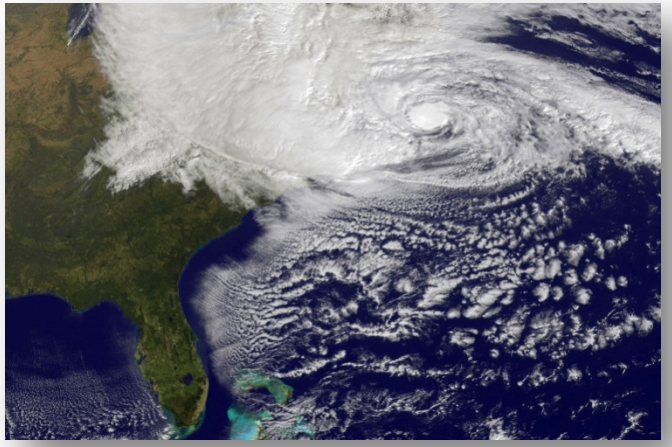
RiskMAP
Increasing Resilience Together

Agenda

- Introduction and Purpose of Briefing
- Hurricane Sandy
  - Advisory Base Flood Elevations
- Transitioning to Preliminary Work Maps
  - Flood hazard mapping changes
- Partnerships
- Next Steps
- Questions and Answers

Hurricane Sandy

- Hurricane Sandy made landfall in New Jersey on October 29, 2012
- Advisory Base Flood Elevations (ABFEs) were released after Hurricane Sandy to provide communities and property owners with the best available flood hazard data *at the time* for rebuilding and recovery
- The ABFEs were an interim step in the flood risk mapping process and used data that FEMA and New Jersey gathered up to October 2012



Preliminary Work Maps

- ABFEs represented the best available flood hazard data *at the time* of Hurricane Sandy
- As of June 17, 2013, the Preliminary Work Maps supersede the ABFE data to show a more accurate reflection of flood risk
  - Incorporates more precise calculation of wave hazards

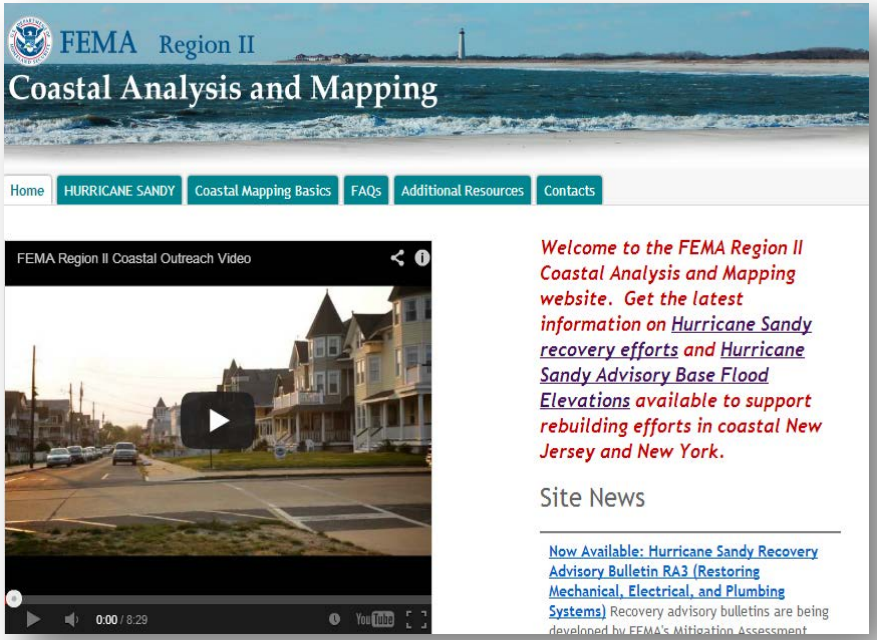
- Preliminary Work Maps are being shared in advance of the preliminary Flood Insurance Study and Flood Insurance Rate Maps (FIS & FIRMs) to provide property owners and communities with updated flood hazard information as quickly as possible to continue rebuilding and recovery
- Preliminary work maps will reflect the same coastal flood hazard as the Preliminary FIRMs, but the Preliminary FIRMS will also include riverine flood hazards

Preliminary Work Maps:
Benefits for New Jersey?

- Preliminary Work Map will:
  - Assist community officials and property owners in understanding the current flood risk
  - Inform rebuilding and recovery actions at the state and local level
  - Inform decisions to reduce loss of life and property through appropriate mitigation actions
  - Inform public investment process
- Preliminary Work Map will not immediately impact flood insurance rates or Federal flood insurance requirements
  - Depiction of likely flood insurance requirements in the near future

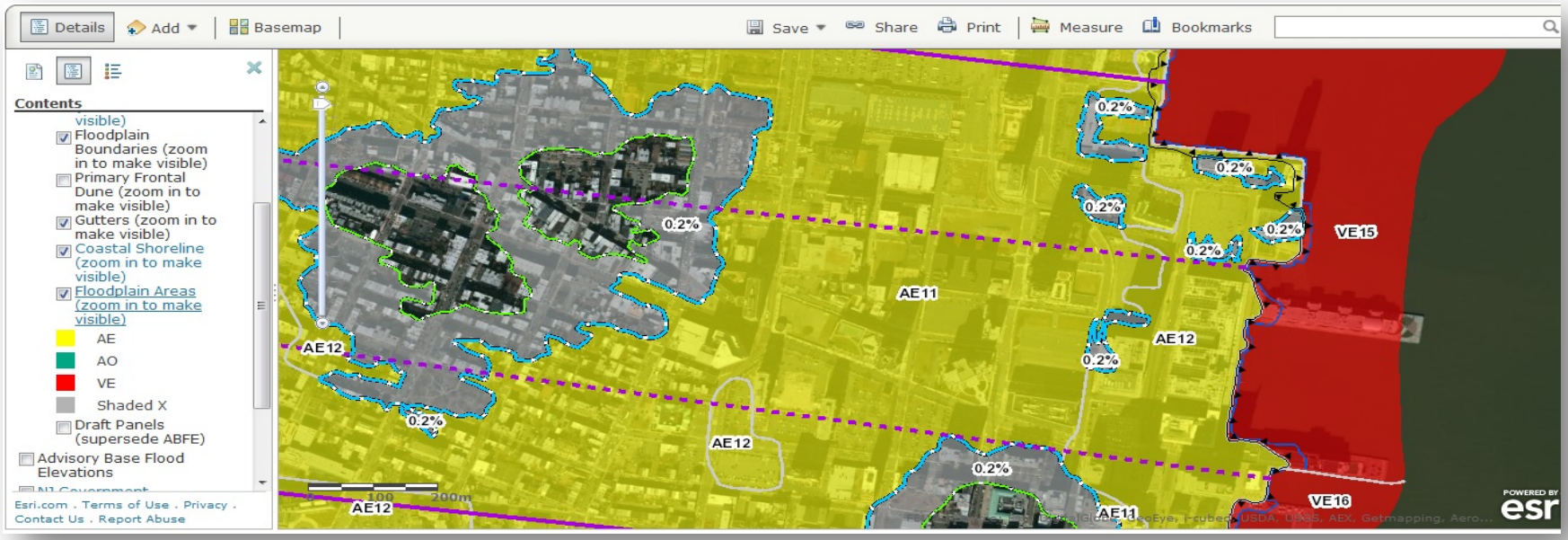
Preliminary Work Maps:
When and Where Can I Find this Information?

- June 17, 2013:
  - Preliminary Work Map information is being released on the FEMA Region 2 Coastal Website: www.Region2Coastal.com
  - The online Tool, "What is my Base Flood Elevation (BFE)?" is also available on www.Region2Coastal.com for residents and property owners



What You Will See in the Preliminary Work Maps?

- Special Flood Hazard Areas
  - Zone VE
  - Zone AE
  - Shaded Zone X
- Base Flood Elevations for 1% annual chance flood
- Estimated area and limit of structurally damaging wave action
- Preliminary Hurricane Sandy high water marks

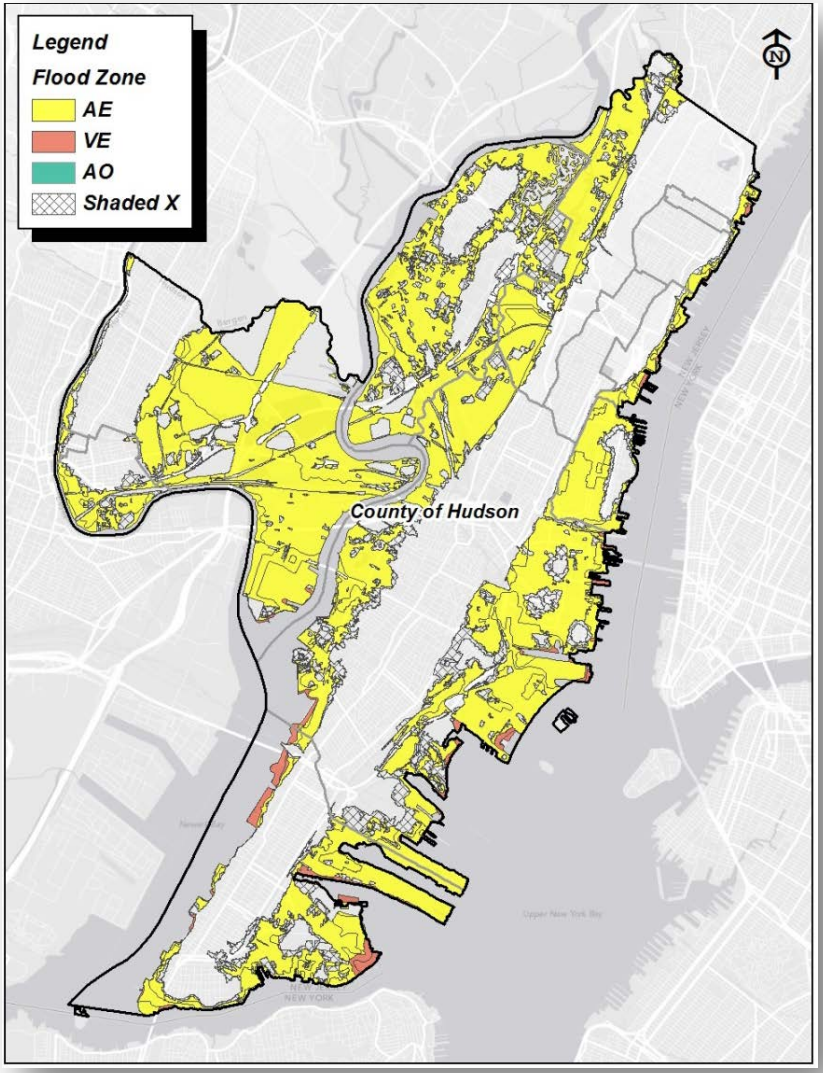


Preliminary Work Maps:
What are the High-Level Changes?

New Jersey:

- Indications are that the risk to coastal floods will increase in the future and communities and the public should plan accordingly
- Increases in the overall size of the coastal high hazard area (or V Zone) from the current effective maps
- Limited increases in the overall size of the A zone from the current maps of record are also now identified

Hudson Preliminary Work Map:



Access to Information:
www.region2coastal.com

People with accessibility needs may call 1-800-427-4661 or use our online form to request and receive assistance in identifying and interpreting the flood information for their property.

Enter an address to view effective and updated coastal flood risk information for that location:

Newark Airport | Get Details | Clear Details

Approximate Address Identified: *Newark Liberty International Airport (EWR), 3 Brewster Road, Newark, NJ 07114, USA*

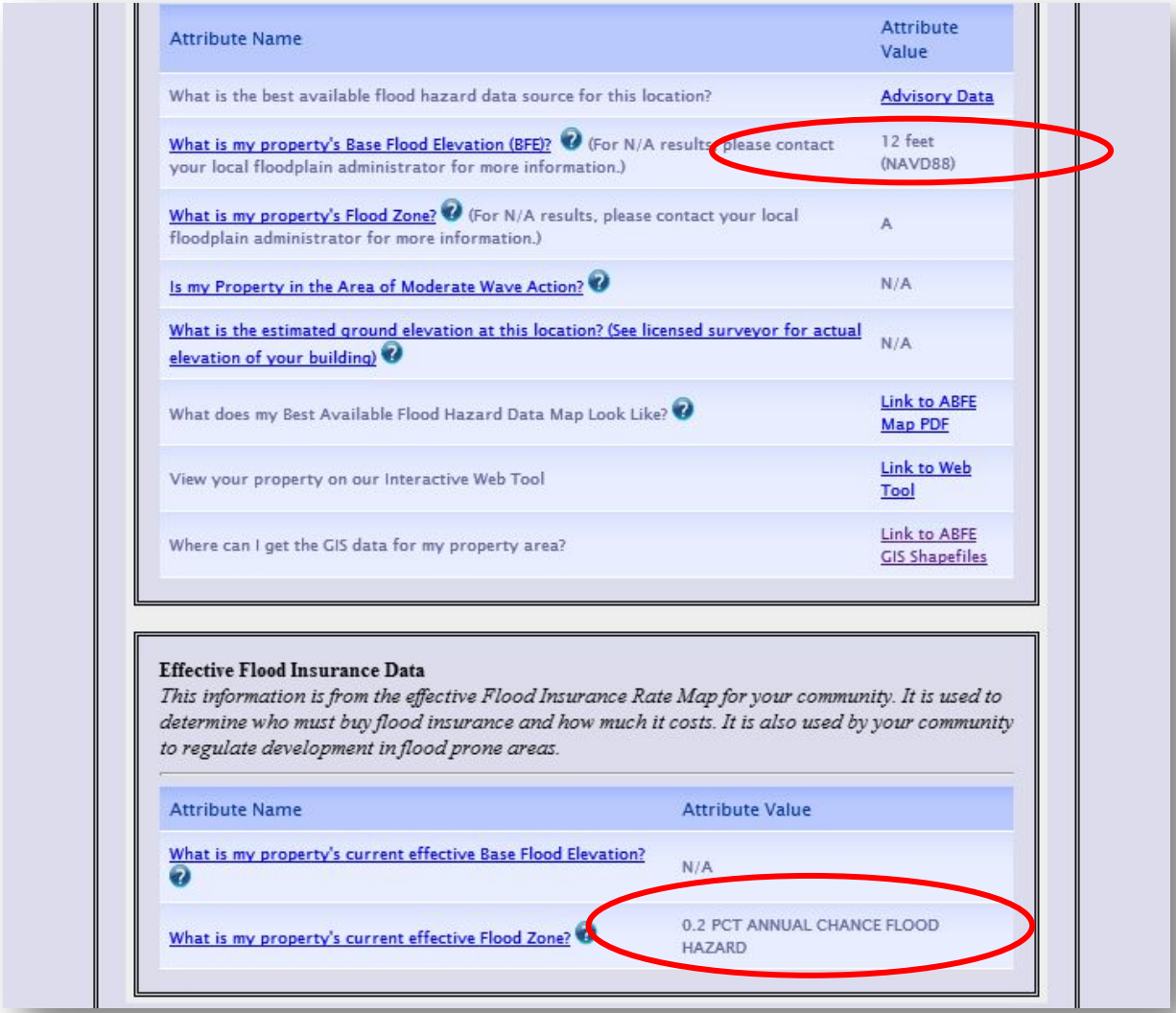
Best Available Flood Hazard Data

The best available flood hazard data for coastal areas of New York and New Jersey is provided below to help you understand the current flood risk to your property and to guide Sandy recovery and rebuilding efforts.

*Please be advised that in most communities, only **coastal** flood risk information is provided below. **Riverine** flood risk information will **not** be shown in most locations. Please contact your local floodplain administrator for more information about those areas.*

Attribute Name	Attribute Value
What is the best available flood hazard data source for this location?	Advisory Data
What is my property's Base Flood Elevation (BFE)? (For N/A results, please contact your local floodplain administrator for more information.)	12 feet (NAVD88)
What is my property's Flood Zone? (For N/A results, please contact your local floodplain administrator for more information.)	A

www.region2coastal.com



Attribute Name	Attribute Value
What is the best available flood hazard data source for this location?	Advisory Data
What is my property's Base Flood Elevation (BFE)? (For N/A results, please contact your local floodplain administrator for more information.)	12 feet (NAVD88)
What is my property's Flood Zone? (For N/A results, please contact your local floodplain administrator for more information.)	A
Is my Property in the Area of Moderate Wave Action?	N/A
What is the estimated ground elevation at this location? (See licensed surveyor for actual elevation of your building)	N/A
What does my Best Available Flood Hazard Data Map Look Like?	Link to ABFE Map PDF
View your property on our Interactive Web Tool	Link to Web Tool
Where can I get the GIS data for my property area?	Link to ABFE GIS Shapefiles

Effective Flood Insurance Data

This information is from the effective Flood Insurance Rate Map for your community. It is used to determine who must buy flood insurance and how much it costs. It is also used by your community to regulate development in flood prone areas.

Attribute Name	Attribute Value
What is my property's current effective Base Flood Elevation?	N/A
What is my property's current effective Flood Zone?	0.2 PCT ANNUAL CHANCE FLOOD HAZARD

Project Partners

- Local Communities
  - Provide technical information that best characterizes local flood risk
  - Communicate flood risk information to their constituents
- New Jersey Governor's Office
  - GAR/GORR responsible for oversight of all recovery and rebuilding
  - Facilitate outreach to local elected officials
- New Jersey Department of Environmental Protection
  - In charge of multiple NJ coastal flood risk study updates
  - Produce non-regulatory products for the entire NJ coastal communities

Project Partners *(continued)*

- Coastal Outreach Advisory Team (COAT)
  - State and local governments; academic organizations; other federal agencies
  - Support New Jersey coastal flooding outreach and education program
- Technical Advisory Panel (TAP)
  - New Jersey floodplain management and coastal engineering experts from diverse backgrounds
  - Review and provide feedback on the on-going coastal flood risk study

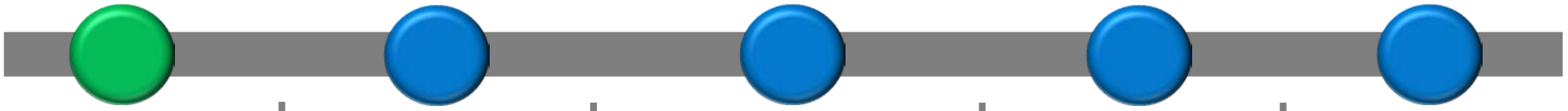
Project Partners *(continued)*

- Academics and Non Government Organizations
  - Jacques Cousteau National Estuarine Research Reserve
  - Richard Stockton College Coastal Research Center
  - Monmouth University Urban Coast Institute
  - Sea Grant Administration
  - Stevens Institute of Technology
  - Liberty Science Center
  - New Jersey Association for Floodplain Managers
- *Co-host workshops/trainings to local officials and information dissemination*

Public Outreach & Support

- Preliminary Work Maps and Datasets are being provided to communities in advance of the preliminary FIRMs:
  - Transect Data and Field Reconnaissance
  - Storm Surge Geographic Information System (GIS) Data
  - Coastal Hazard Analysis Modeling Program (CHAMP) Database
  - Preliminary Work Maps
- Each Community receives an FTP link for download
- Preliminary Work Maps will be available through the GeoPortal at www.Region2Coastal.com
- For technical questions about the Preliminary Work Maps and datasets provided, submit your questions:
  - *Community Officials and General Public* online at www.region2coastal.com/contacts

Timeline of Events



Preliminary Work Map Release

Preliminary Work Maps are released on Region 2 Coastal Website

WE ARE HERE

Preliminary FIRM Release

Preliminary Flood Insurance Rate Maps are released to the communities and the general public

Post-Release of Preliminary FIRMS

Regulatory and formal 90 days appeals and comments period will be determined

Post-Appeals

FEMA will issue Letter of Final Determination (LFD) that initiates the 6 month adoption period before the new maps become effective – all appeals will be resolved prior to LFD

Post-LFD

Effective FIRMs become the basis for flood insurance rates, community floodplain management regulations, and determining which structures require flood insurance

Providing Input

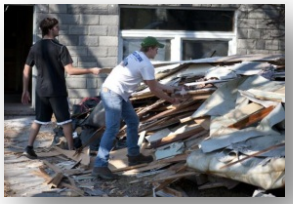
- FEMA is encouraging communities and property owners to submit technical information to Local FPA's for review and submittal to FEMA
- Validated appeals may result in revisions to FIRMs through the regulatory process
- Data submitted needs to be comprehensive, detailed and consistent with the process for developing preliminary FIRMs
- Coastal analysis and mapping information must follow FEMA Guidelines & Specifications for Flood Hazard Mapping Partners
- Technical information should be submitted to:
  - Robert J. Schaefer, P.E. FEMA Region II: Robert.Schaefer@fema.dhs.gov

Next Steps

- Review the technical and preliminary work map data
  - State agencies, property owners, general public
- Communicate the improved flood risk information to your residents and property owners
- Continue engagement in the ongoing flood risk analysis and flood insurance study update by:
  - Attending Flood Risk Review Meetings
  - Attending Resilience Meetings
  - Attending Community Coordination Officer Meetings
  - Informing residents and property owners of upcoming Public Open House Meetings

Conclusion: Community Resilience

Risk Changes Over Time → FEMA Provides Best Available Data → Community Officials Adopt Higher Standards → Property Owners Build to Higher Standards → More Resilient Communities Created



Together, we all can create stronger and safer communities

Resources

- Region 2 Coastal Flood Study Information: www.Region2Coastal.com
- FEMA: www.fema.gov
- FloodSmart (official site of NFIP): www.floodsmart.gov
- Risk Assessment, Mapping and Planning Partners (RAMPP): www.RAMPP-team.com/nj.htm
- New Jersey GORR: http://www.state.nj.us/gorr/
- New Jersey DEP: http://www.nj.gov/dep/ec/

Local Communities – *Data Gathering*

- Areas of Mitigation Interest Questionnaire
- To be sent to community officials early next week
  - This information will:
    - Help document the flood risk and will be used in Non-Regulatory Products development
    - Aid in identifying areas that may be affecting flood risk that would benefit from a raised local awareness
    - Provide input to local mitigation plans
    - We will provide the draft products and go over it with you during the Flood Risk Review meeting

Q&A

Contacts

FEMA

Bill McDonnell | William.McDonnell@fema.dhs.gov
Andy Read | Andrew.L.Read@URS.com

Storm Surge GIS Data: Important Mapping Process Input

Overview

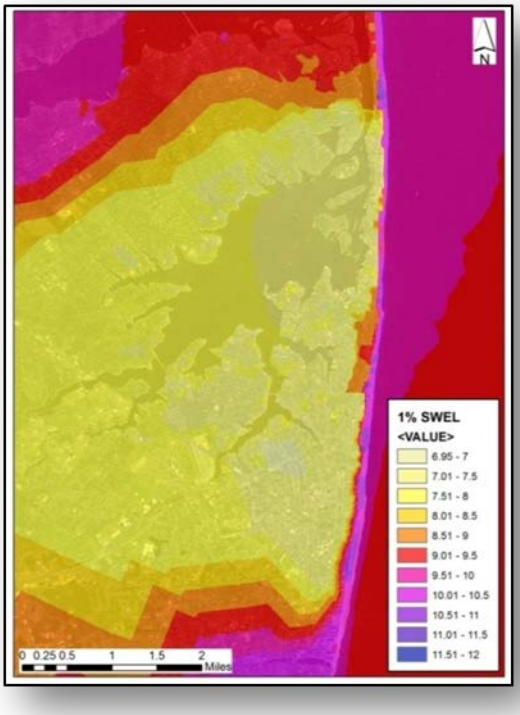
FEMA is committed to continuing the recovery process in New Jersey by providing the best available flood risk data to help guide communities in their efforts to reduce the impact of flood events and protect lives and property from future damages. To accomplish this, FEMA is implementing a comprehensive outreach initiative to share data and to ensure that affected communities are fully engaged and informed throughout the Flood Insurance Rate Map (FIRM) development process.

FEMA has prepared a series of fact sheets that provide important information regarding the types of data that communities will receive. In addition to describing the data, these fact sheets provide guidance on how communities can use that data to better understand their flood risk, as a tool in the decision making process, and to plan for mitigation activities. Other fact sheets available in this series include:

- Field Reconnaissance and Transect Data: Important Mapping Process Inputs
- Coastal Hazard Analysis Modeling Program (CHAMP) Database Interpretation
- New Jersey Preliminary Work Map Interpretation

Storm Surge and how it is Modeled

Storm surge is the amount of water, combined with the effect of normal tides, which is pushed towards the shore during a storm. The height of the storm surge is driven by many variables, such as the strength, size, and direction of the storm. The ADCIRC (ADvanced CIRCulation) coastal circulation and storm surge computer model in conjunction with the Simulating Waves Nearshore (SWAN) computer model was used to model the effects of storm surge in this coastal flood study. Specifically, the models were used to determine the probability of storm surge events of the 10 percent, 2 percent, 1 percent, and 0.2 percent annual chance magnitudes.



GIS showing one percent SWEL surface

Storm Surge Data

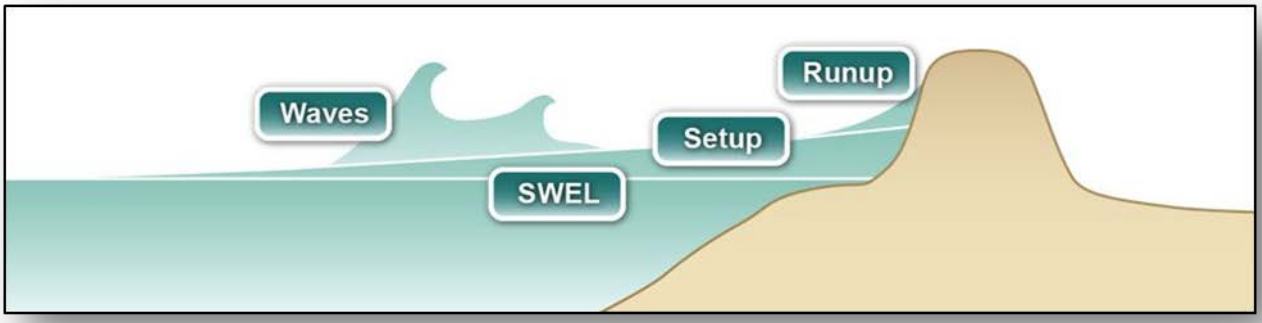
The digital storm surge data is initially developed as a series of points. Then, using GIS software, the points are connected to make a seamless surface of pixels called a "raster." This surface shows how the water surface is connected between the points. These data are also called the Stillwater Elevation (or SWEL) surfaces.

The graphic above shows a sample 1 percent annual chance SWEL surface. The line where the surface is at the same elevation as the ground is the flood hazard boundary for the various annual chance events. Keep in mind a stillwater elevation does not take into account all effects from waves coming ashore during a storm event. The storm surge GIS dataset includes digital data for the 10 percent-, 2 percent -, 1 percent -, and 0.2 percent-annual-chance events.

Why this Data is Important

The 1 percent SWEL surface is used as the starting stillwater elevation for the erosion analysis, overland wave height modeling, and runup modeling, which have also been performed as part of this coastal flood study, and are necessary to accurately determine coastal flood hazards in conjunction with storm surge. The 1 percent SWEL is one of three components that must be combined to create the Base Flood Elevations (BFEs) included on the FIRMs. The three components are:

- Storm Surge Stillwater Elevation (SWEL) and wave setup
- Wave height above storm surge (stillwater) elevation
- Wave runup above storm surge elevation.



Coastal storm surge stillwater elevation (SWEL), wave setup, and wave runup

How the Data can be Used

These data can be reviewed to see the storm surge elevations for the various return intervals. In most cases, these data will be lower than the final BFEs included on the FIRM, but can give a sense of the location of the mapped flood hazard areas before erosion and wave runup are taken into account.

Where to Go for More Information

The New Jersey Department of Environmental Protection will be hosting a series of webinars and community meetings in coordination with FEMA to further explain the data that is received and answer questions about next steps. Please visit http://www.region2coastal.com/ for more information on FEMA's data sharing initiative with New Jersey coastal communities.

Hudson County, NJ
Preliminary Work Map

Miles

0 0.125 0.25 0.5 0.75 1

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary
- Elevation: 4, 8, 12, 16

Elevation information is provided in feet NAVD88.
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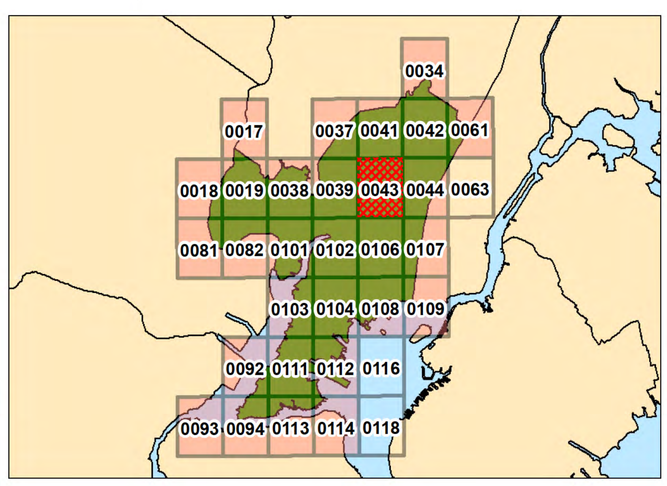
Panel 0043

This preliminary work map contains coastal flood hazard information only, riverine flood hazard information not included



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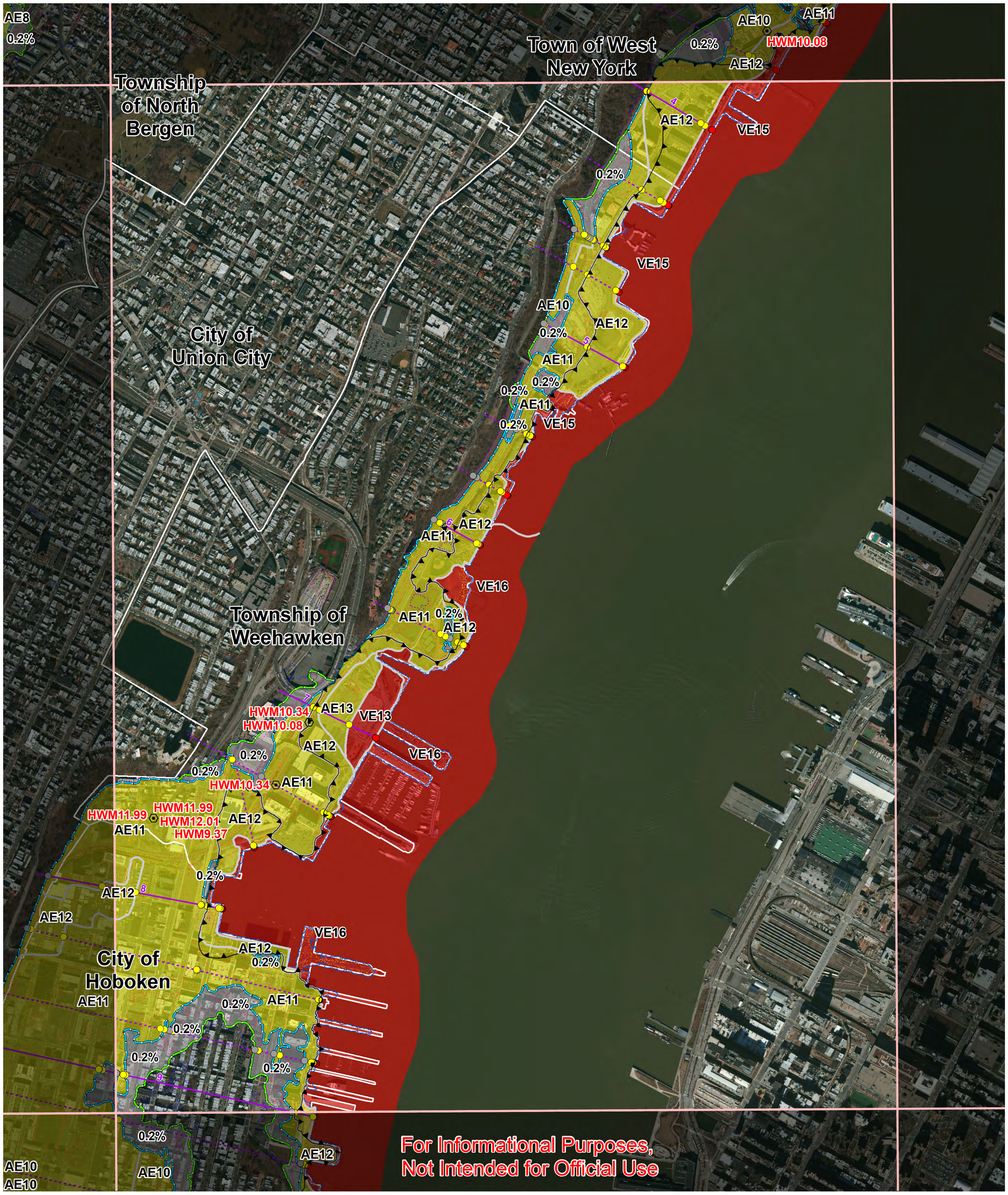
Hudson County, NJ
Preliminary Work Map



0 0.125 0.25 0.5 0.75 1 Miles

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary
- Elevation: 4, 8, 12, 16

AE
VE
X

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Panel 0044

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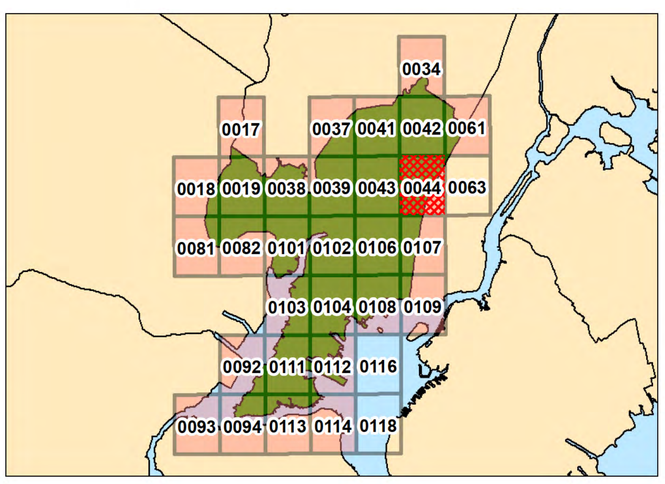
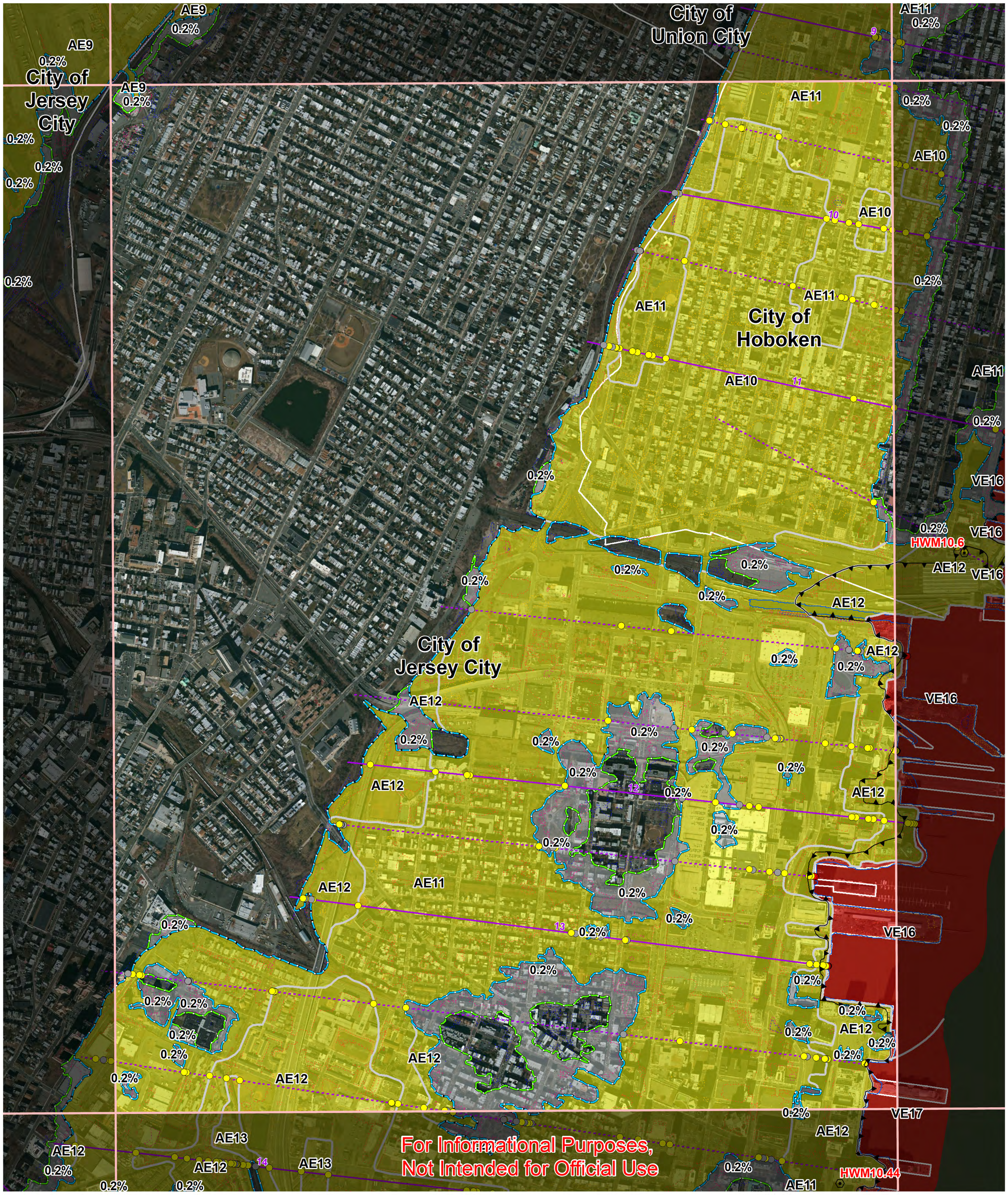


Hudson County, NJ
Preliminary Work Map



0 0.125 0.25 0.5 0.75 1 Miles

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
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- Shaded X (0.2% Floodplain)
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Panel 0106

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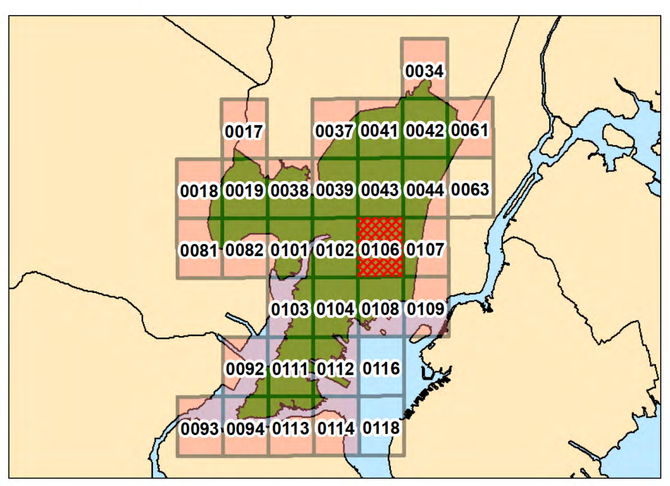

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Hudson County, NJ
Preliminary Work Map

Miles

0 0.125 0.25 0.5 0.75 1

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
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- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary

Transect Station: AE, VE, X

Elevation: 4, 8, 12, 16

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Panel 0107

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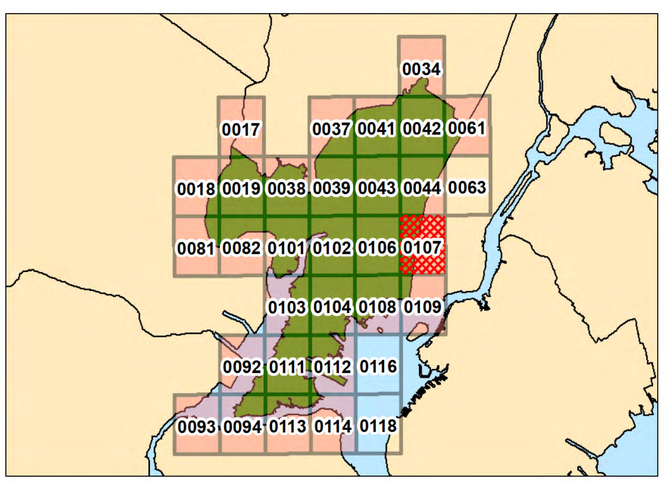
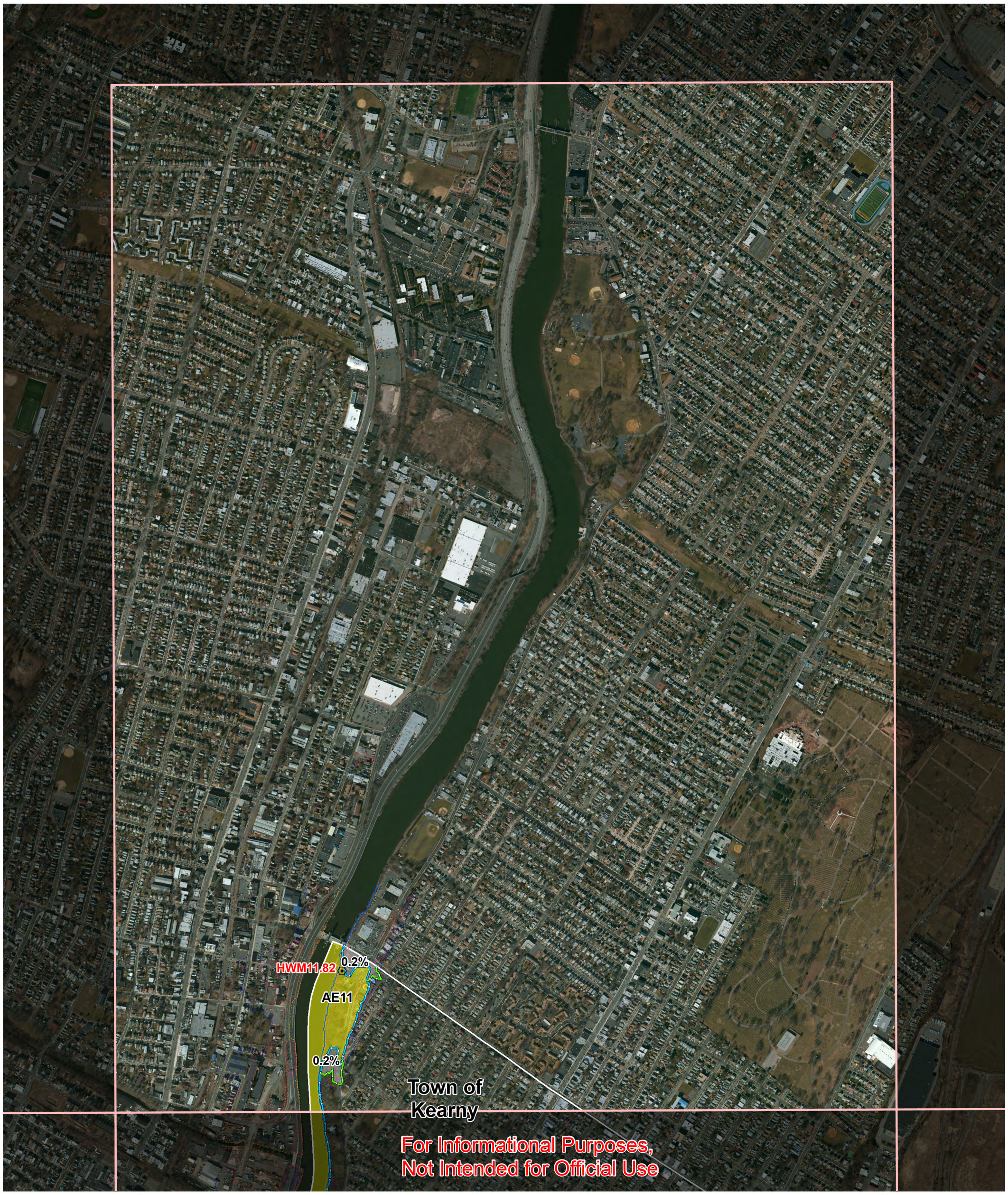


Hudson County, NJ
Preliminary Work Map



0 0.125 0.25 0.5 0.75 1 Miles

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
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  - AE
  - VE
  - X
  - 4
  - 8
  - 12
  - 16

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Panel 0017

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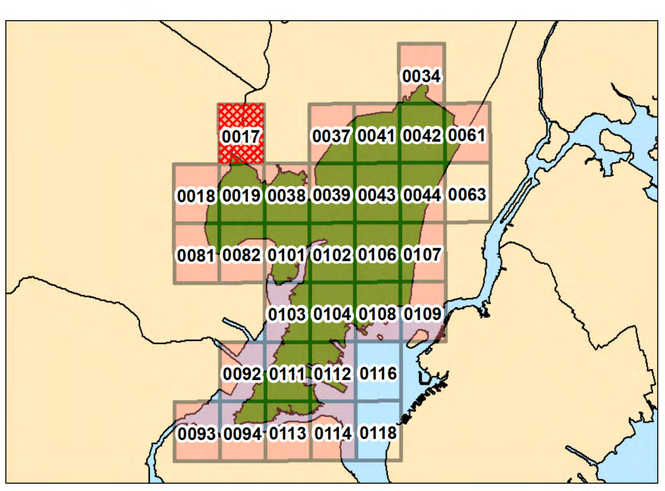

Hudson County, NJ
Preliminary Work Map

0 0.125 0.25 0.5 0.75 1 Miles

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary

Transect Station: AE, VE, X

Elevation: 4, 8, 12, 16

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Panel 0018

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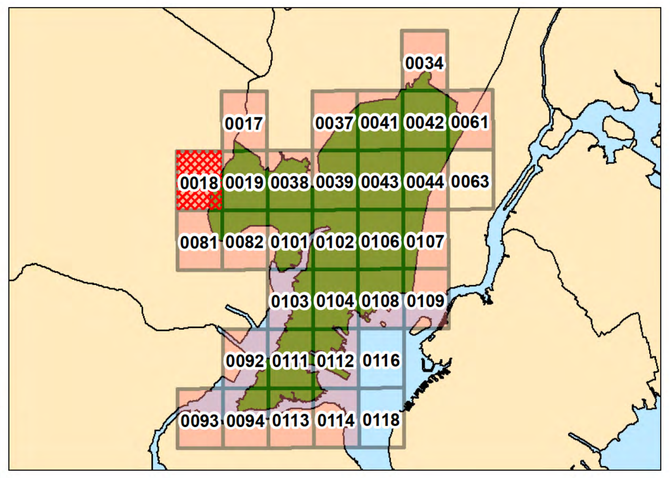

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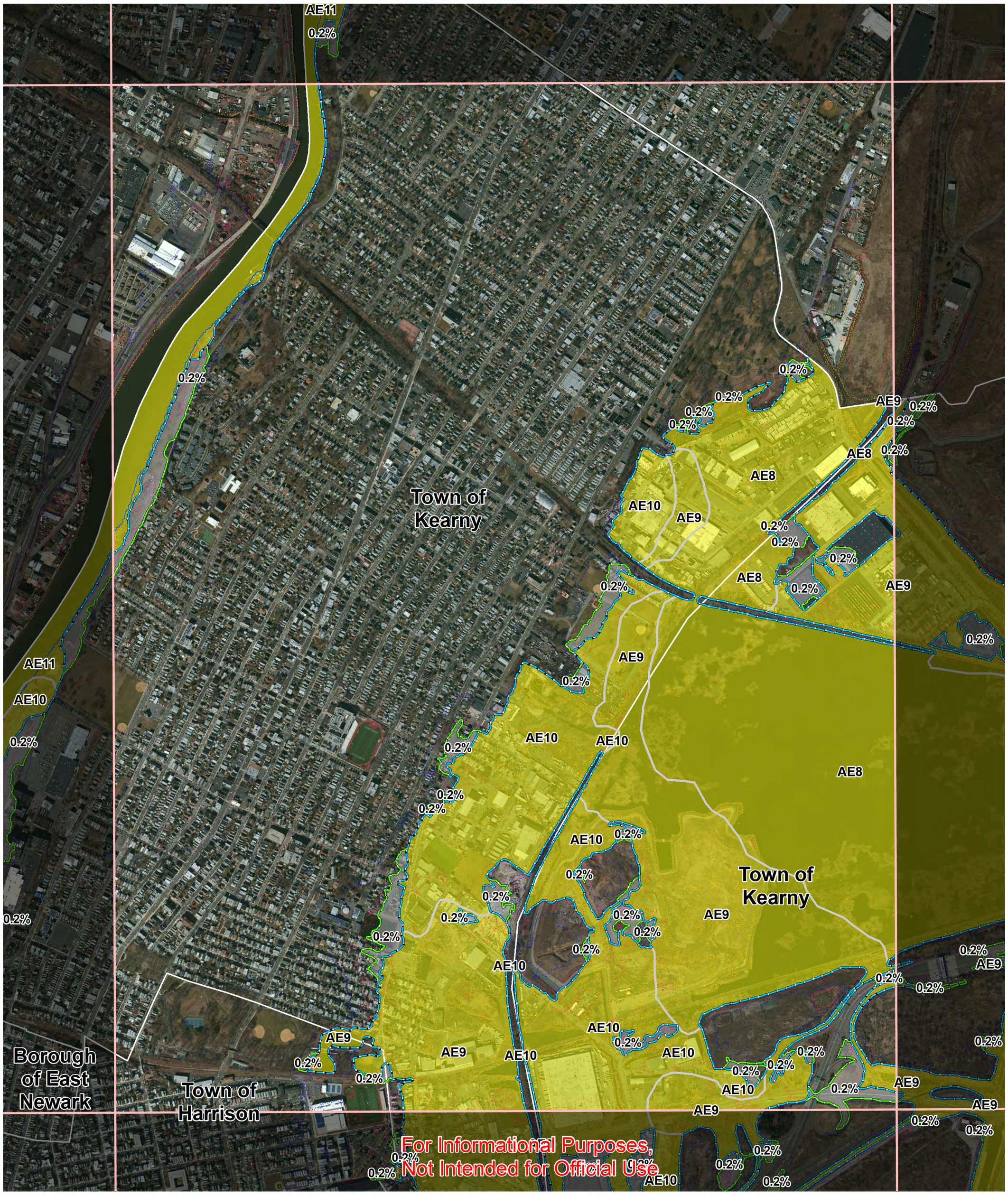
Hudson County, NJ
Preliminary Work Map



0 0.125 0.25 0.5 0.75 1 Miles

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
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- Mapping Transects
- Shoreline
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- Elevation
  - 4
  - 8
  - 12
  - 16

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Panel 0019

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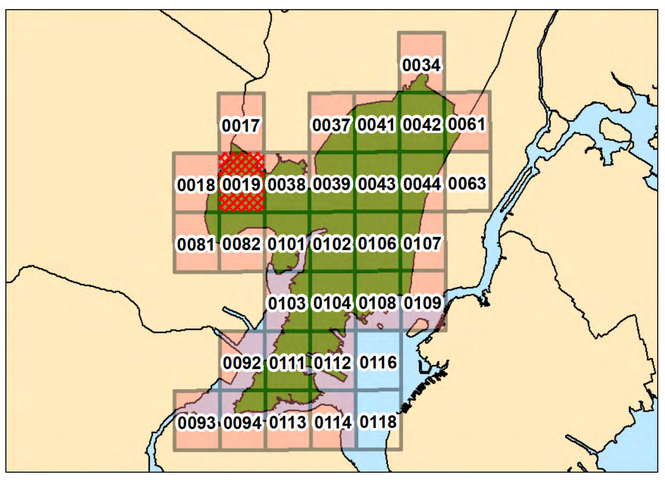

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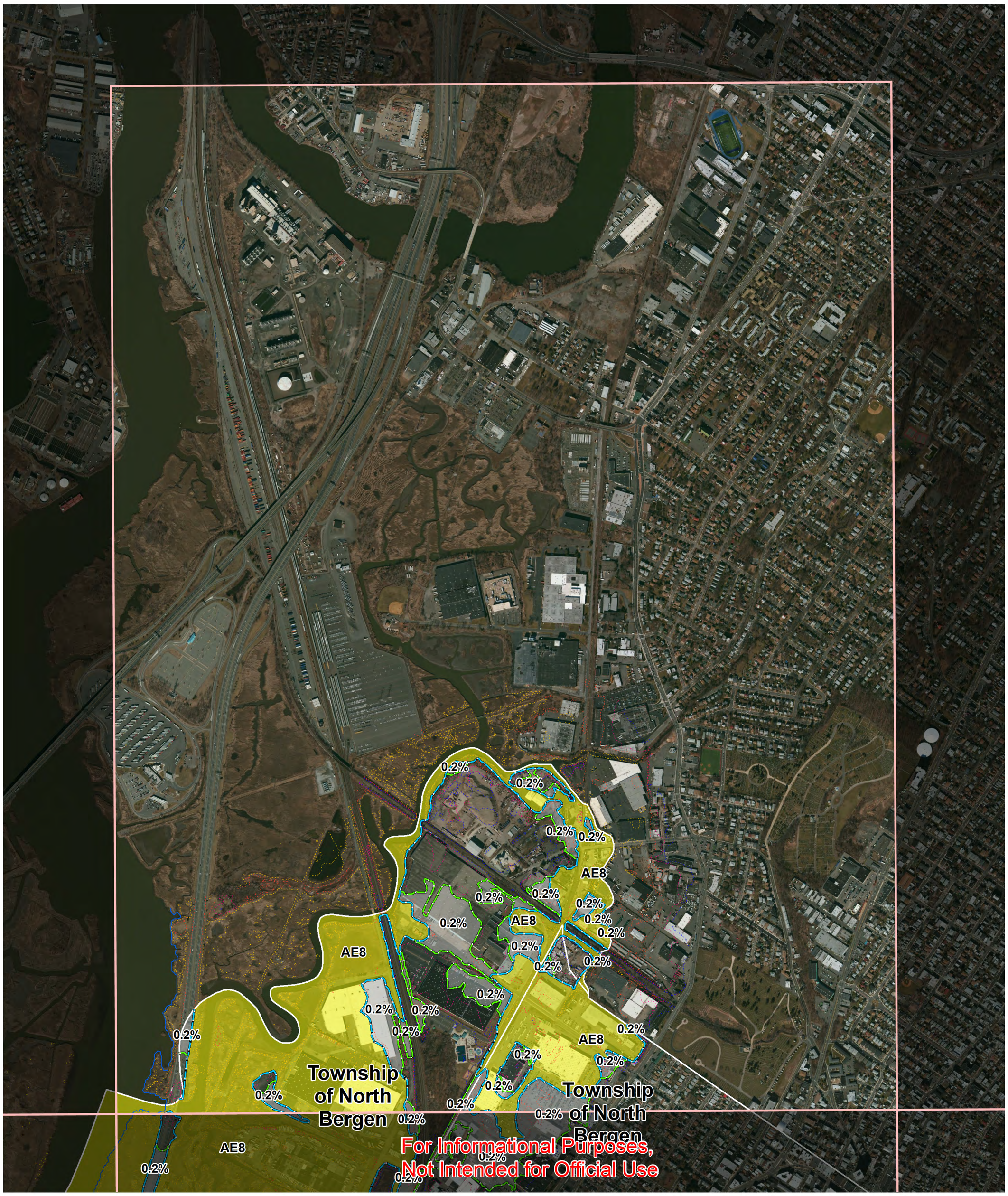
Preliminary Work Map



0 0.125 0.25 0.5 0.75 1 Miles

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
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- Published Transects
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- Shoreline
- Political Boundary
- Elevation
  - AE
  - VE
  - X
  - 4
  - 8
  - 12
  - 16

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Panel 0034

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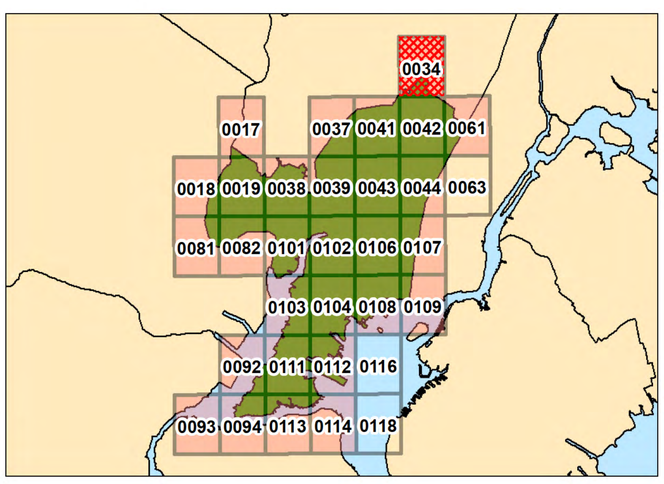

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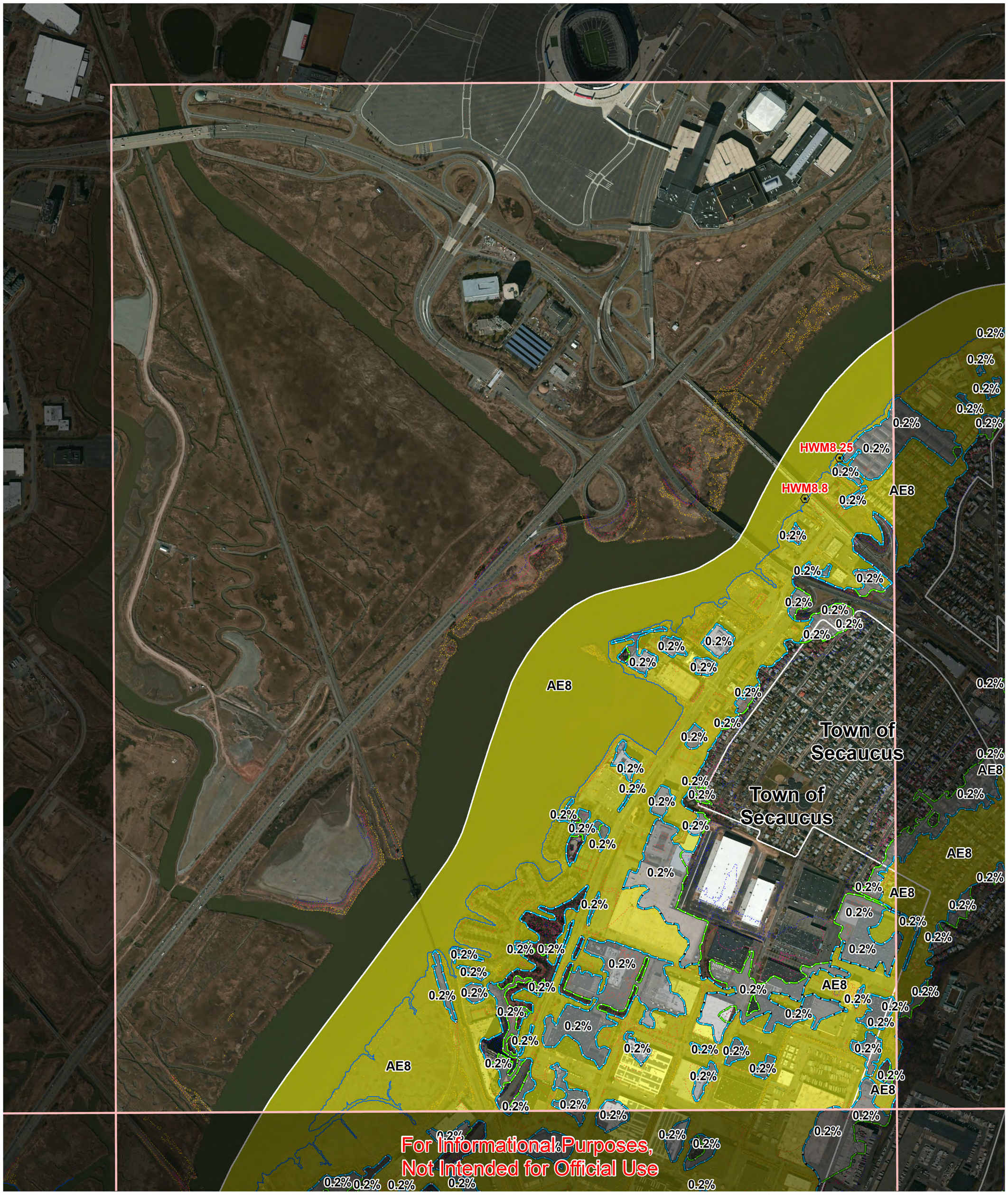
Preliminary Work Map



0 0.125 0.25 0.5 0.75 1 Miles

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary

Transect Station: AE, VE, X

Elevation: 4, 8, 12, 16

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Panel 0037

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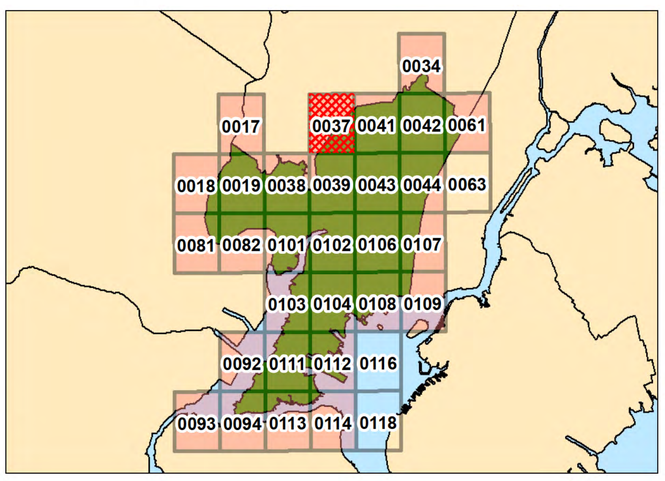

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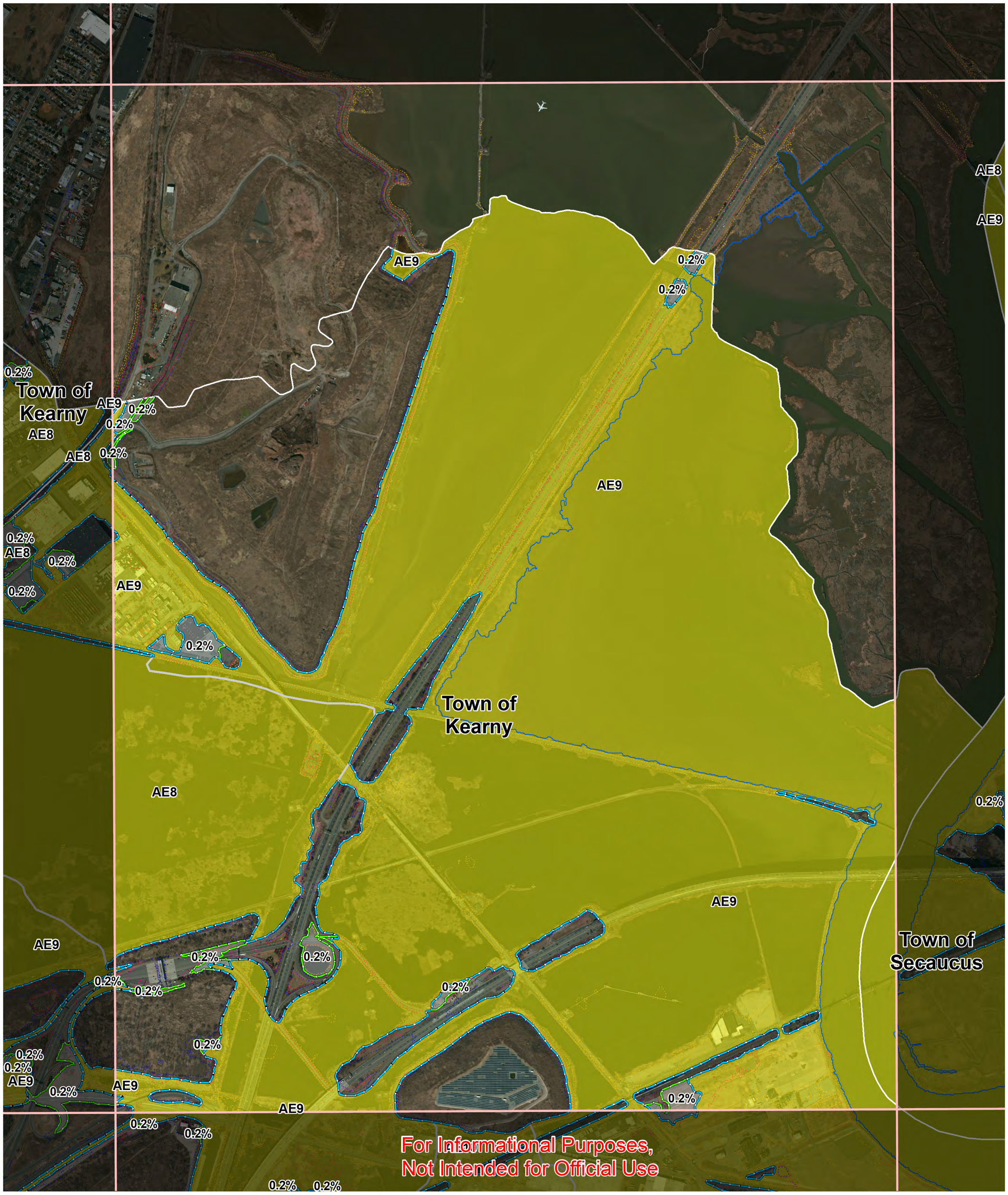
Hudson County, NJ
Preliminary Work Map



Miles

0 0.125 0.25 0.5 0.75 1

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
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- VE
- AO
- Shaded X (0.2% Floodplain)
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- Shoreline
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- Elevation
  - AE
  - VE
  - X
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  - 12
  - 16

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Panel 0038

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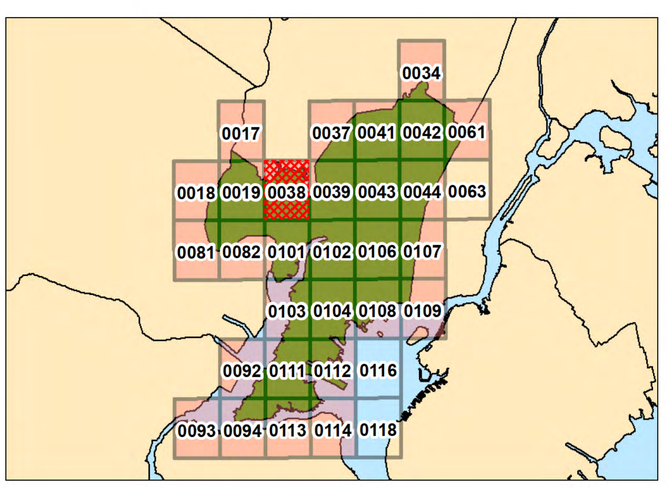

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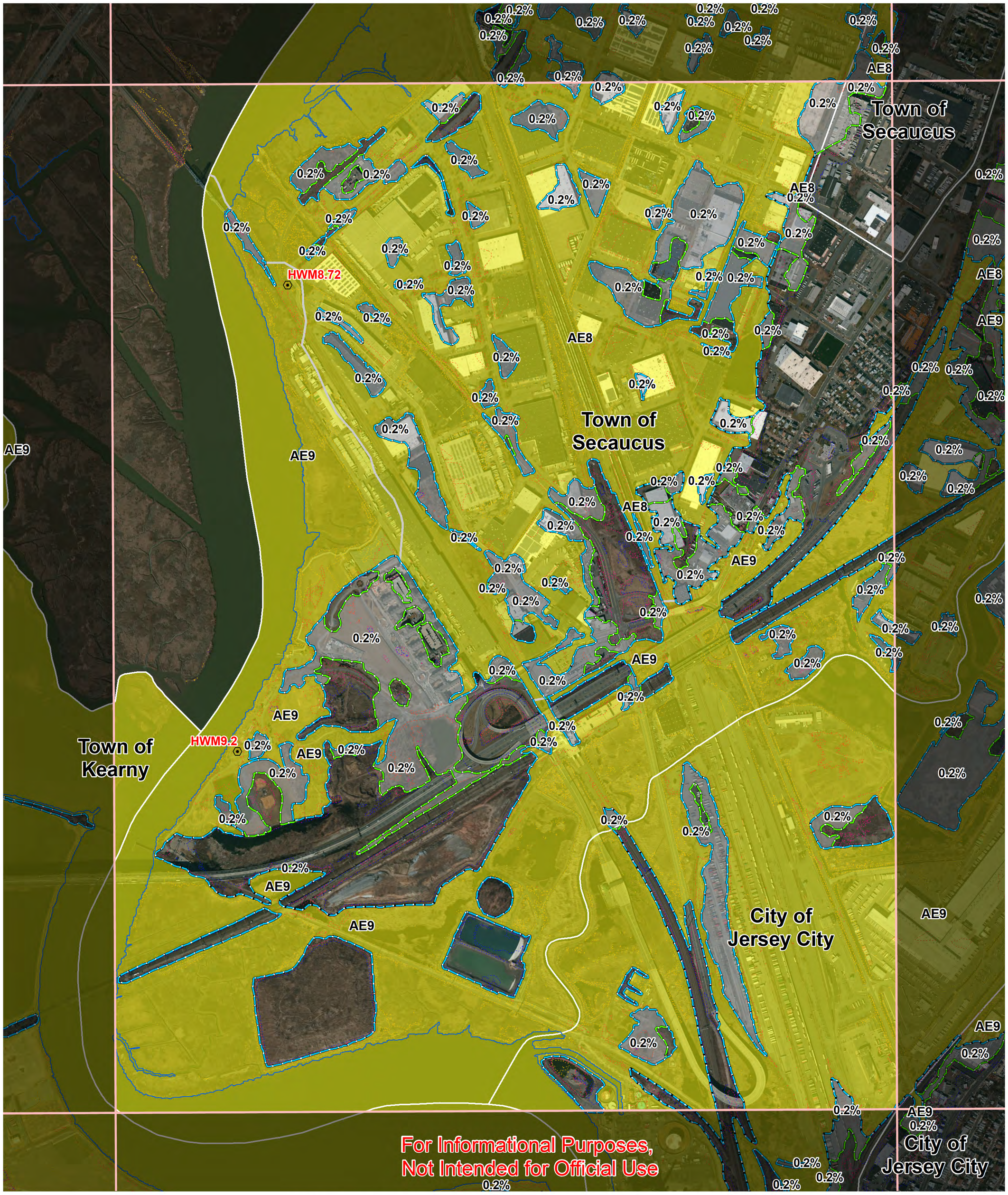
Hudson County, NJ
Preliminary Work Map



Miles
0 0.125 0.25 0.5 0.75 1

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
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- AO
- Shaded X (0.2% Floodplain)
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- Shoreline
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- Elevation: 4, 8, 12, 16

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Panel 0039

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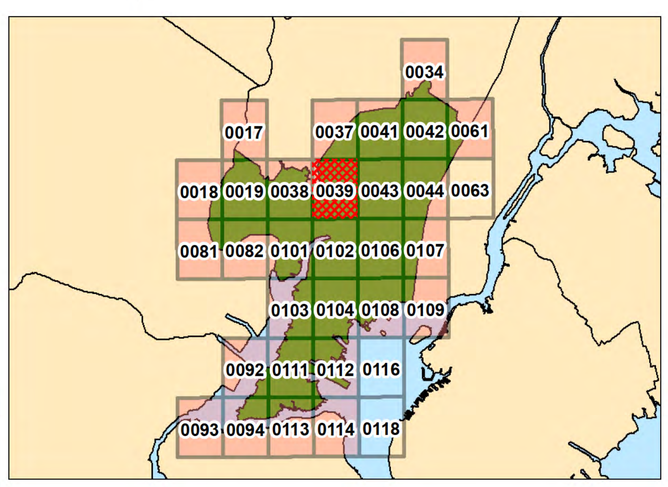

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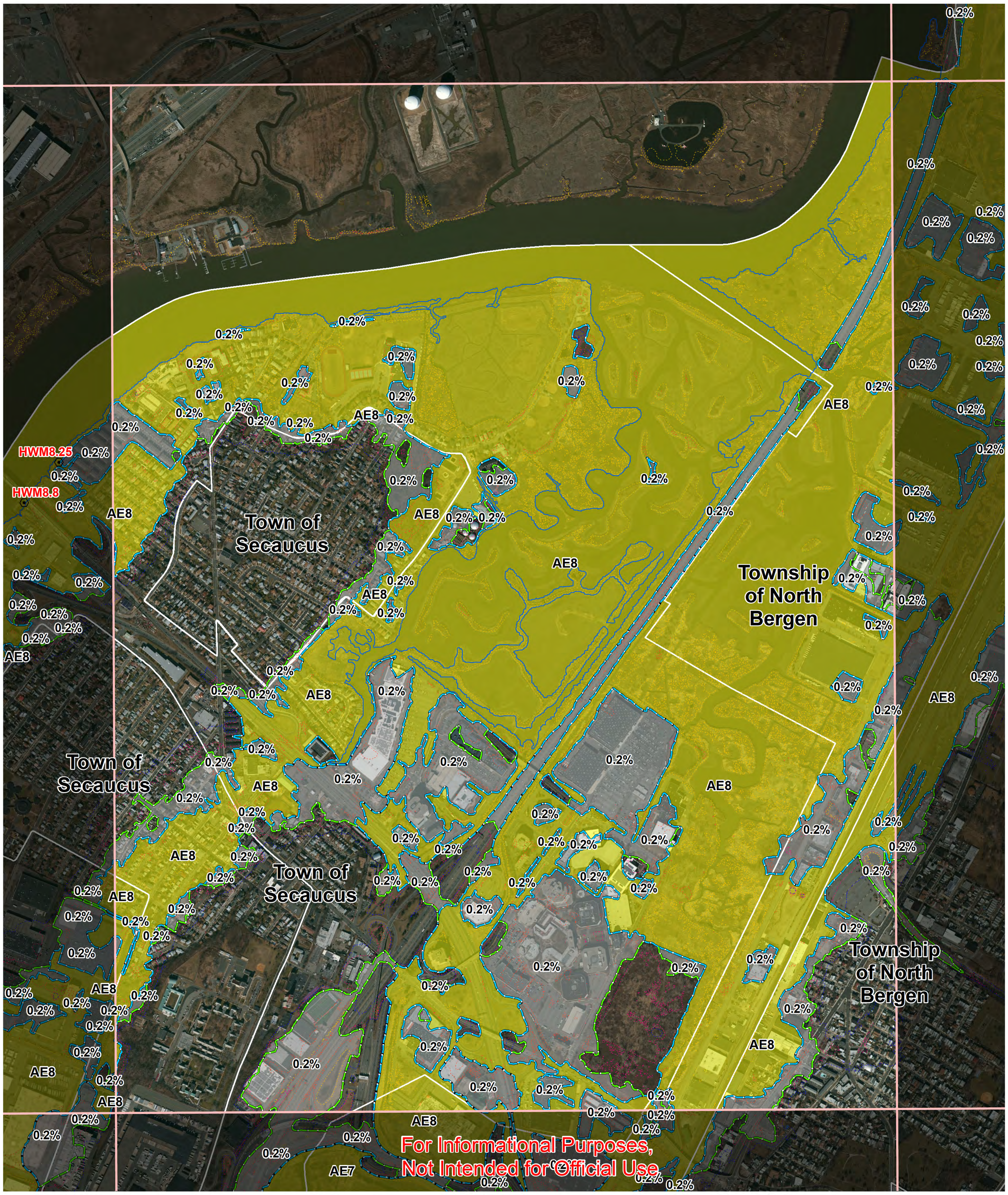
Hudson County, NJ
Preliminary Work Map



0 0.125 0.25 0.5 0.75 1 Miles

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
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Panel 0041

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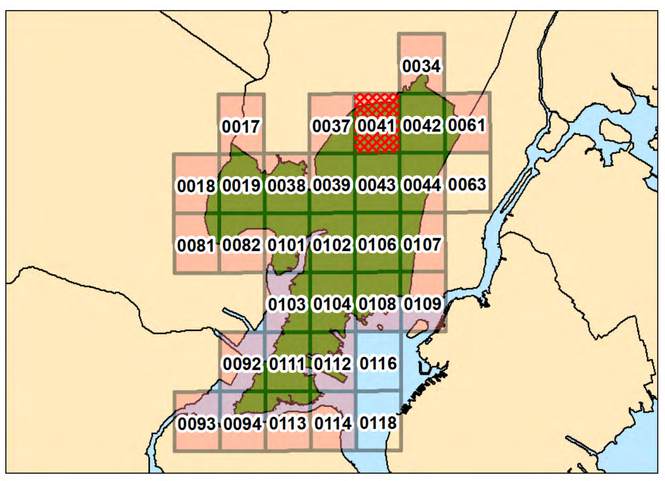
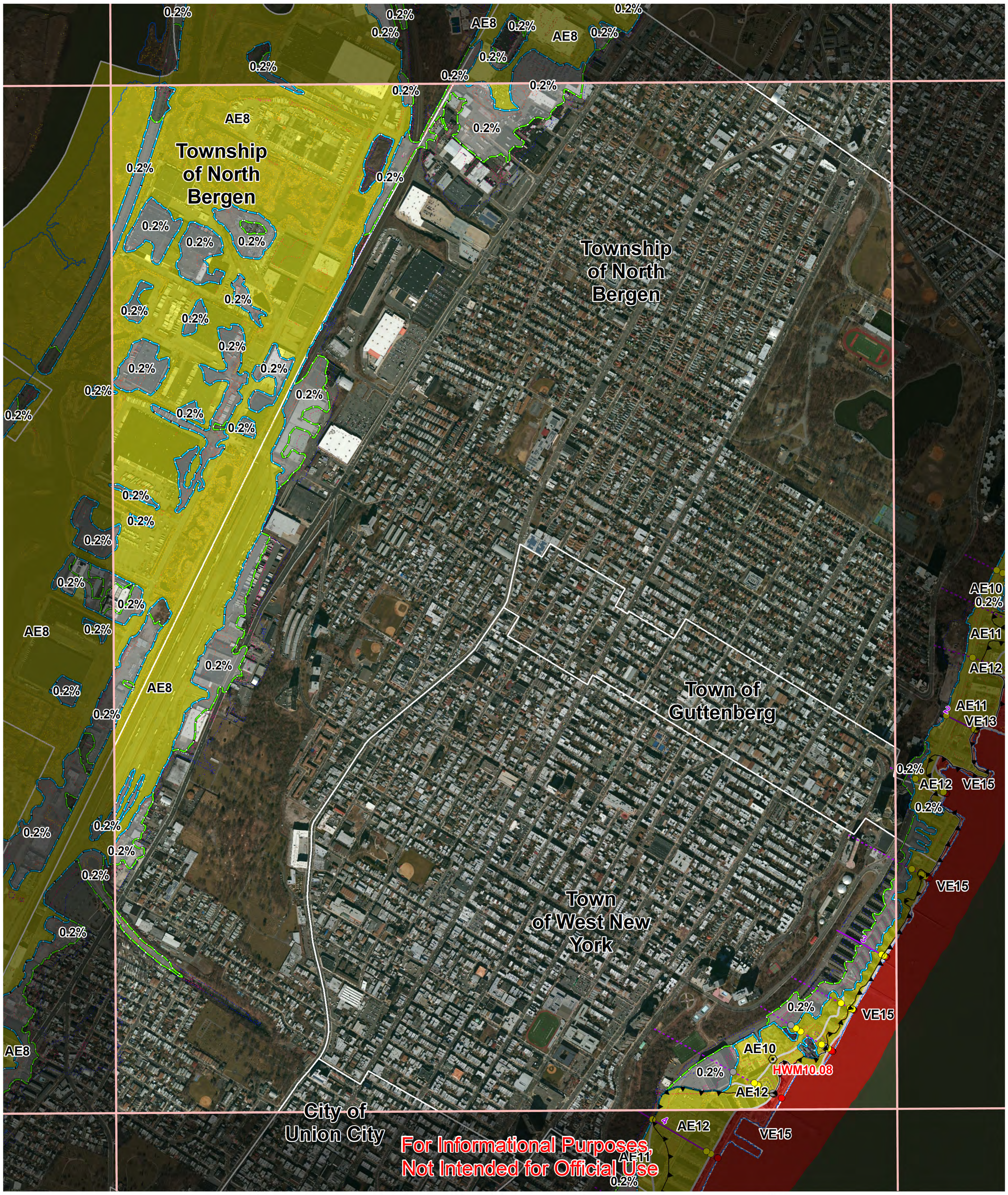


Hudson County, NJ
Preliminary Work Map



0 0.125 0.25 0.5 0.75 1 Miles

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
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- AE
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- Shaded X (0.2% Floodplain)
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- Published Transects
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- Shoreline
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Panel 0042

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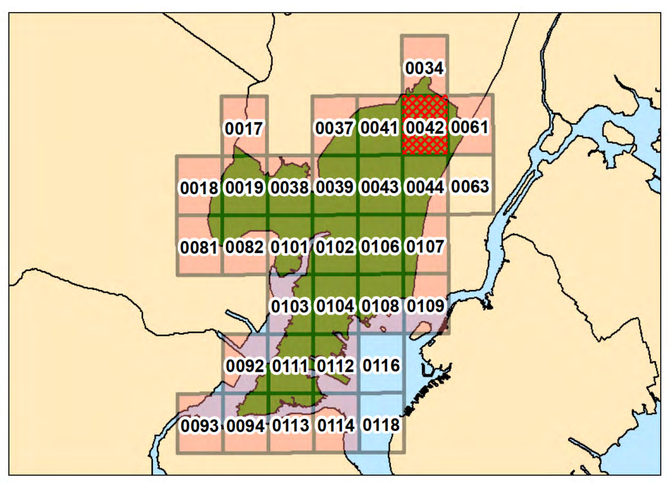

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Hudson County, NJ
Preliminary Work Map

Miles

0 0.125 0.25 0.5 0.75 1

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
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- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
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- Shoreline
- Political Boundary
- Elevation: 4, 8, 12, 16

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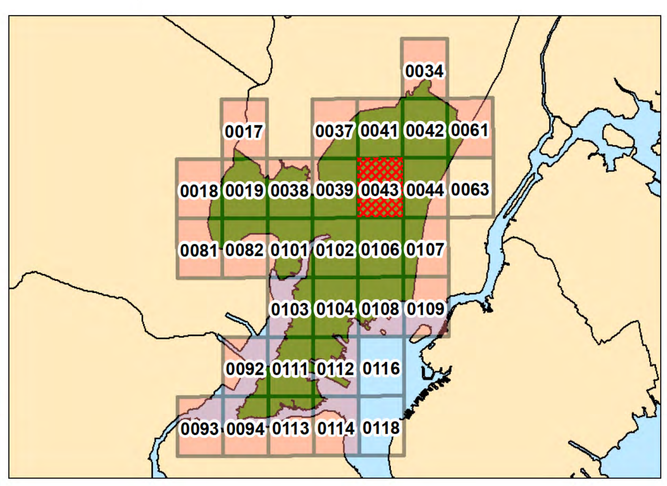
Panel 0043

This preliminary work map contains coastal flood hazard information only, riverine flood hazard information not included



FEMA

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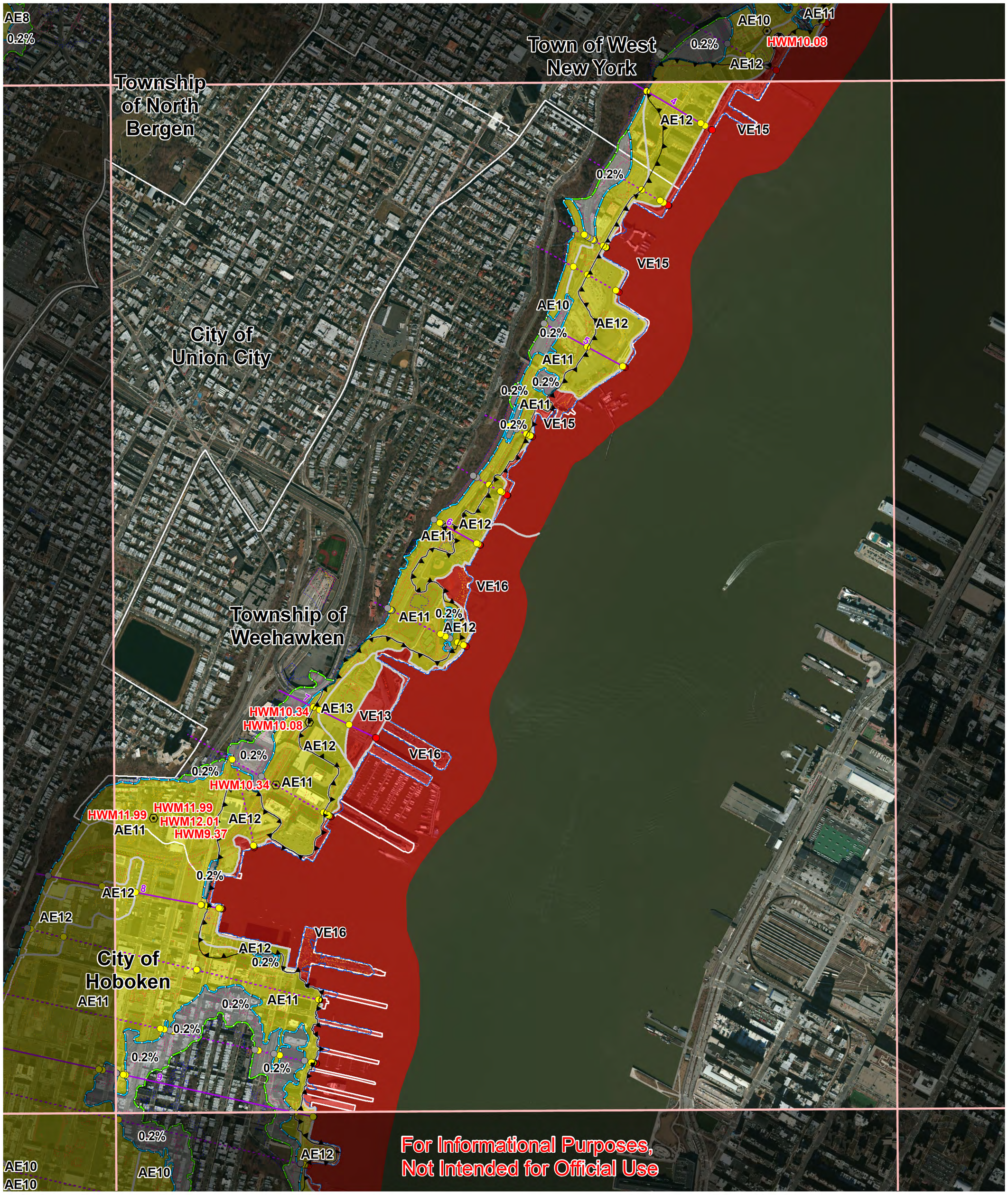
Risk Assessment, Mapping, and Planning Partners

Hudson County, NJ
Preliminary Work Map



0 0.125 0.25 0.5 0.75 1 Miles

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary
- Elevation: 4, 8, 12, 16

AE
VE
X

Elevation information is provided in feet NAVD88.
High water marks are provided for reference to a historical storm event. They are not intended to be used for validation of the coastal mapping and are not expected to match the coastal BFEs.

Panel 0044

This preliminary work map contains coastal flood hazard information only, riverine flood hazard information not included

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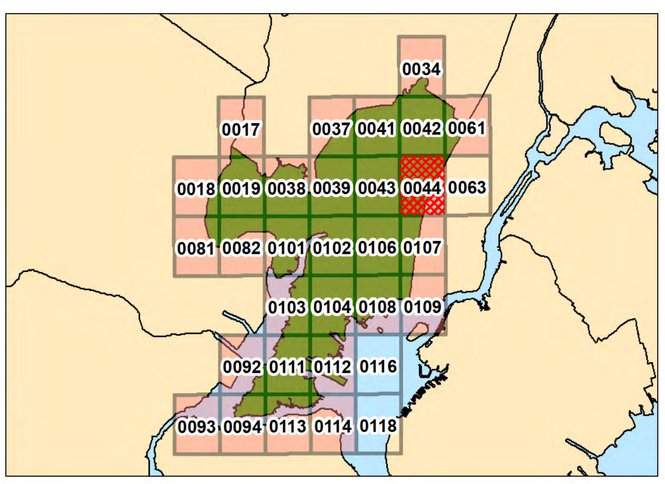
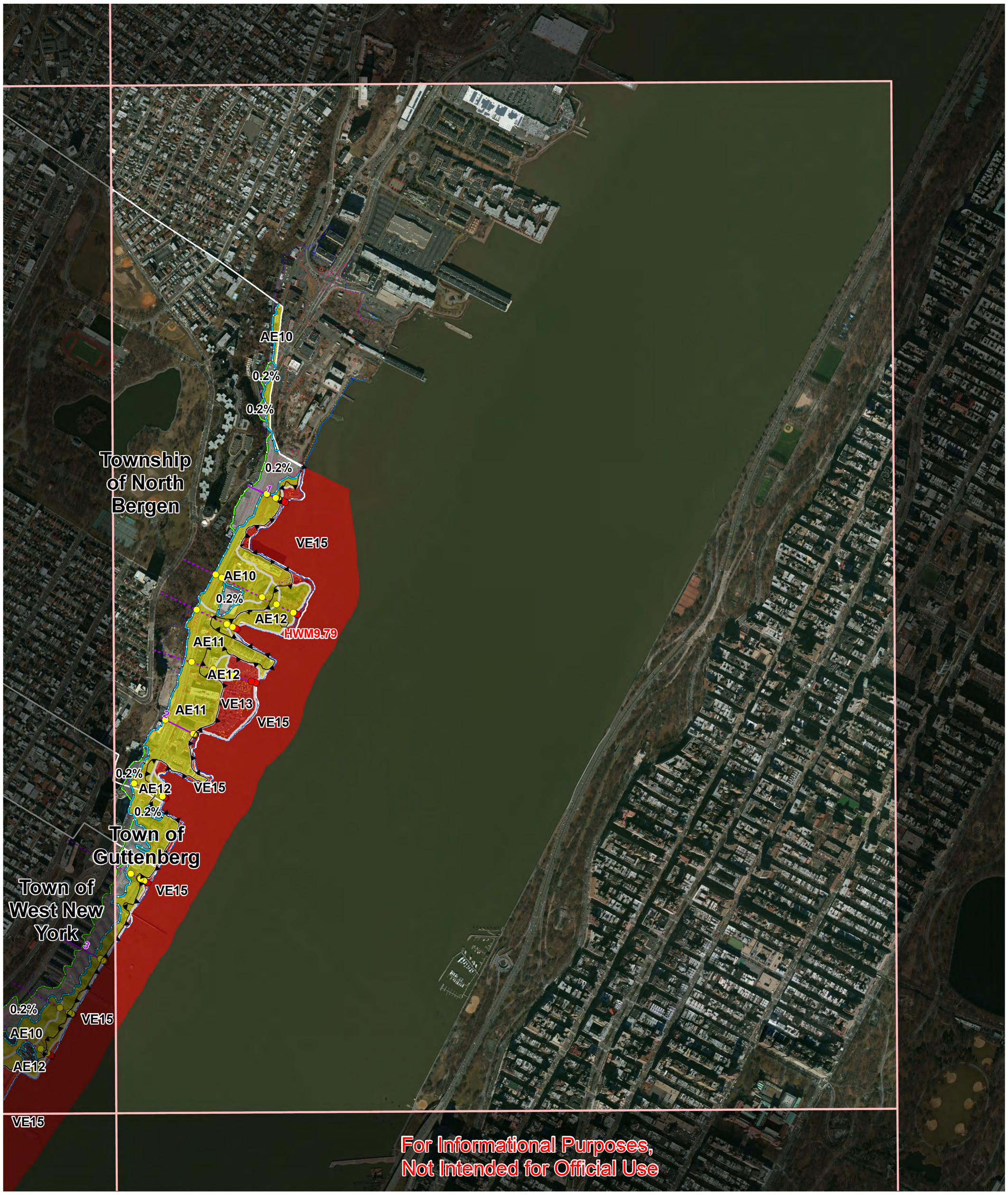


Hudson County, NJ
Preliminary Work Map



Miles

0 0.125 0.25 0.5 0.75 1

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary
- Elevation
  - AE
  - VE
  - X
  - 4
  - 8
  - 12
  - 16

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Panel 0061

This preliminary work map contains coastal flood hazard information only, riverine flood hazard information not included

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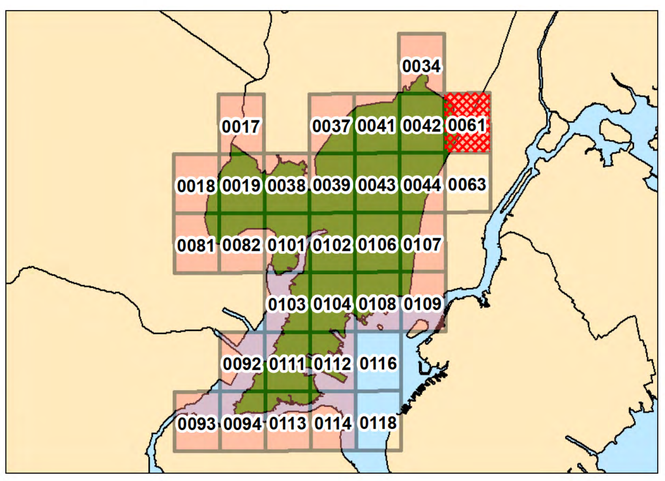

Hudson County, NJ
Preliminary Work Map

0 0.125 0.25 0.5 0.75 1 Miles

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary

Transect Station: AE, VE, X

Elevation: 4, 8, 12, 16

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Panel 0081

This preliminary work map contains coastal flood hazard information only, riverine flood hazard information not included

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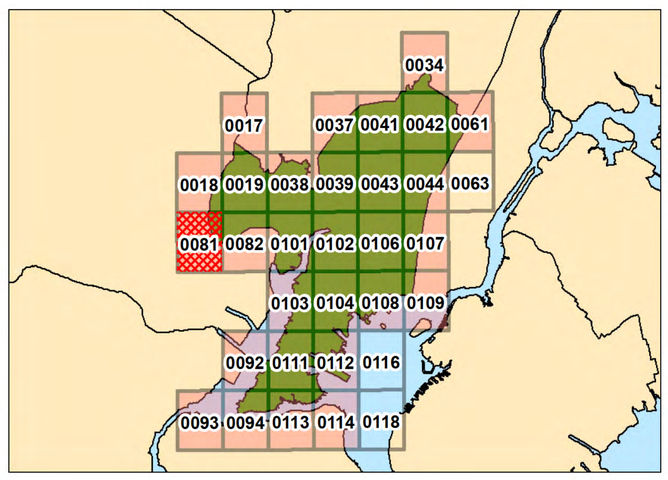

Hudson County, NJ
Preliminary Work Map

0 0.125 0.25 0.5 0.75 1 Miles

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary
- Elevation: 4, 8, 12, 16

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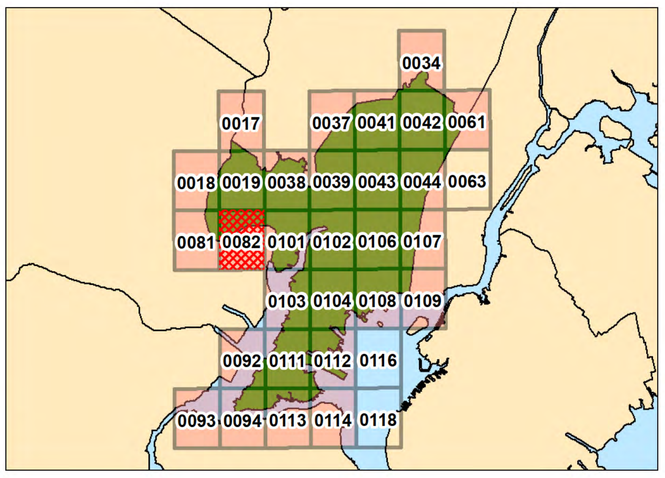
Panel 0082

This preliminary work map contains coastal flood hazard information only, riverine flood hazard information not included



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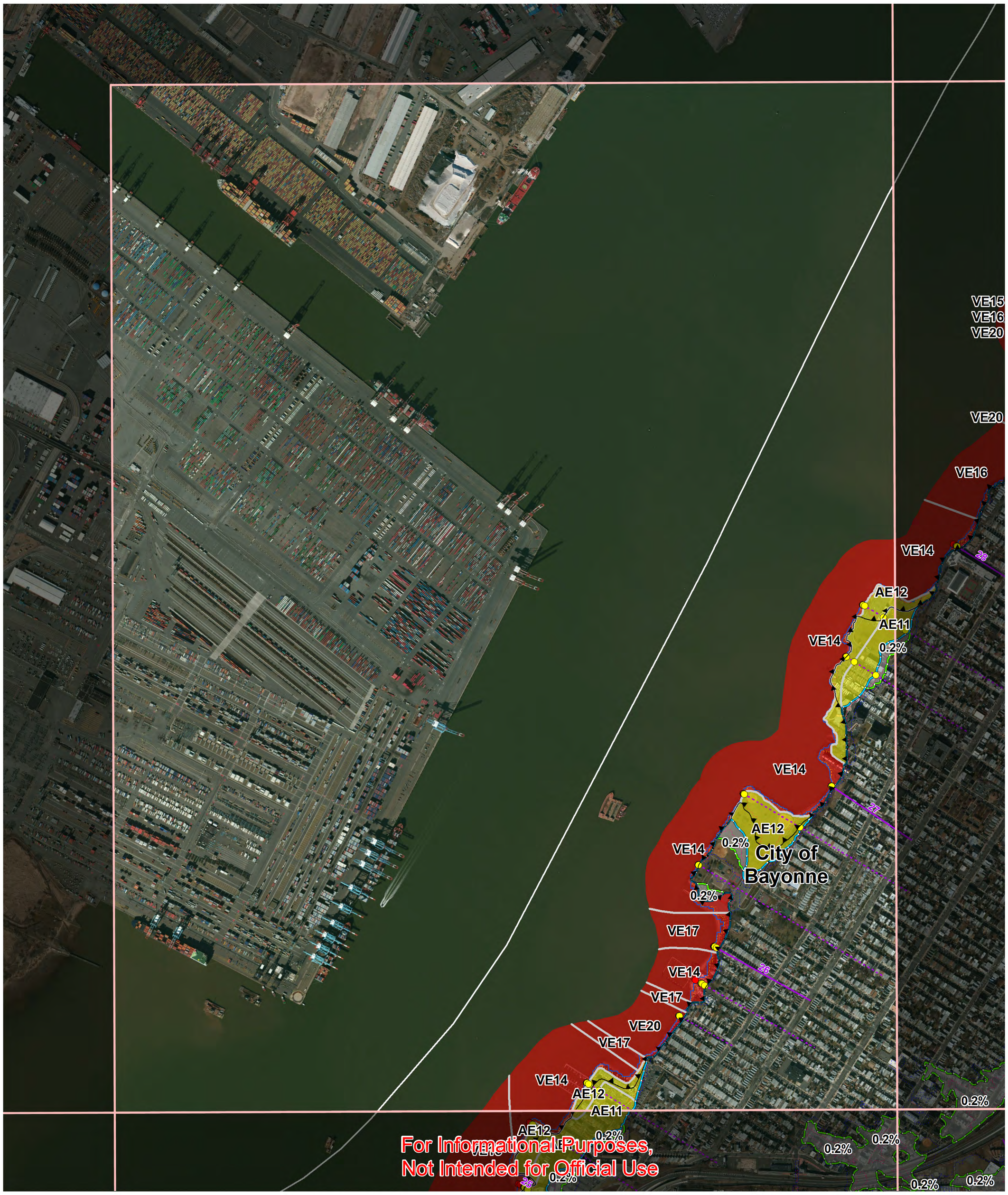
Hudson County, NJ
Preliminary Work Map



Miles

0 0.125 0.25 0.5 0.75 1

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary

Transect Station: AE, VE, X

Elevation: 4, 8, 12, 16

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Panel 0092

This preliminary work map contains coastal flood hazard information only, riverine flood hazard information not included

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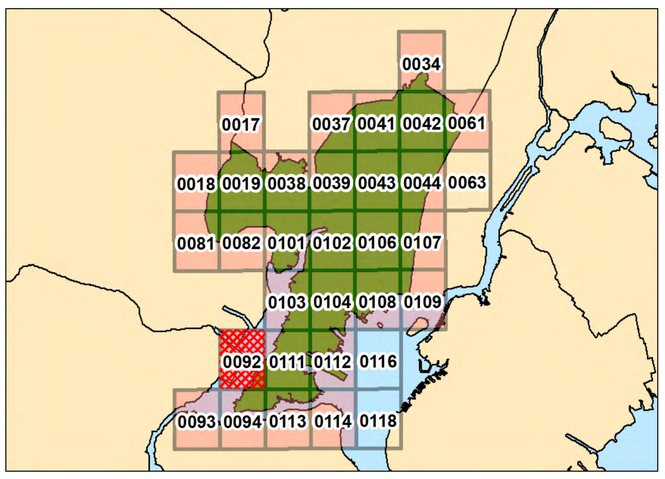

Hudson County, NJ
Preliminary Work Map

Miles

0 0.125 0.25 0.5 0.75 1

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary
- Elevation
  - AE
  - VE
  - X
  - 4
  - 8
  - 12
  - 16

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Panel 0093

This preliminary work map contains coastal flood hazard information only, riverine flood hazard information not included

FEMA

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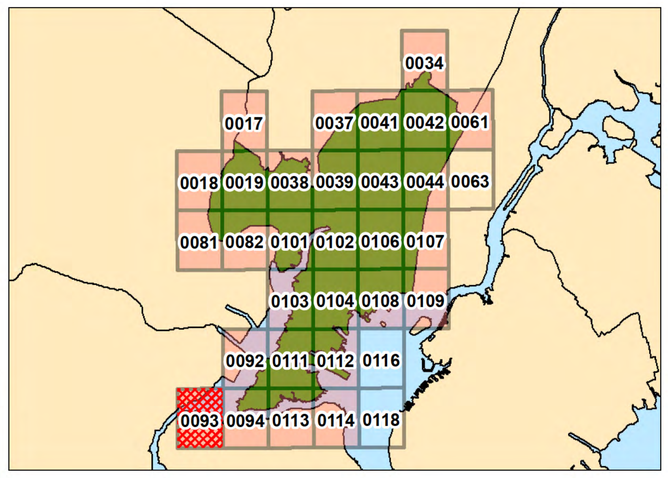
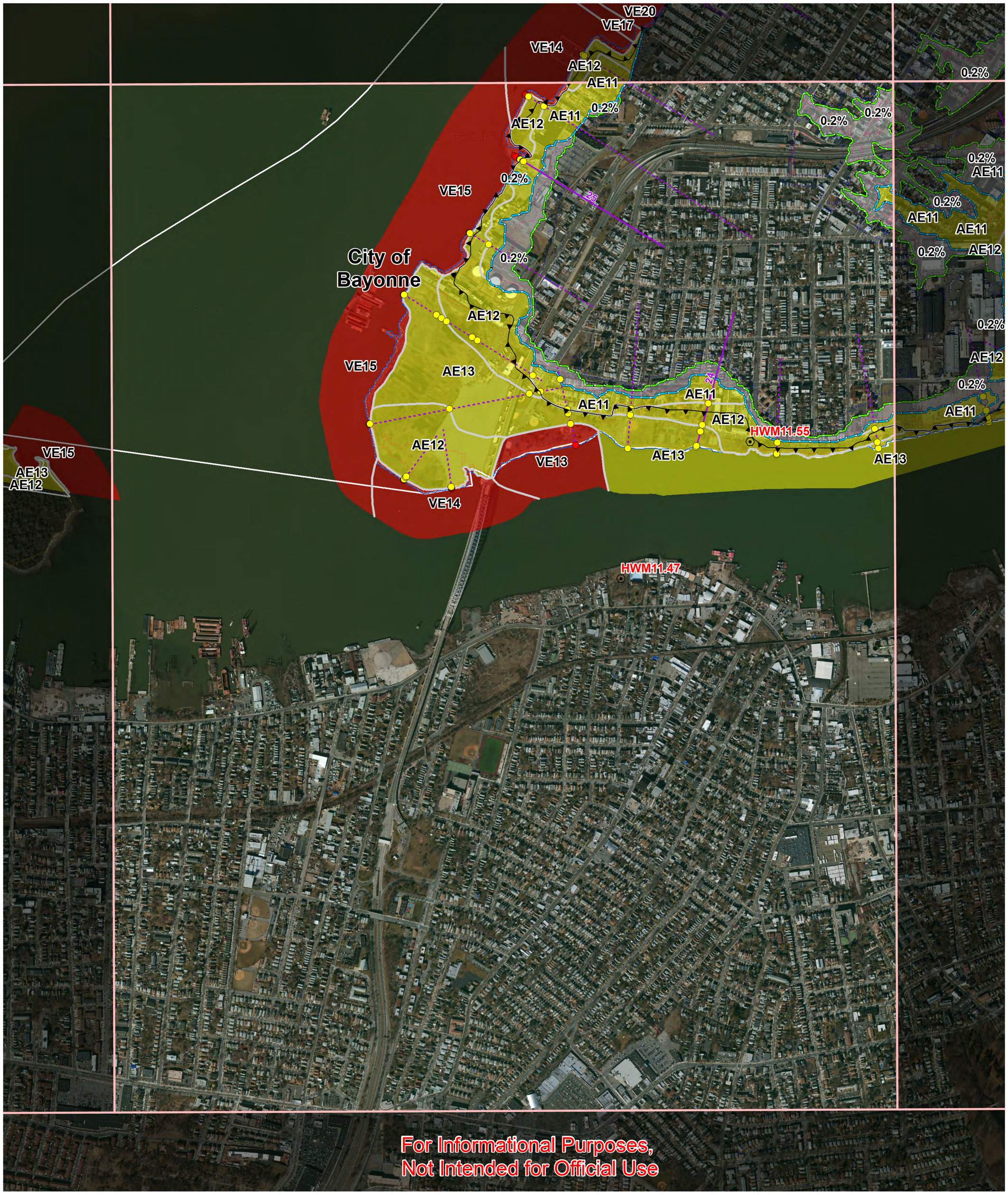


Hudson County, NJ
Preliminary Work Map



Miles

0 0.125 0.25 0.5 0.75 1

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary

Transect Station: AE, VE, X

Elevation: 4, 8, 12, 16

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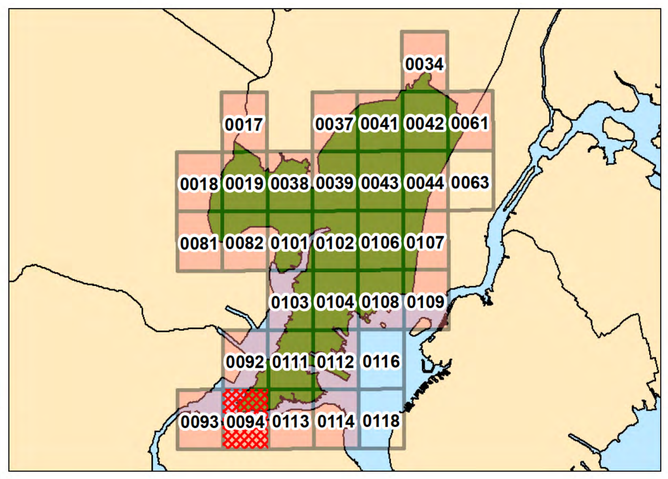
Panel 0094

This preliminary work map contains coastal flood hazard information only, riverine flood hazard information not included

N



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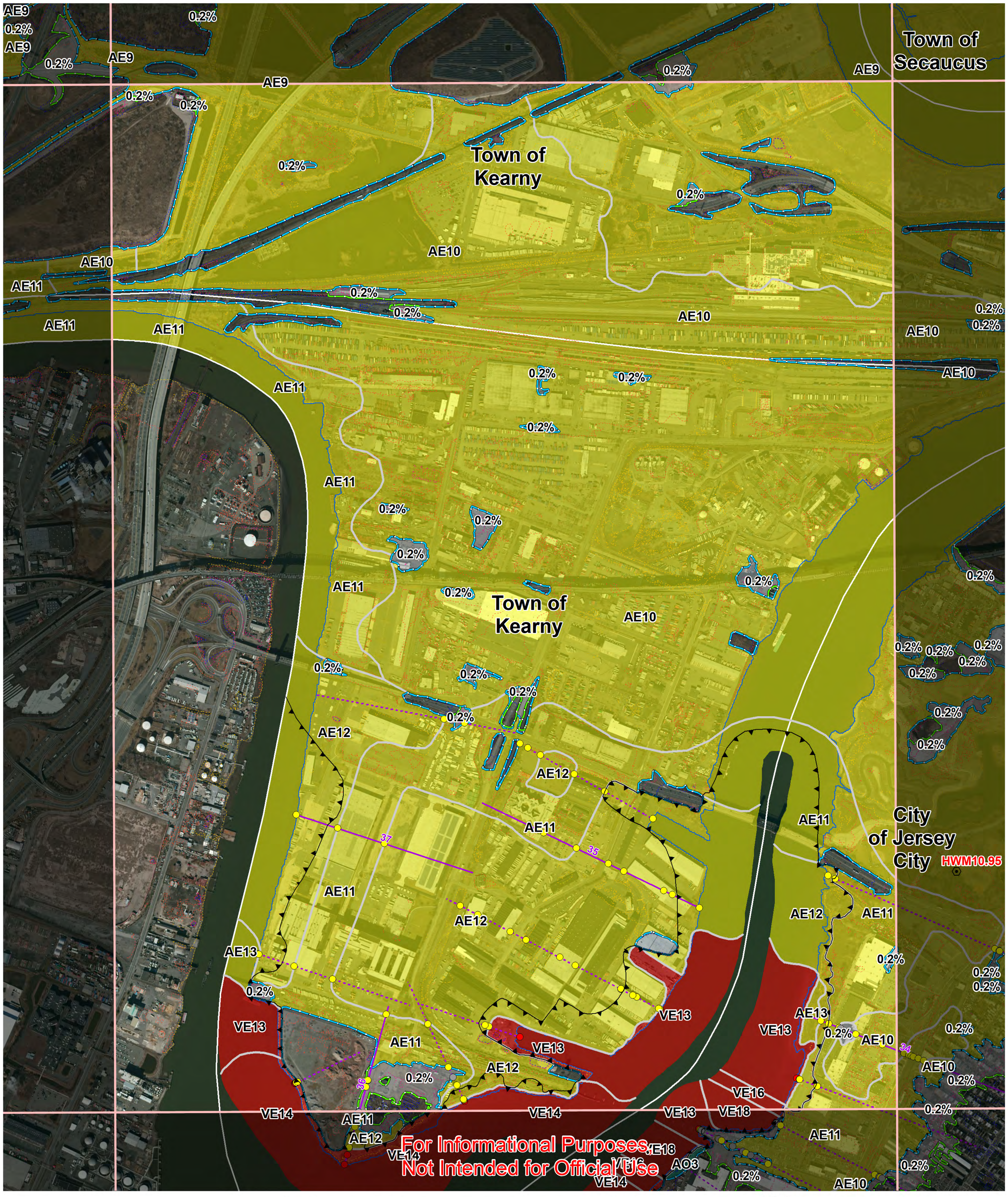
Hudson County, NJ
Preliminary Work Map



0 0.125 0.25 0.5 0.75 1 Miles

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary

Transect Station: AE, VE, X

Elevation: 4, 8, 12, 16

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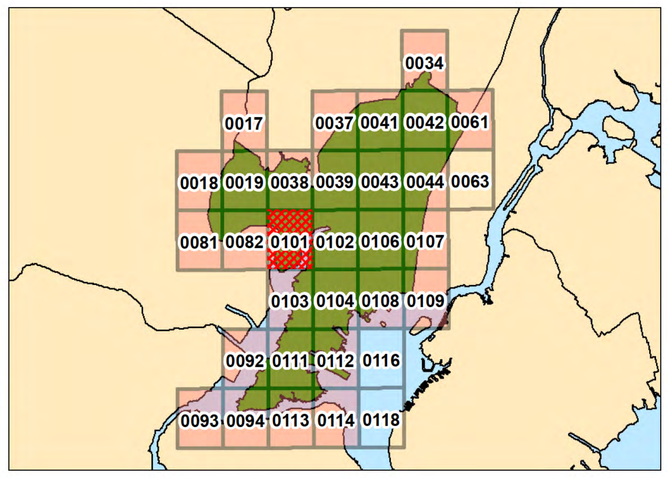
Panel 0101

This preliminary work map contains coastal flood hazard information only, riverine flood hazard information not included



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Hudson County, NJ
Preliminary Work Map

0 0.125 0.25 0.5 0.75 1 Miles

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary
- Elevation: 4, 8, 12, 16

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Panel 0102

This preliminary work map contains coastal flood hazard information only, riverine flood hazard information not included

FEMA

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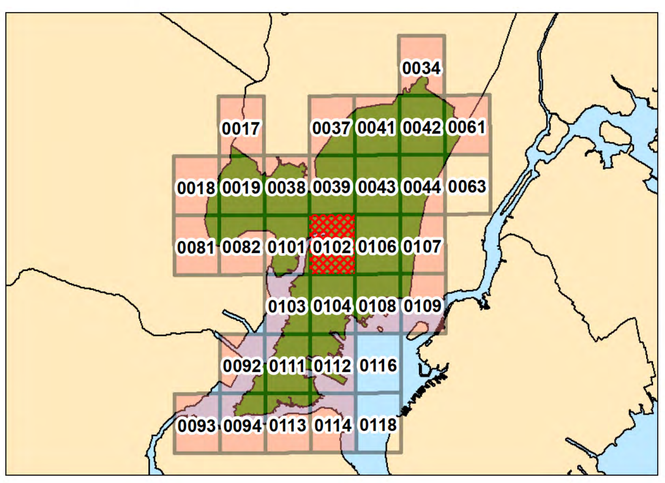
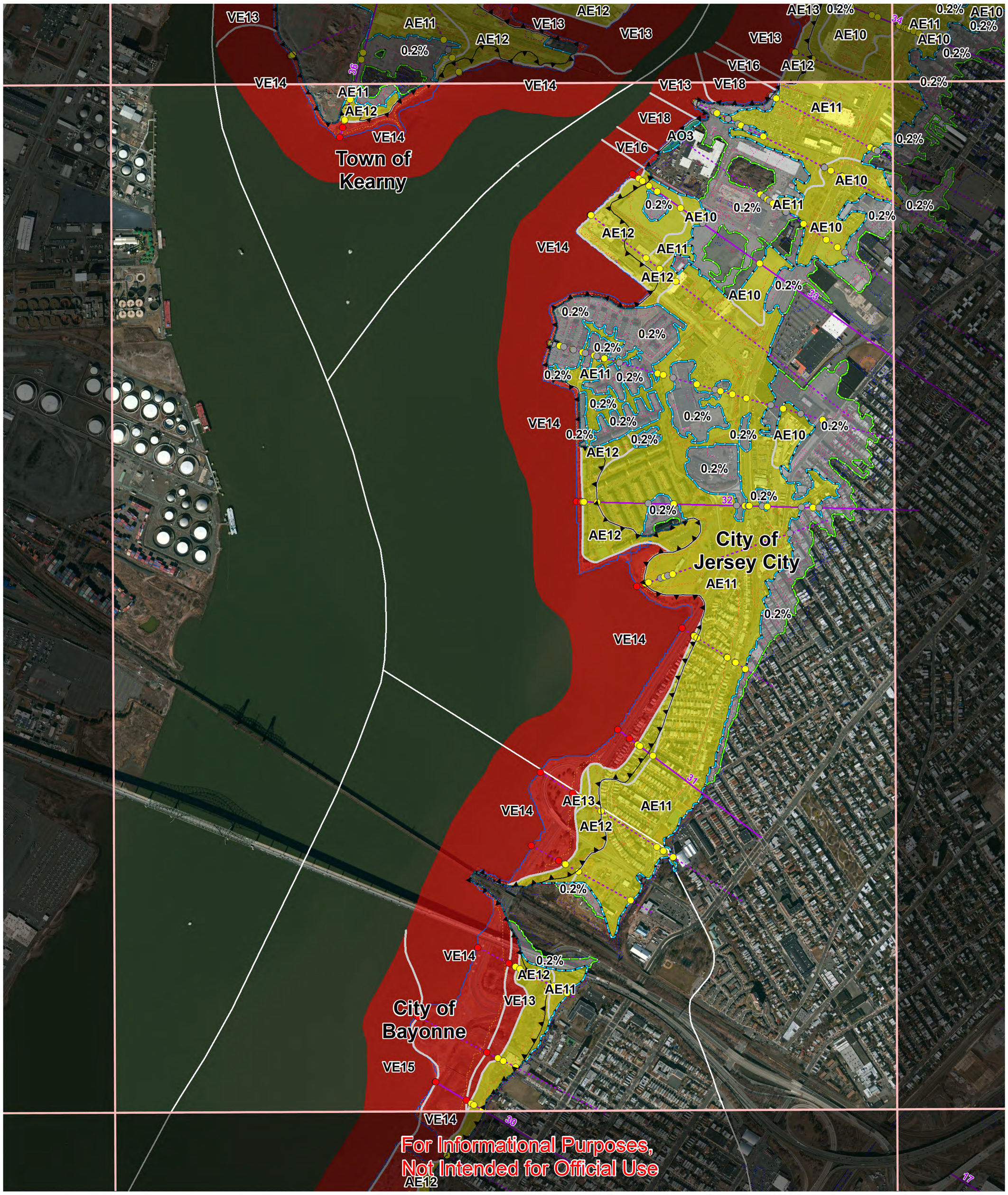


Hudson County, NJ
Preliminary Work Map



0 0.125 0.25 0.5 0.75 1 Miles

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary
- Elevation: 4, 8, 12, 16

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Panel 0103

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FEMA

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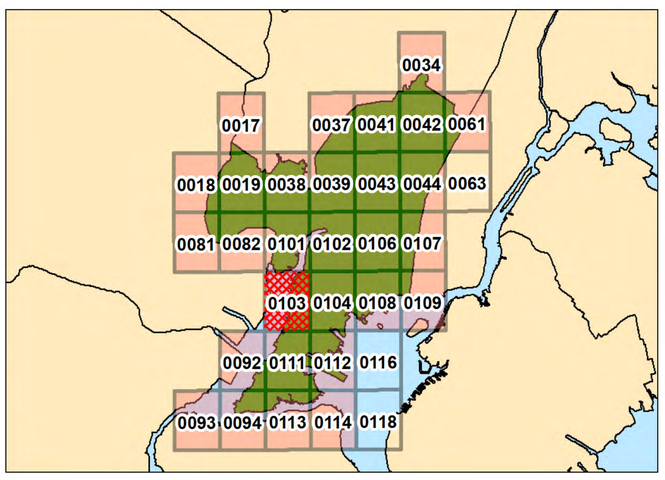

Hudson County, NJ
Preliminary Work Map

0 0.125 0.25 0.5 0.75 1 Miles

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary
- Elevation: 4, 8, 12, 16

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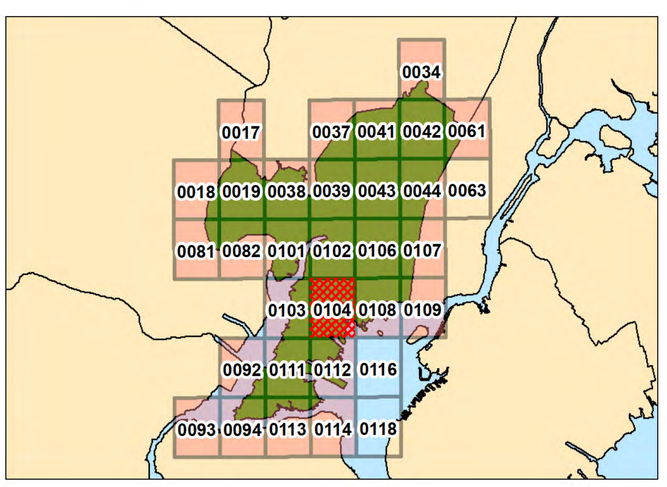
Panel 0104

This preliminary work map contains coastal flood hazard information only, riverine flood hazard information not included



FEMA

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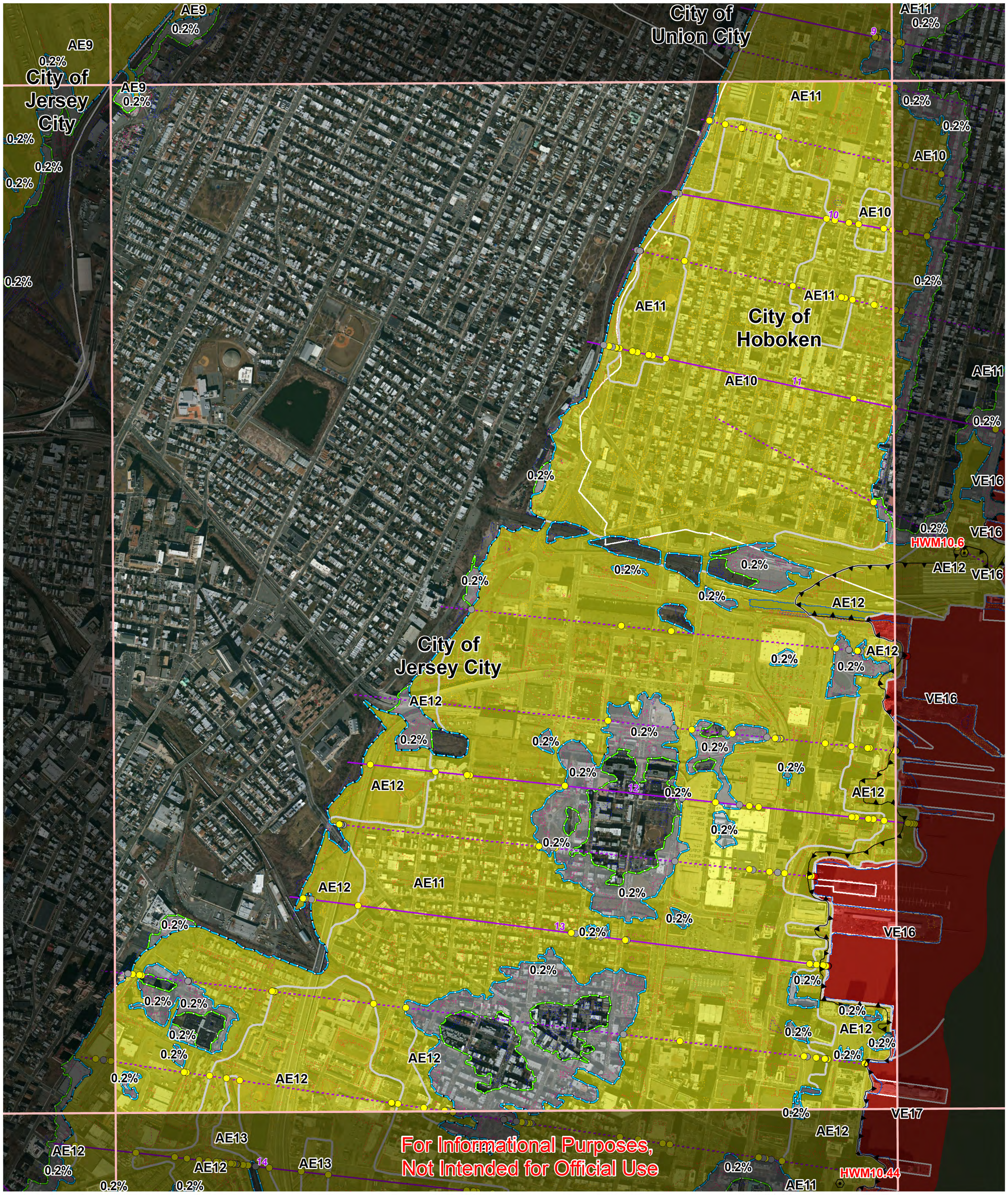
Hudson County, NJ
Preliminary Work Map



0 0.125 0.25 0.5 0.75 1 Miles

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary
- Elevation: 4, 8, 12, 16

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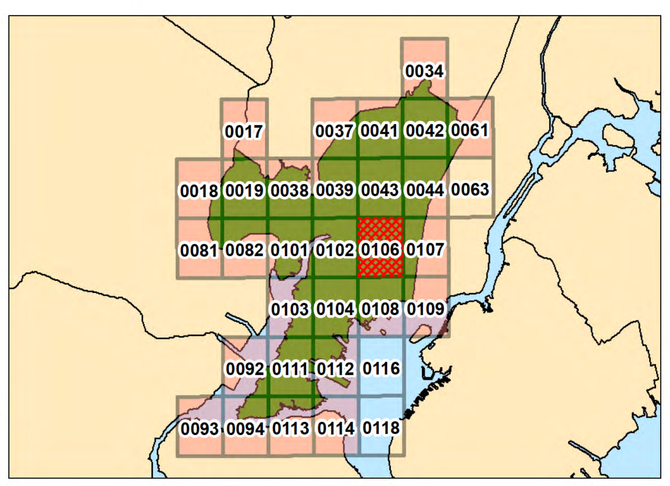
Panel 0106

This preliminary work map contains coastal flood hazard information only, riverine flood hazard information not included



FEMA

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Hudson County, NJ
Preliminary Work Map

Miles

0 0.125 0.25 0.5 0.75 1

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary

Transect Station: AE, VE, X

Elevation: 4, 8, 12, 16

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Panel 0107

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FEMA

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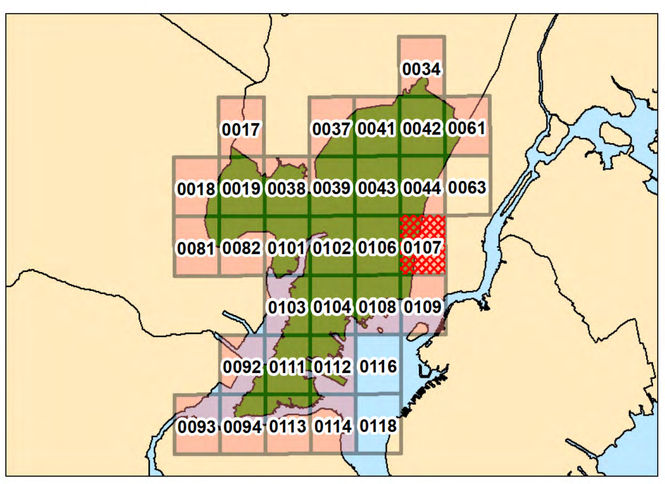

Hudson County, NJ
Preliminary Work Map

Miles
0 0.125 0.25 0.5 0.75 1

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary
- Elevation: 4, 8, 12, 16

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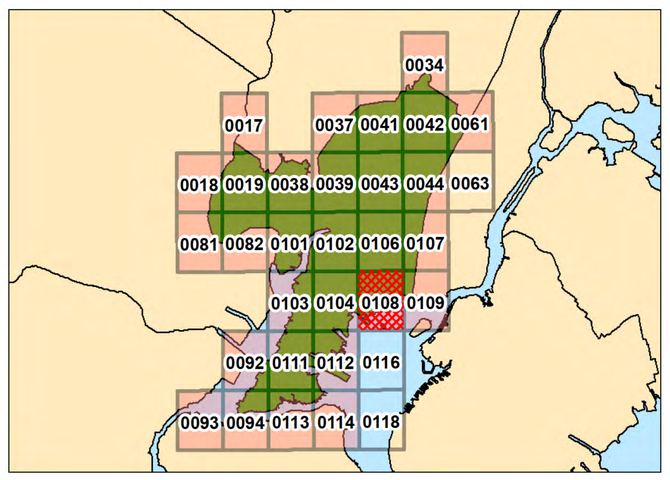
Panel 0108

This preliminary work map contains coastal flood hazard information only, riverine flood hazard information not included



FEMA

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Hudson County, NJ
Preliminary Work Map

0 0.125 0.25 0.5 0.75 1 Miles

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary
- Elevation
  - AE
  - VE
  - X
  - 4
  - 8
  - 12
  - 16

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Panel 0109

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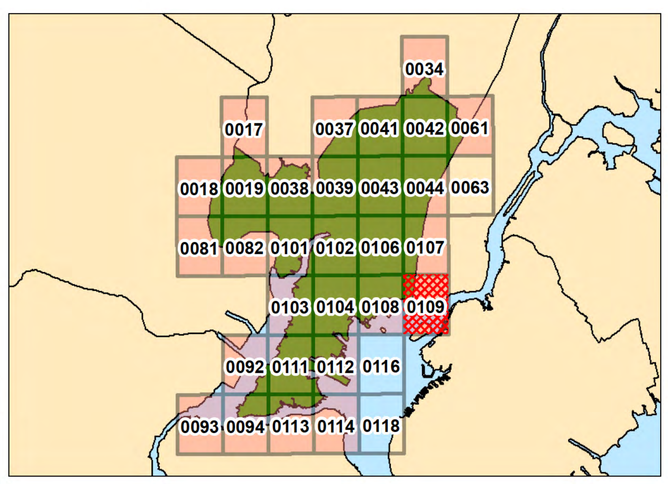

FEMA

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Hudson County, NJ
Preliminary Work Map

0 0.125 0.25 0.5 0.75 1 Miles

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary
- Elevation: 4, 8, 12, 16

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Panel 0111

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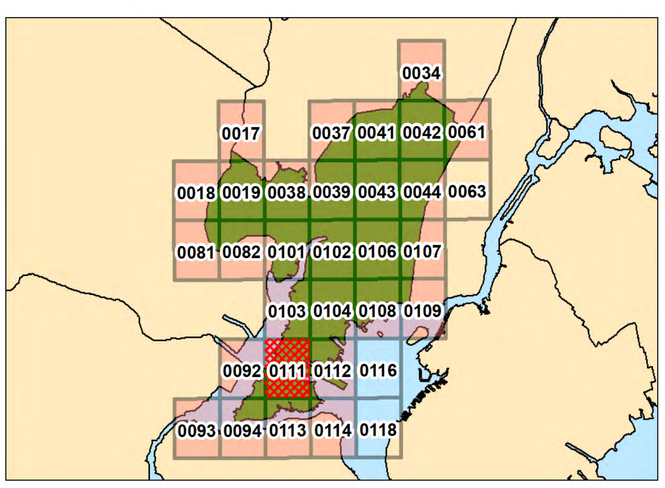

FEMA

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Hudson County, NJ
Preliminary Work Map

0 0.125 0.25 0.5 0.75 1 Miles

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary
- Elevation
  - 4
  - 8
  - 12
  - 16

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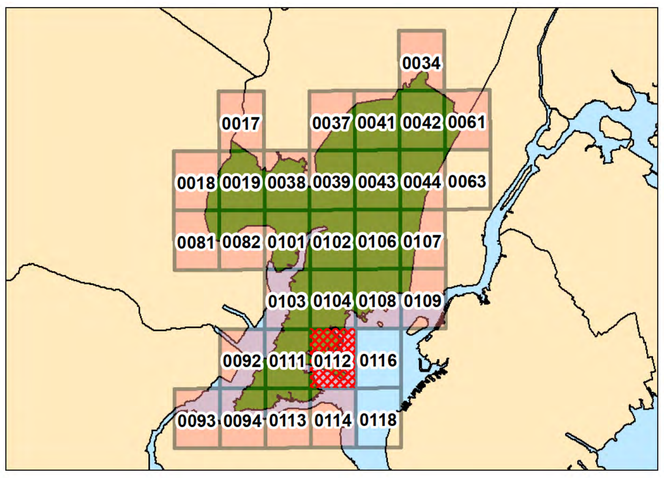
Panel 0112

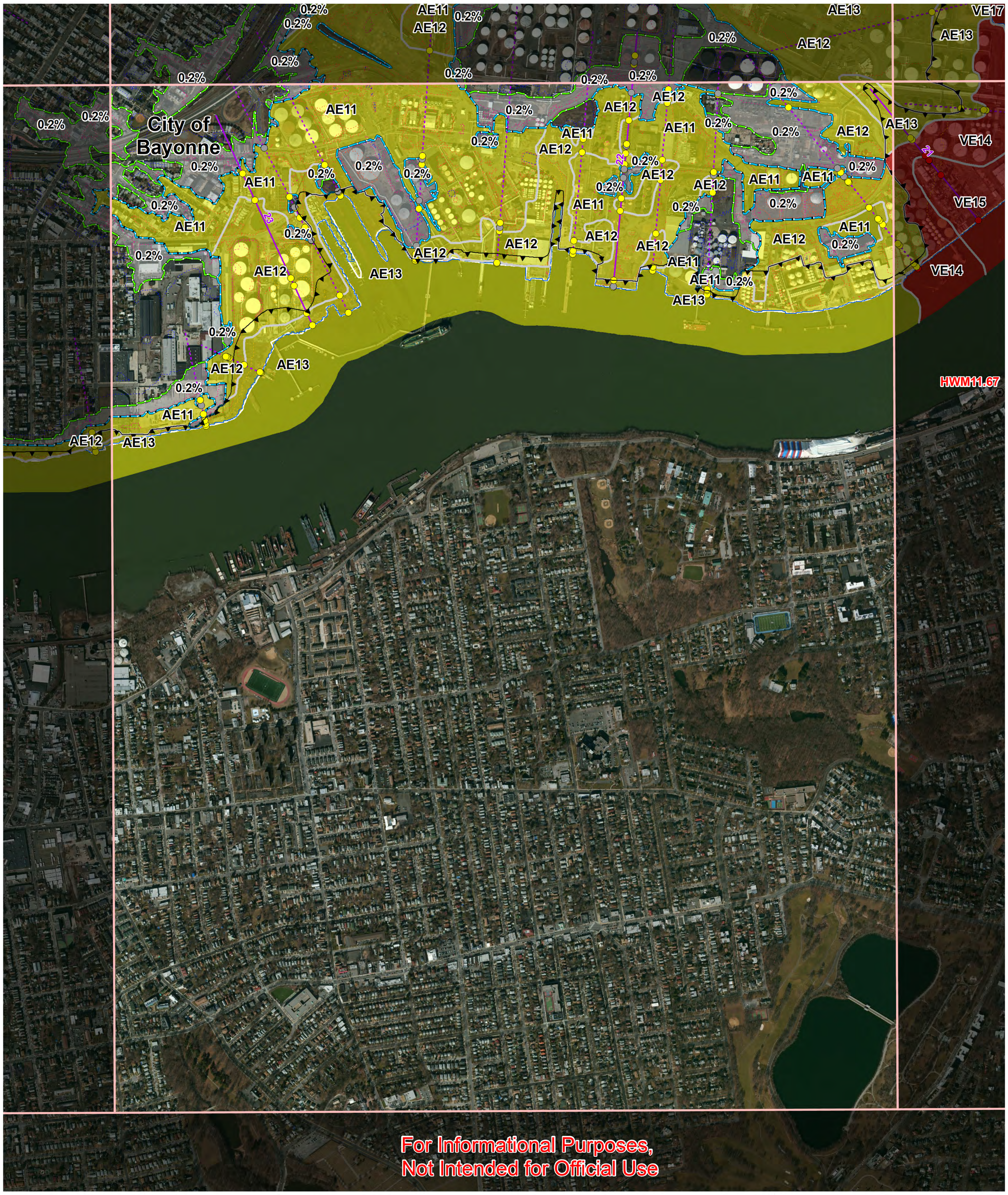
This preliminary work map contains coastal flood hazard information only, riverine flood hazard information not included



FEMA

A JV of Dewberry, URS and ESP
RAMPP
Risk Assessment, Mapping, and Planning Partners

Hudson County, NJ
Preliminary Work Map



Miles
0 0.125 0.25 0.5 0.75 1

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary
- Elevation: 4, 8, 12, 16

Elevation information is provided in feet NAVD88.
High water marks are provided for reference to a historical storm event. They are not intended to be used for validation of the coastal mapping and are not expected to match the coastal BFEs.

Panel 0113

This preliminary work map contains coastal flood hazard information only, riverine flood hazard information not included

FEMA

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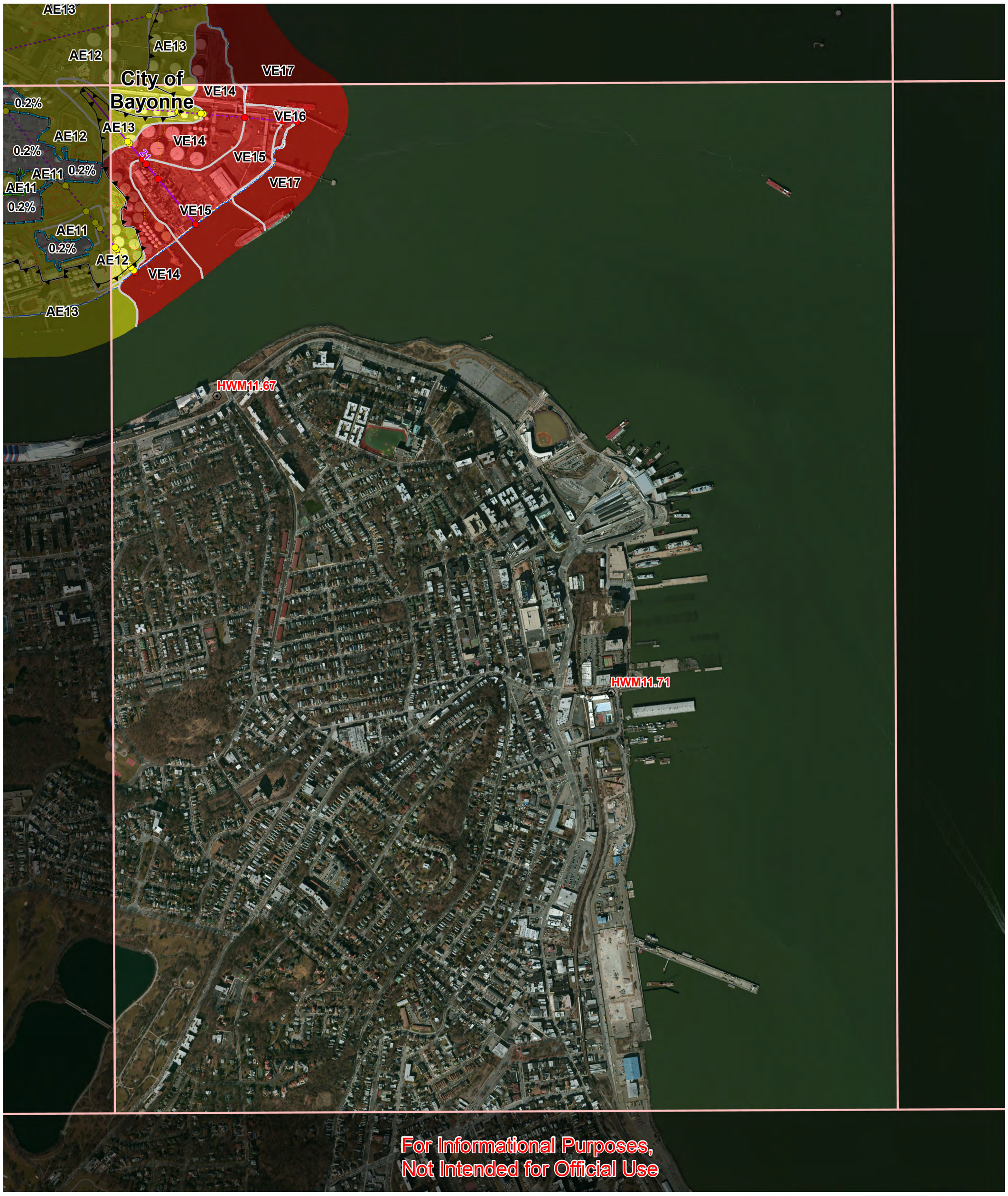
Hudson County, NJ
Preliminary Work Map



Miles

0 0.125 0.25 0.5 0.75 1

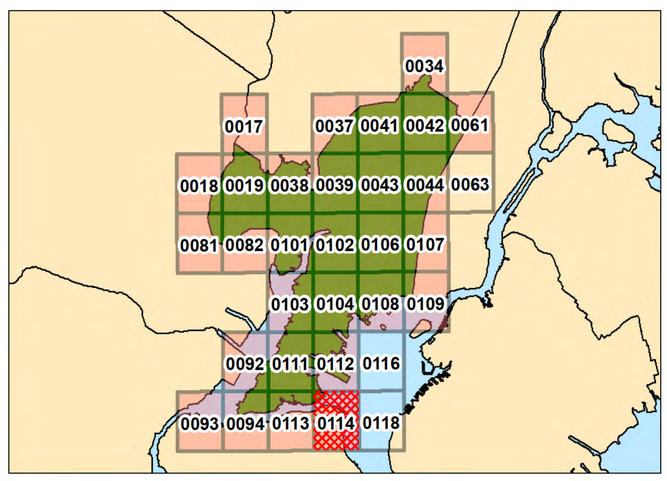
Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary
- Elevation
  - AE
  - VE
  - X
  - 4
  - 8
  - 12
  - 16

Elevation information is provided in feet NAVD88.
High water marks are provided for reference to a historical storm event. They are not intended to be used for validation of the coastal mapping and are not expected to match the coastal BFEs.

Panel 0114

This preliminary work map contains coastal flood hazard information only, riverine flood hazard information not included



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FEMA (Federal Emergency Management Agency)

Historic Preliminary Work Map

Last Modified: June 15, 2013

Description

Before Hurricane Sandy, FEMA had begun a coastal flood study to update Flood Insurance Rate Maps (FIRMs) for portions of New York and New Jersey using improved methods and data to better reflect coastal flood risk. After Sandy, FEMA released Advisory Base Flood Elevation (ABFE) information based on the partially completed flood study for certain communities which were designed to help in rebuilding and recovery efforts. FEMA is now releasing preliminary work map data including the full results of the coastal flood study. The preliminary work map data is a "draft" product that FEMA is sharing in advance of the upcoming release of the preliminary FIRMs. The preliminary work map data replaces the ABFE information (where released) as the best available flood hazard data until the release of the preliminary FIRMs.

This historical map serves as an archive of all preliminary work map information released to date since June 2013 for New Jersey and New York communities affected by the coastal flood study. When an updated version of the preliminary work map data is released, a new layer will be added to this map, with the layer name reflecting the original release date of the information.

Access and Use Constraints

The preliminary work map data replaces the ABFE information (where released) as the best available flood hazard data until the release of the preliminary FIRMs. Until preliminary FIRMs are released for a community, the preliminary work map information will represent the best available flood hazard data in those areas. To find the best flood hazard data currently available for New Jersey and New York communities affected by the coastal flood study, visit the Region 2 Coastal Outreach website.

For most communities, the preliminary work map data shows coastal flood hazard areas only. Updates to riverine flood hazards in most cases will not be reflected. Both coastal and riverine areas will be included on the official preliminary FIRMs once released.

The preliminary work maps are not intended to support regulatory flood hazard zone designation or insurance ratings.

Properties

Before building, property and business owners should consult their local government officials to determine the mandatory elevations for their home or building.

Hudson County, NJ
Preliminary Work Map

Miles

0 0.125 0.25 0.5 0.75 1

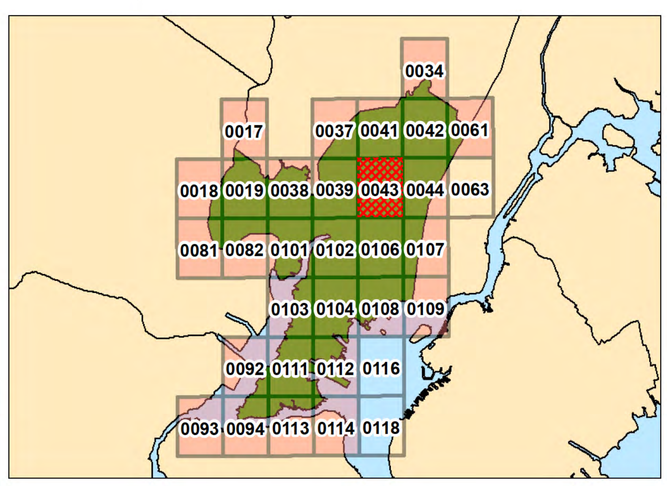
Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary
- Elevation: 4, 8, 12, 16

Elevation information is provided in feet NAVD88.
High water marks are provided for reference to a historical storm event. They are not intended to be used for validation of the coastal mapping and are not expected to match the coastal BFEs.

Panel 0043

This preliminary work map contains coastal flood hazard information only, riverine flood hazard information not included



FEMA

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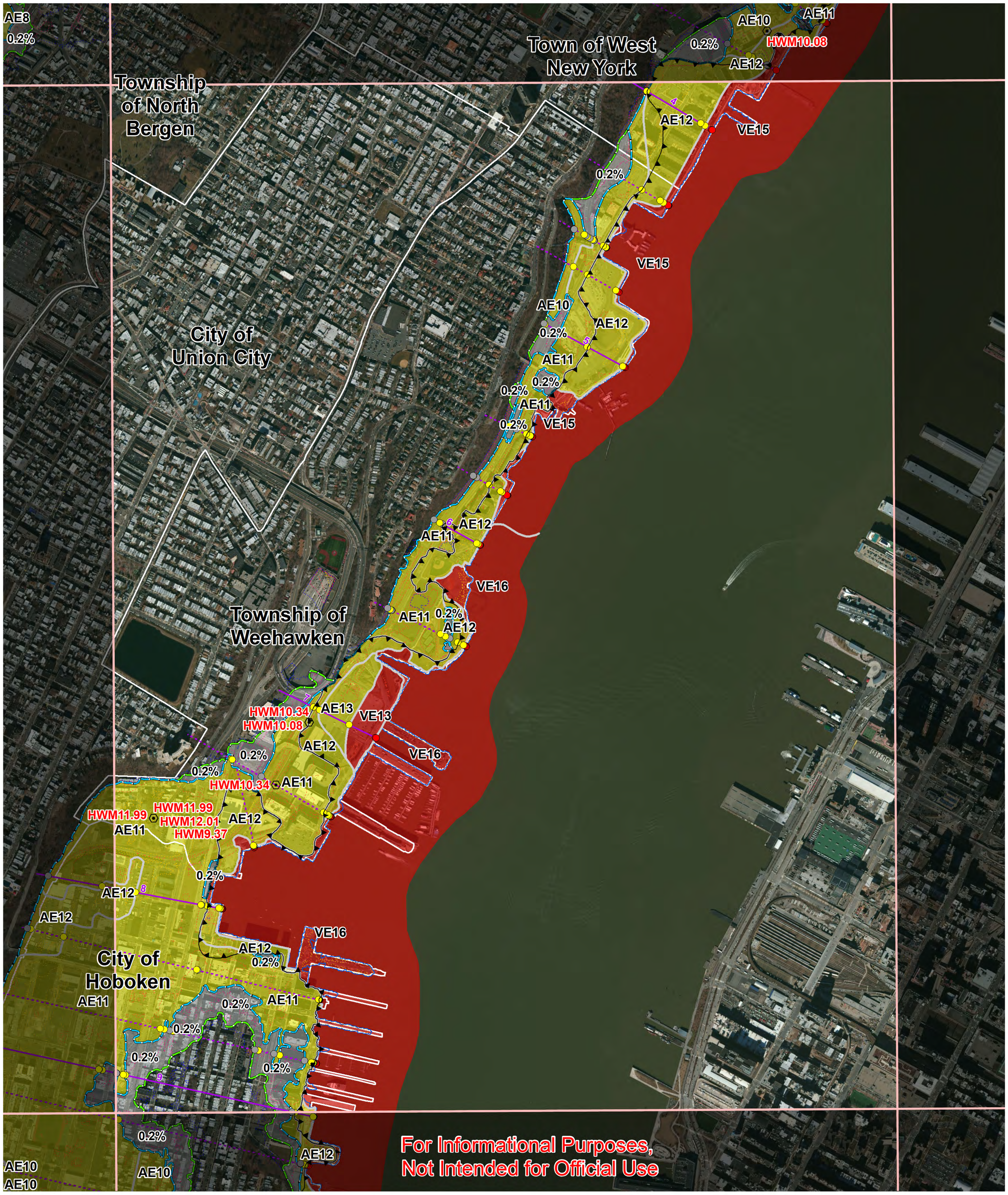
Hudson County, NJ
Preliminary Work Map



0 0.125 0.25 0.5 0.75 1 Miles

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary
- Elevation: 4, 8, 12, 16

AE
VE
X

Elevation information is provided in feet NAVD88.
High water marks are provided for reference to a historical storm event. They are not intended to be used for validation of the coastal mapping and are not expected to match the coastal BFEs.

Panel 0044

This preliminary work map contains coastal flood hazard information only, riverine flood hazard information not included

FEMA

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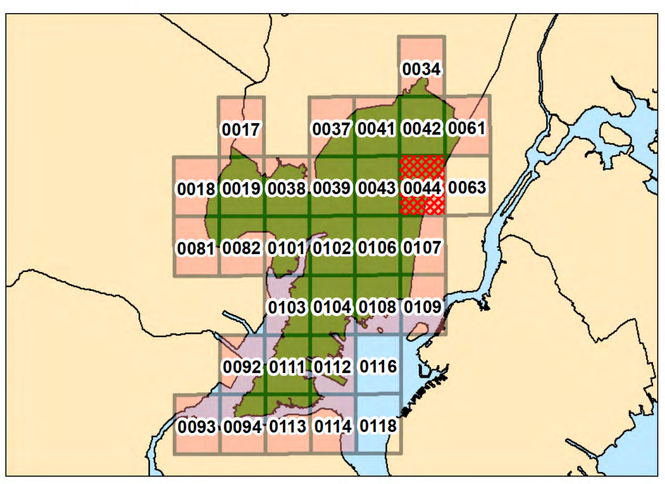
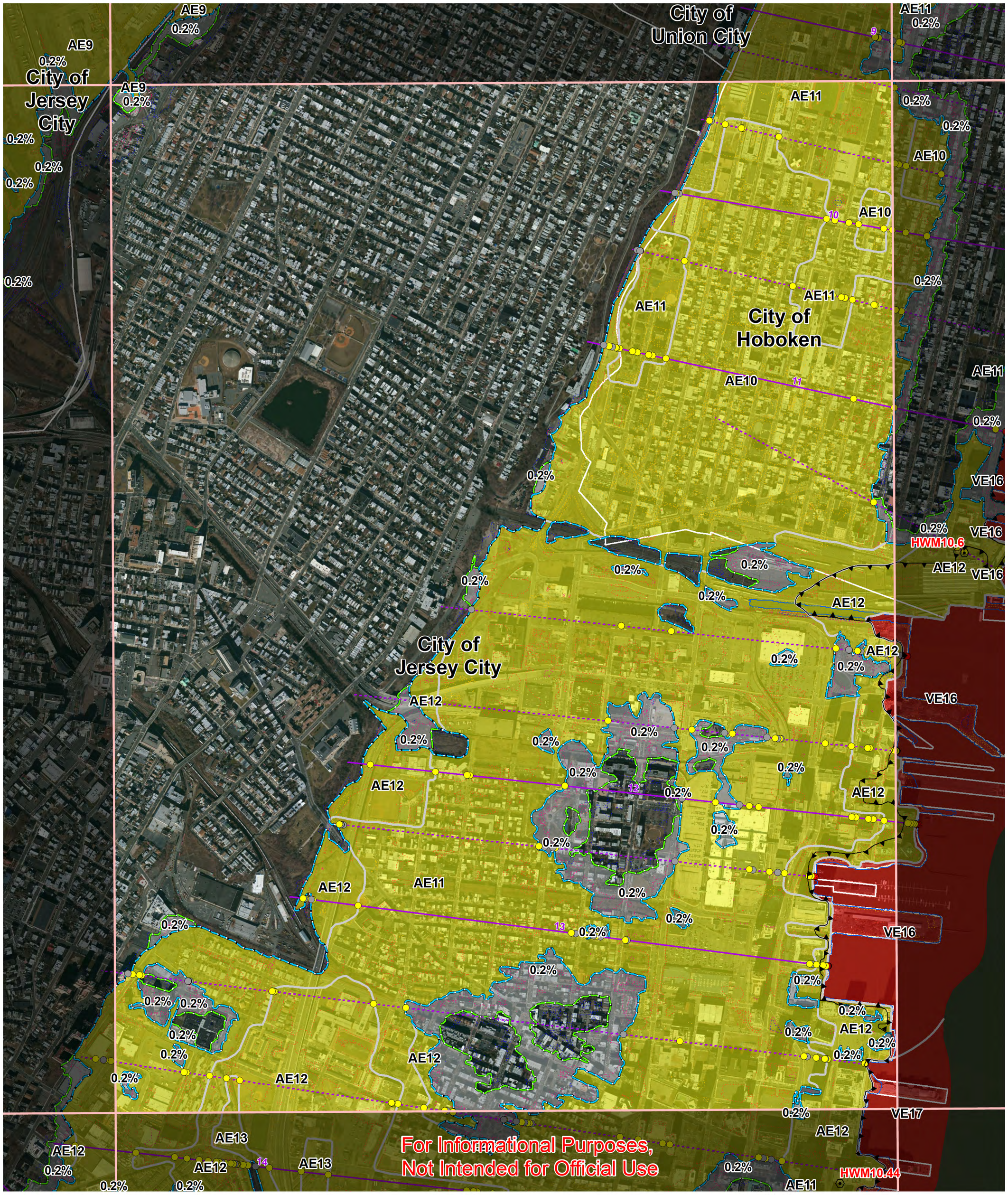


Hudson County, NJ
Preliminary Work Map



0 0.125 0.25 0.5 0.75 1 Miles

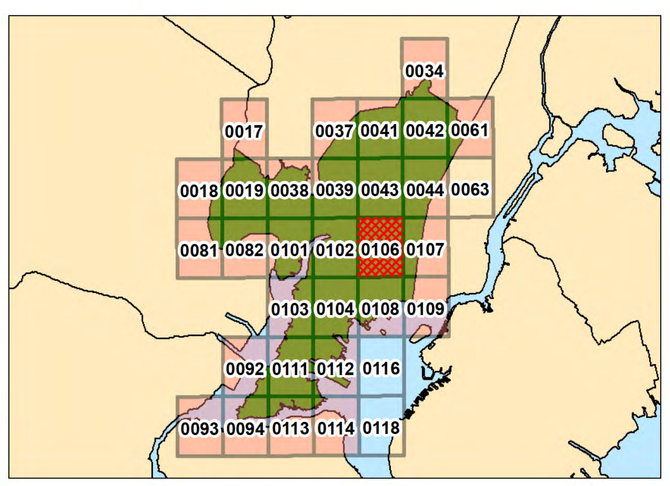
Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary
- Elevation: 4, 8, 12, 16

Elevation information is provided in feet NAVD88.
High water marks are provided for reference to a historical storm event. They are not intended to be used for validation of the coastal mapping and are not expected to match the coastal BFEs.

Panel 0106

This preliminary work map contains coastal flood hazard information only, riverine flood hazard information not included



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Risk Assessment, Mapping, and Planning Partners

Hudson County, NJ
Preliminary Work Map

Miles

0 0.125 0.25 0.5 0.75 1

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary

Transect Station: AE, VE, X

Elevation: 4, 8, 12, 16

Elevation information is provided in feet NAVD88.
High water marks are provided for reference to a historical storm event. They are not intended to be used for validation of the coastal mapping and are not expected to match the coastal BFEs.

Panel 0107

This preliminary work map contains coastal flood hazard information only, riverine flood hazard information not included

FEMA

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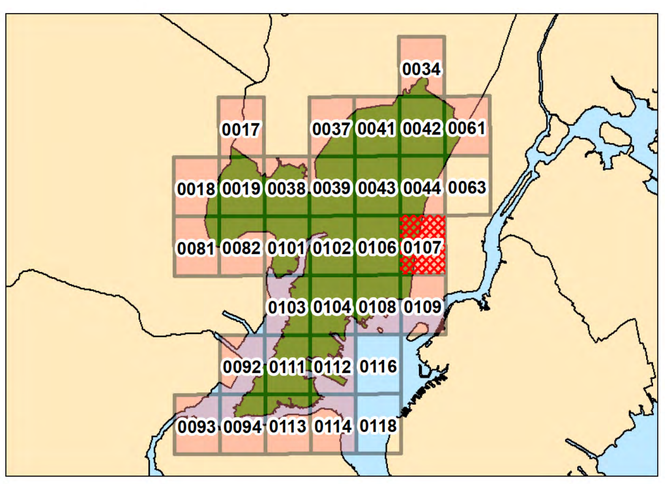
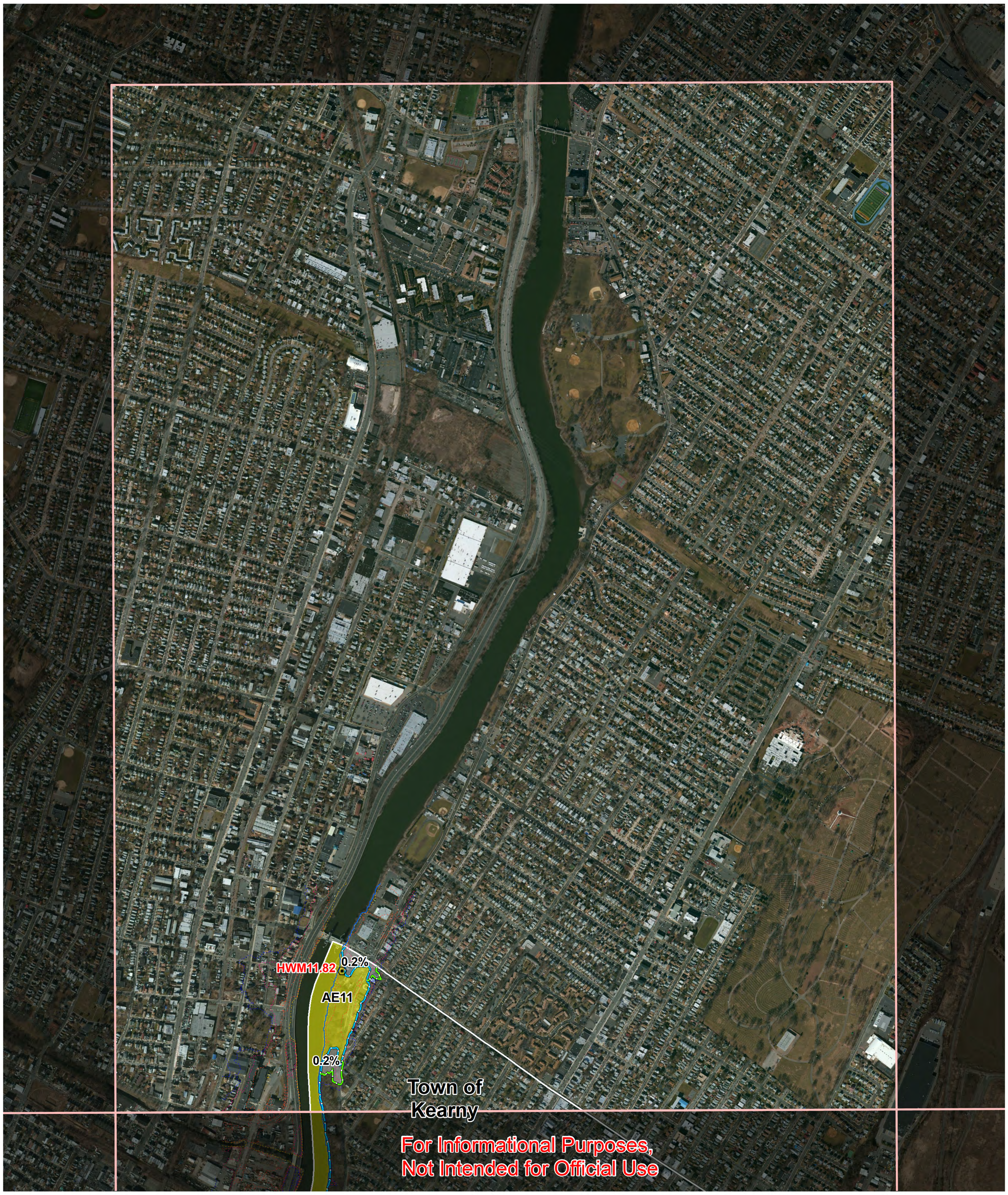


Hudson County, NJ
Preliminary Work Map



0 0.125 0.25 0.5 0.75 1 Miles

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary
- Elevation
  - AE
  - VE
  - X
  - 4
  - 8
  - 12
  - 16

Elevation information is provided in feet NAVD88.
High water marks are provided for reference to a historical storm event. They are not intended to be used for validation of the coastal mapping and are not expected to match the coastal BFEs.

Panel 0017

This preliminary work map contains coastal flood hazard information only, riverine flood hazard information not included

FEMA

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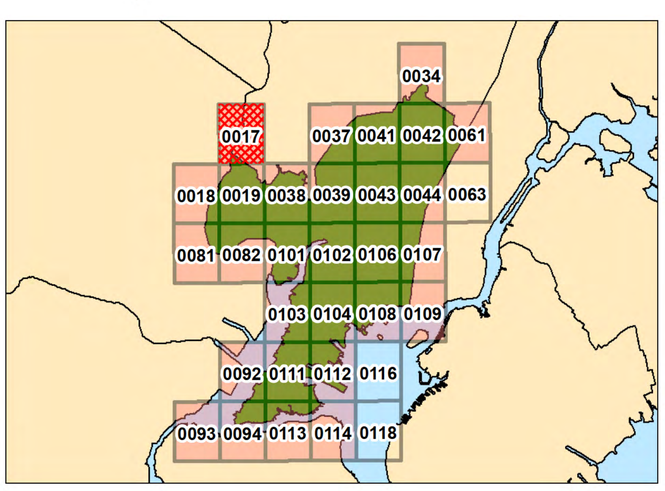


Hudson County, NJ
Preliminary Work Map

0 0.125 0.25 0.5 0.75 1 Miles

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary

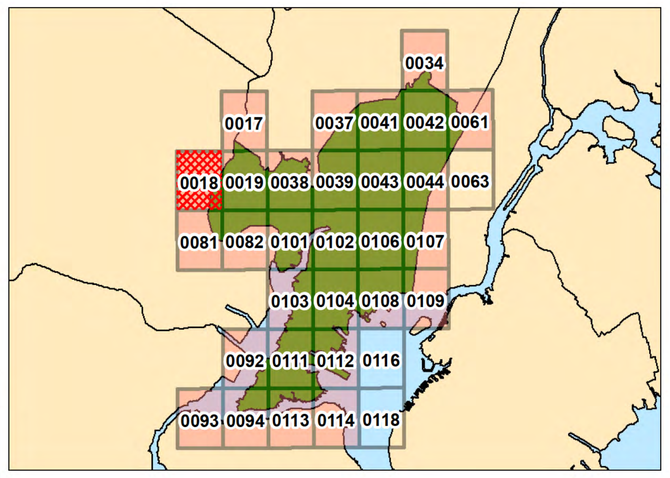
Transect Station: AE, VE, X

Elevation: 4, 8, 12, 16

Elevation information is provided in feet NAVD88.
High water marks are provided for reference to a historical storm event. They are not intended to be used for validation of the coastal mapping and are not expected to match the coastal BFEs.

Panel 0018

This preliminary work map contains coastal flood hazard information only, riverine flood hazard information not included



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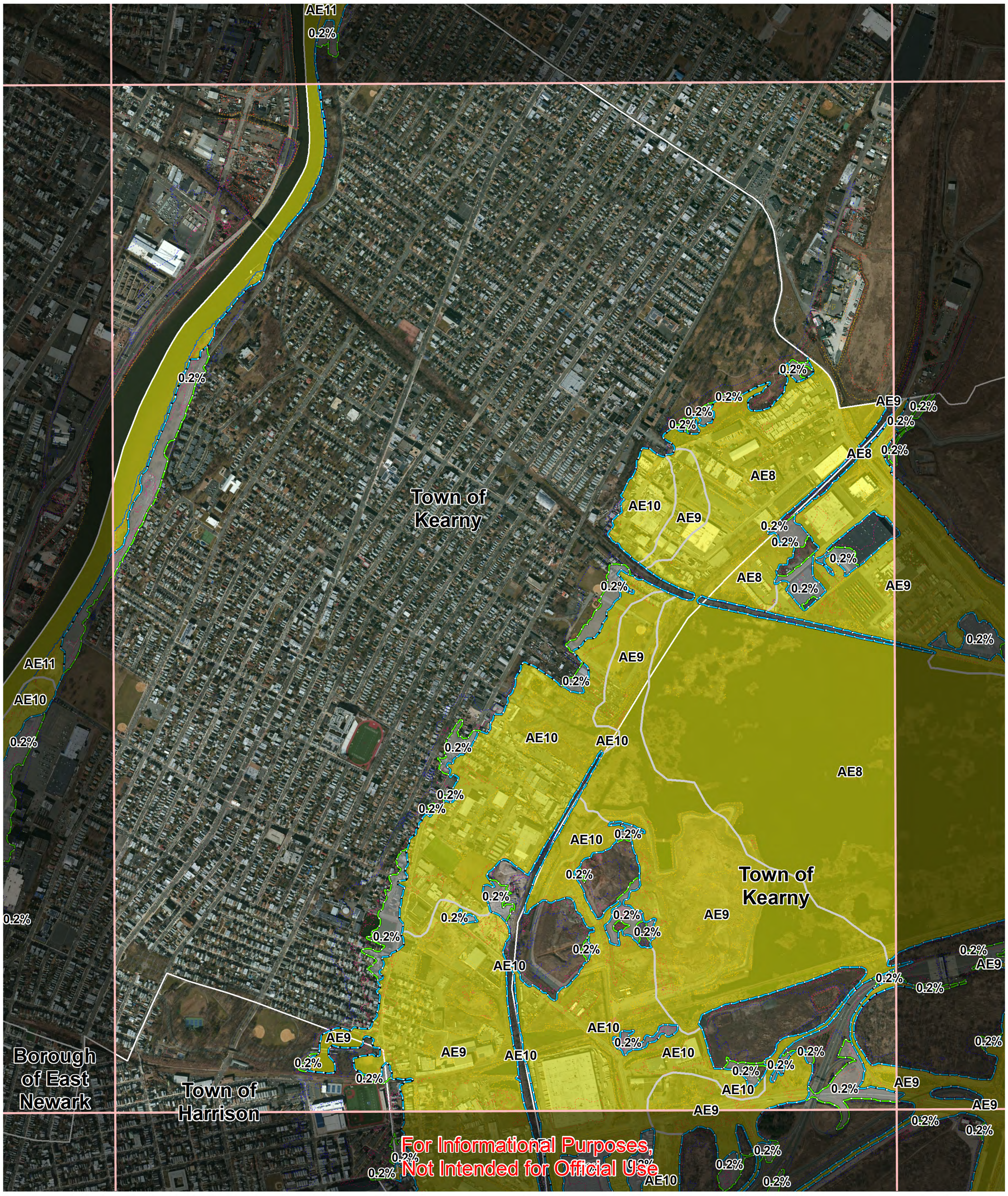
Hudson County, NJ
Preliminary Work Map



0 0.125 0.25 0.5 0.75 1 Miles

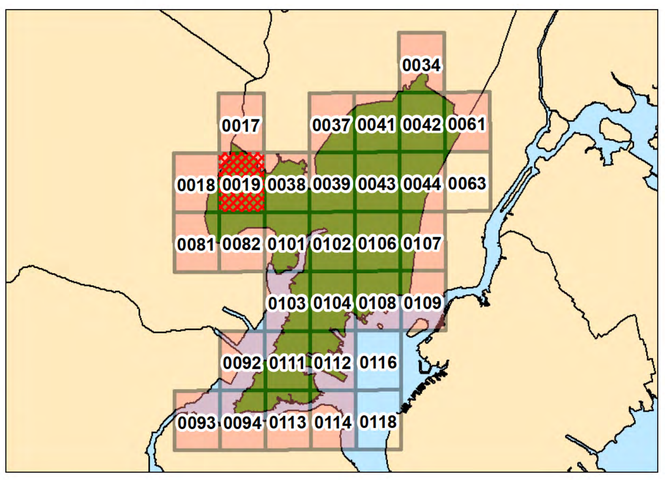
Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary
- Elevation
  - 4
  - 8
  - 12
  - 16

Elevation information is provided in feet NAVD88.
High water marks are provided for reference to a historical storm event. They are not intended to be used for validation of the coastal mapping and are not expected to match the coastal BFEs.

Panel 0019

This preliminary work map contains coastal flood hazard information only, riverine flood hazard information not included



FEMA

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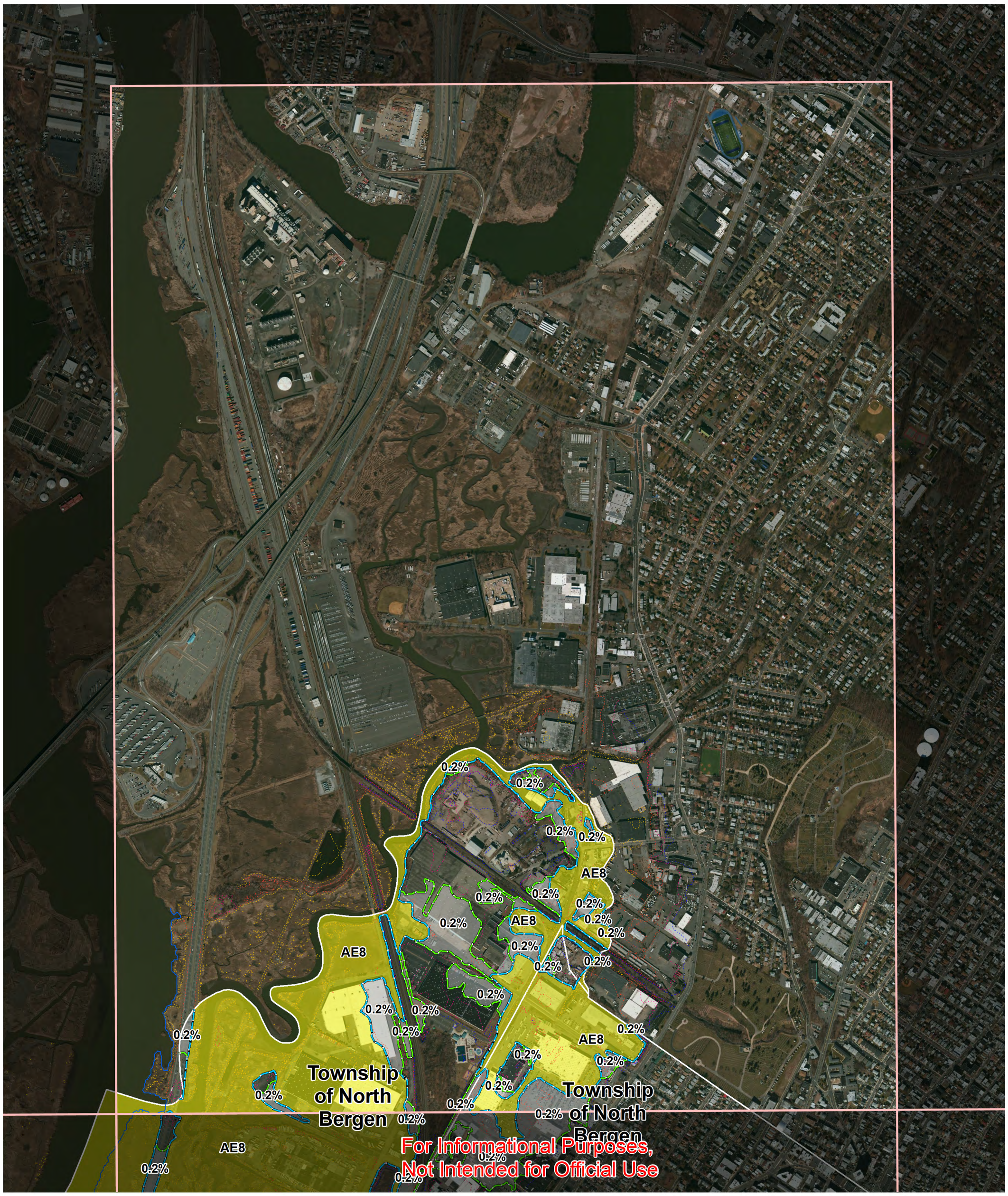
Risk Assessment, Mapping, and Planning Partners

Hudson County, NJ
Preliminary Work Map



0 0.125 0.25 0.5 0.75 1 Miles

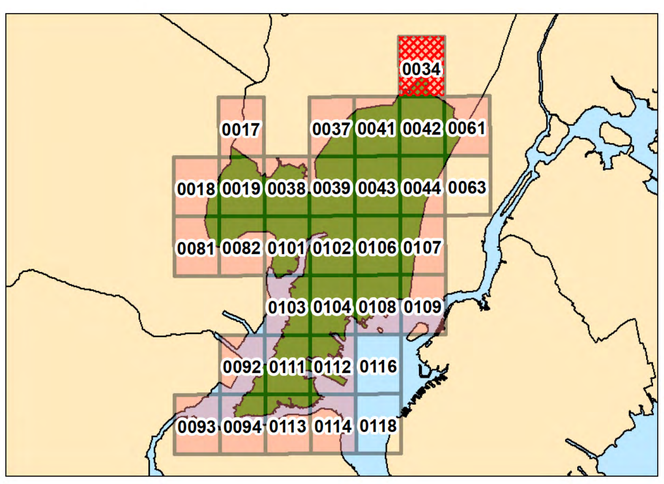
Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary
- Elevation
  - AE
  - VE
  - X
  - 4
  - 8
  - 12
  - 16

Elevation information is provided in feet NAVD88.
High water marks are provided for reference to a historical storm event. They are not intended to be used for validation of the coastal mapping and are not expected to match the coastal BFEs.

Panel 0034

This preliminary work map contains coastal flood hazard information only, riverine flood hazard information not included



FEMA

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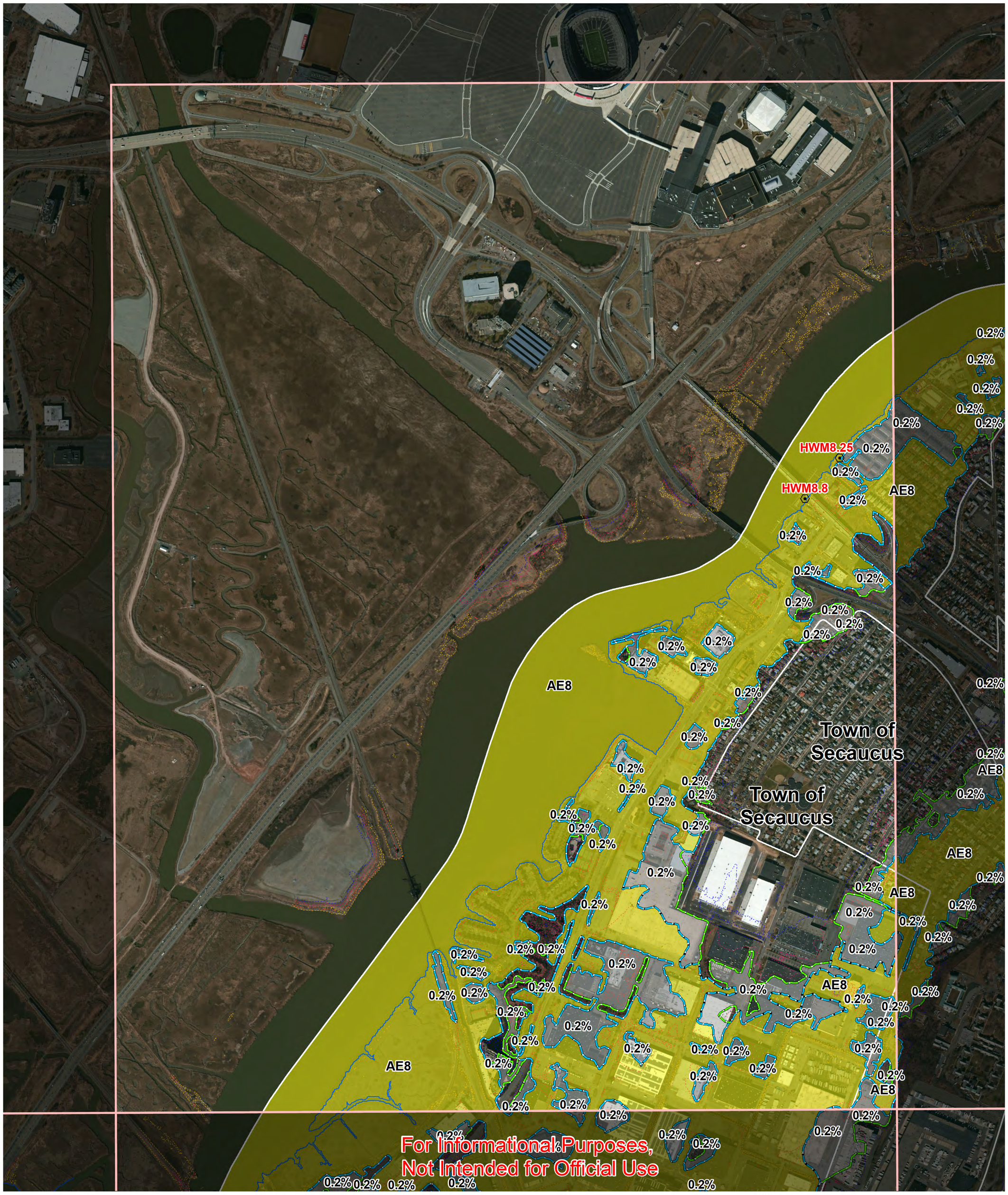
Hudson County, NJ
Preliminary Work Map



0 0.125 0.25 0.5 0.75 1 Miles

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary

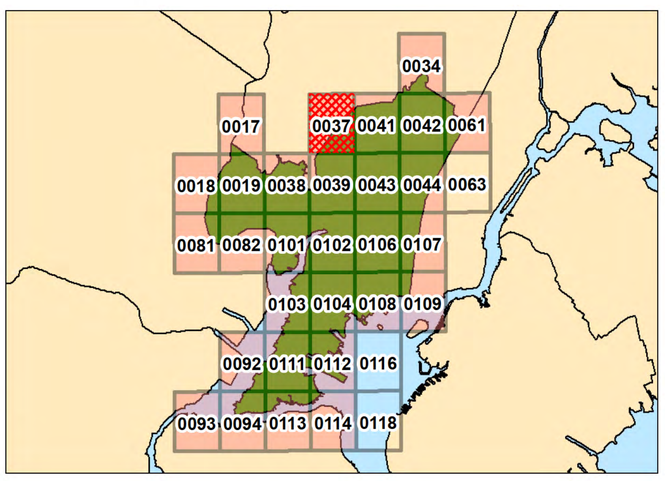
Transect Station: AE, VE, X

Elevation: 4, 8, 12, 16

Elevation information is provided in feet NAVD88.
High water marks are provided for reference to a historical storm event. They are not intended to be used for validation of the coastal mapping and are not expected to match the coastal BFEs.

Panel 0037

This preliminary work map contains coastal flood hazard information only, riverine flood hazard information not included



FEMA

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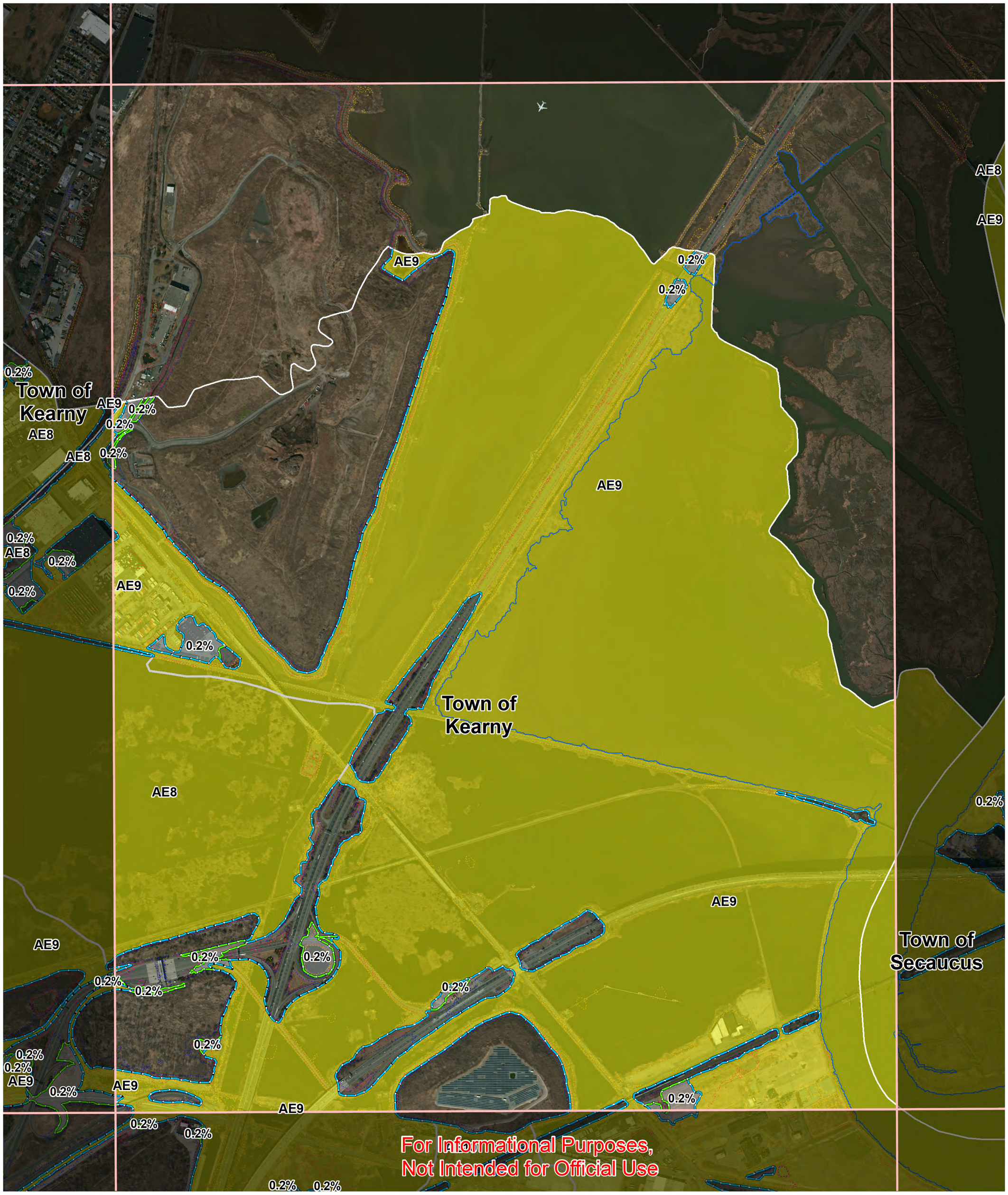
Risk Assessment, Mapping, and Planning Partners

Hudson County, NJ
Preliminary Work Map



Miles

0 0.125 0.25 0.5 0.75 1

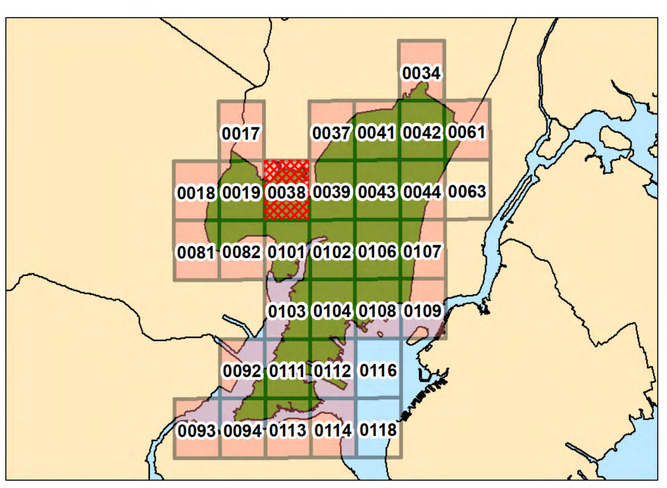
Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary
- Elevation
  - AE
  - VE
  - X
  - 4
  - 8
  - 12
  - 16

Elevation information is provided in feet NAVD88.
High water marks are provided for reference to a historical storm event. They are not intended to be used for validation of the coastal mapping and are not expected to match the coastal BFEs.

Panel 0038

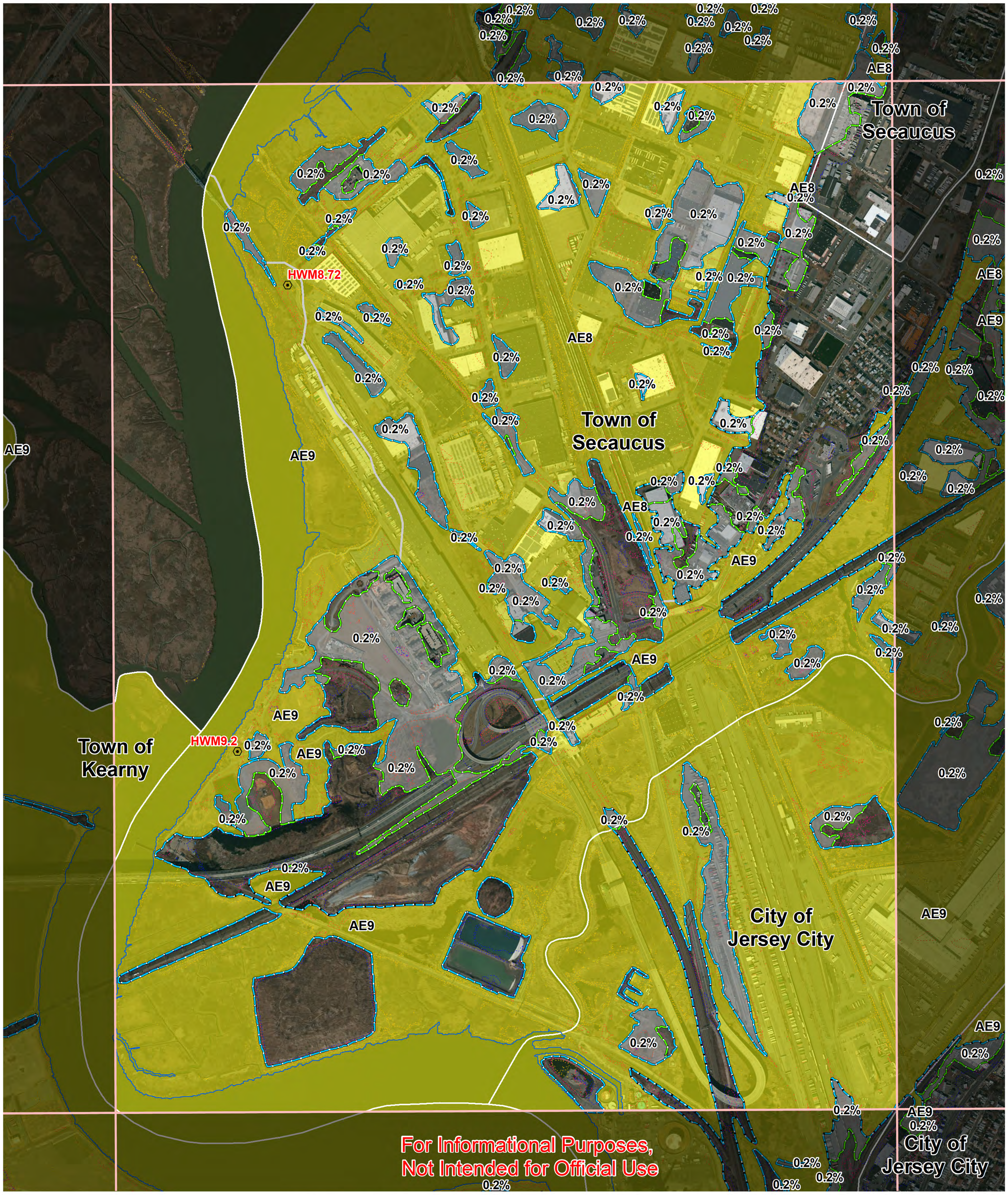
This preliminary work map contains coastal flood hazard information only, riverine flood hazard information not included



FEMA

A JV of Dewberry, URS and ESP
RAMPP
Risk Assessment, Mapping, and Planning Partners

Hudson County, NJ
Preliminary Work Map



Miles
0 0.125 0.25 0.5 0.75 1

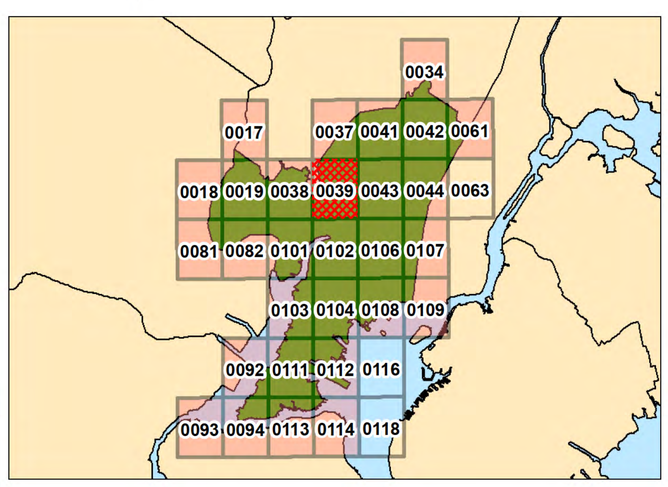
Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary
- Elevation: 4, 8, 12, 16

Elevation information is provided in feet NAVD88.
High water marks are provided for reference to a historical storm event. They are not intended to be used for validation of the coastal mapping and are not expected to match the coastal BFEs.

Panel 0039

This preliminary work map contains coastal flood hazard information only, riverine flood hazard information not included



FEMA

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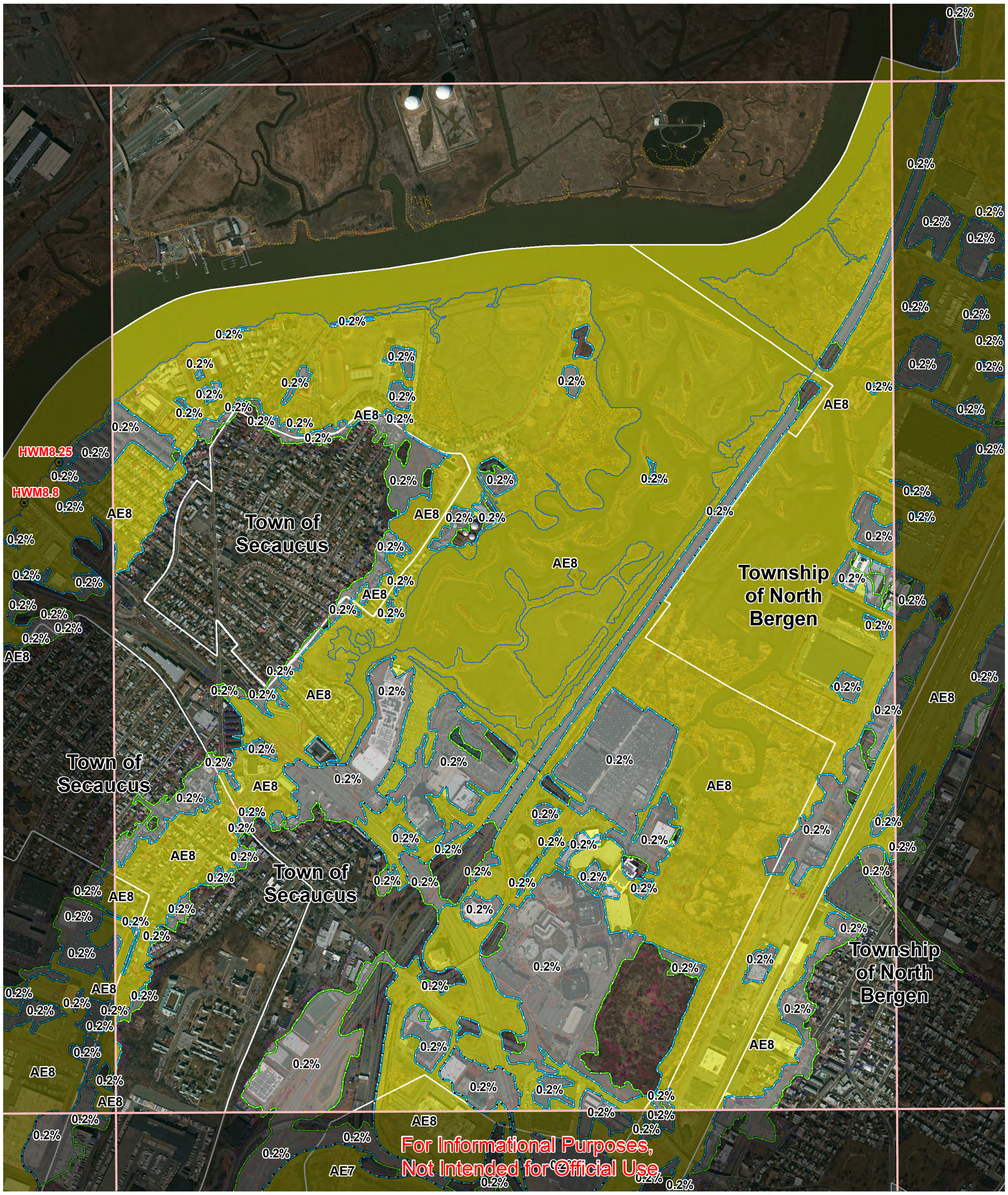
Risk Assessment, Mapping, and Planning Partners

Hudson County, NJ
Preliminary Work Map



0 0.125 0.25 0.5 0.75 1 Miles

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary
- Elevation: 4, 8, 12, 16

Elevation information is provided in feet NAVD88.
High water marks are provided for reference to a historical storm event. They are not intended to be used for validation of the coastal mapping and are not expected to match the coastal BFEs.

Panel 0041

This preliminary work map contains coastal flood hazard information only, riverine flood hazard information not included

FEMA

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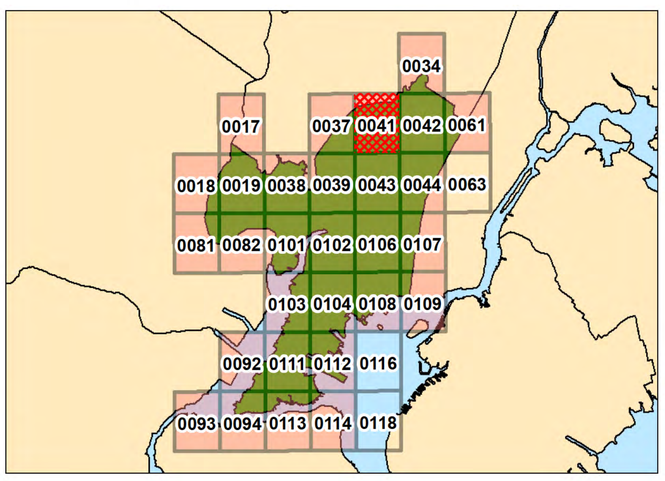
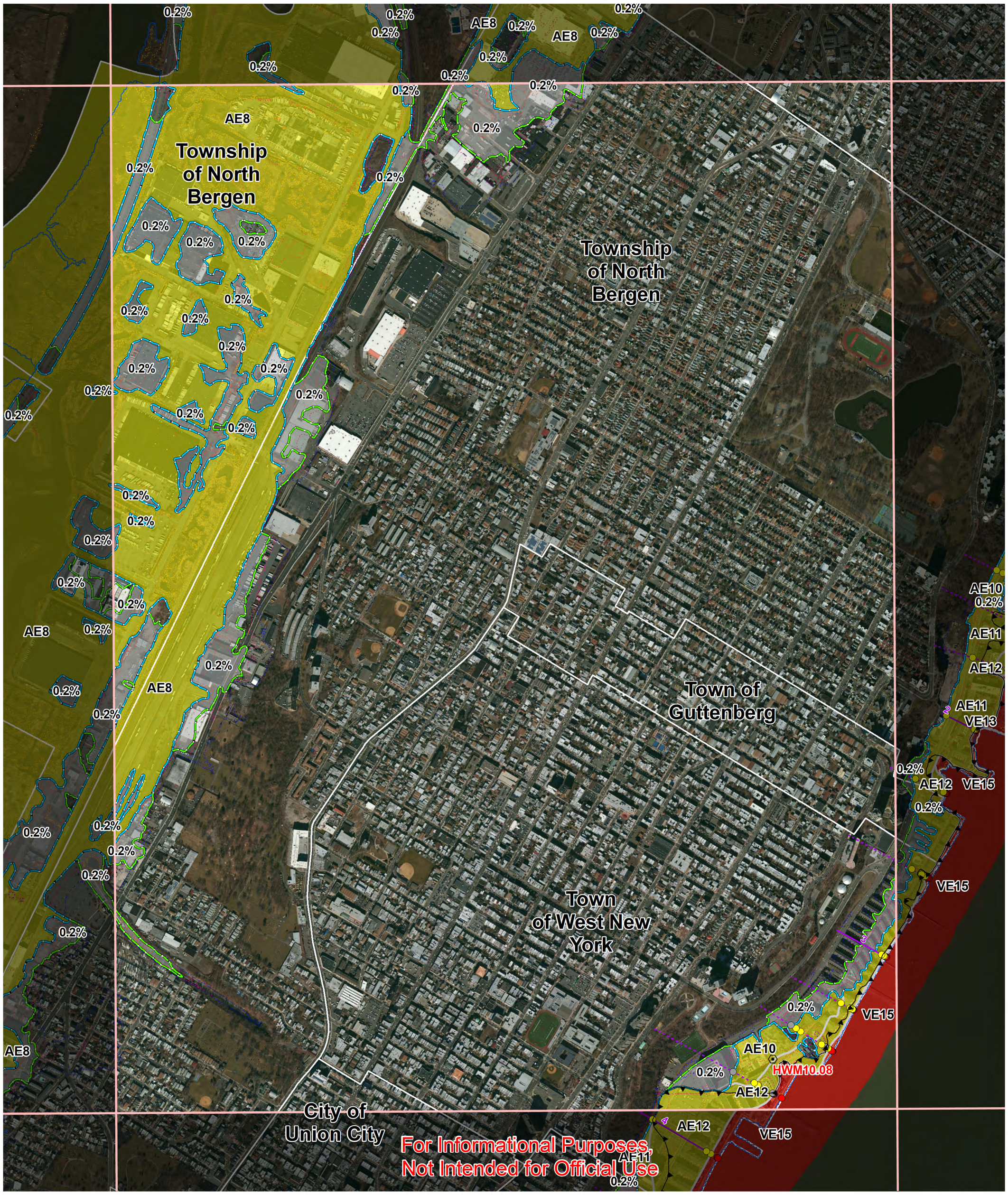
Risk Assessment, Mapping, and Planning Partners



Hudson County, NJ
Preliminary Work Map



0 0.125 0.25 0.5 0.75 1 Miles

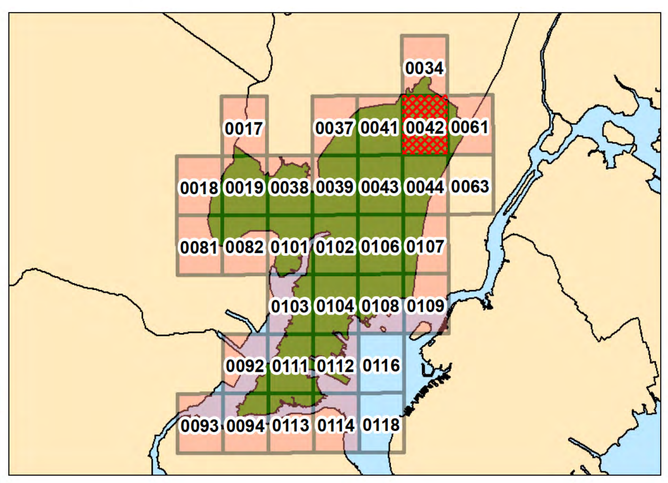
Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary
- Elevation: 4, 8, 12, 16

Elevation information is provided in feet NAVD88.
High water marks are provided for reference to a historical storm event. They are not intended to be used for validation of the coastal mapping and are not expected to match the coastal BFEs.

Panel 0042

This preliminary work map contains coastal flood hazard information only, riverine flood hazard information not included



FEMA

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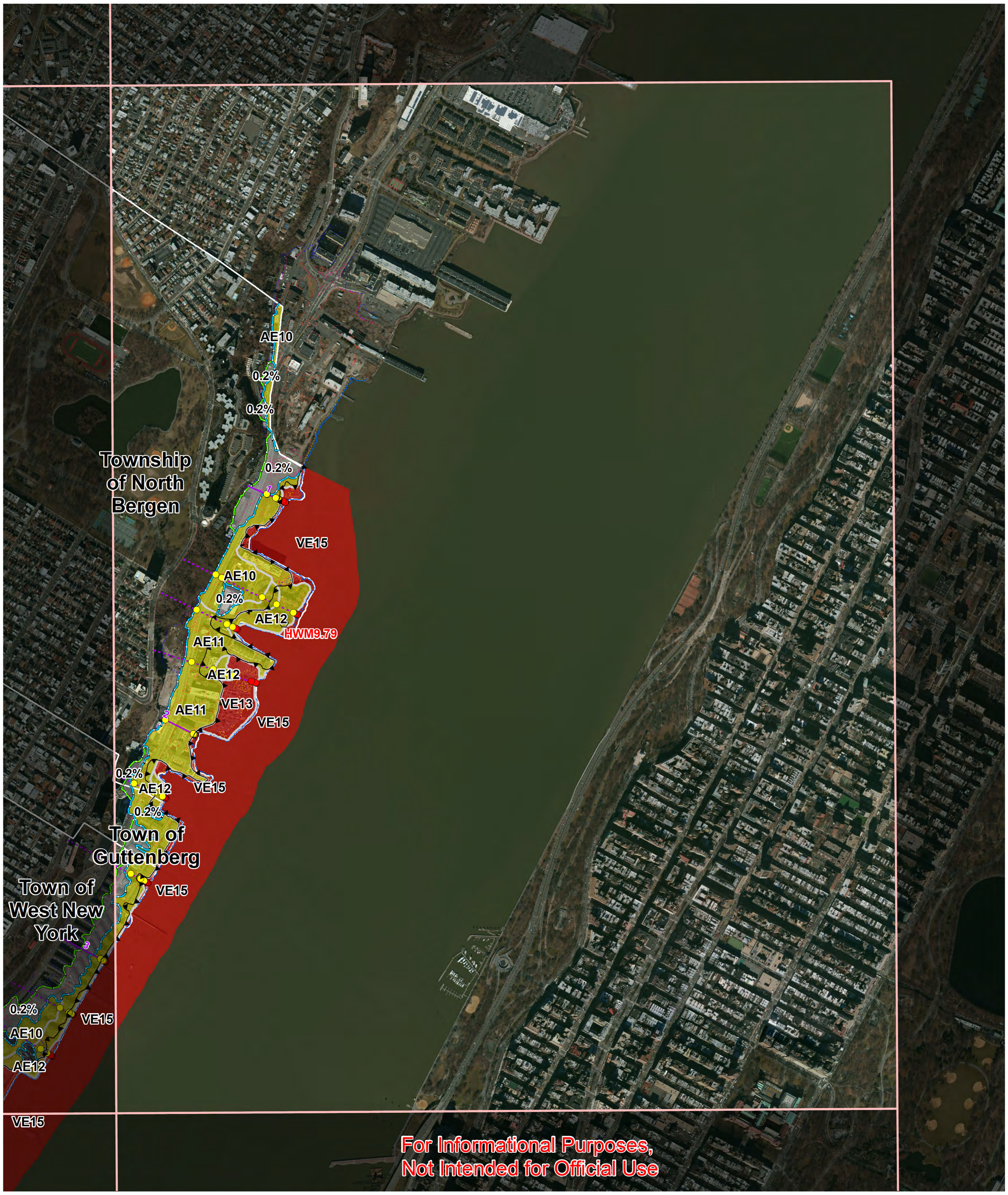
RAMPP
Risk Assessment, Mapping, and Planning Partners

Hudson County, NJ
Preliminary Work Map



Miles

0 0.125 0.25 0.5 0.75 1

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary
- Elevation
  - AE
  - VE
  - X
  - 4
  - 8
  - 12
  - 16

Elevation information is provided in feet NAVD88.
High water marks are provided for reference to a historical storm event. They are not intended to be used for validation of the coastal mapping and are not expected to match the coastal BFEs.

Panel 0061

This preliminary work map contains coastal flood hazard information only, riverine flood hazard information not included

FEMA

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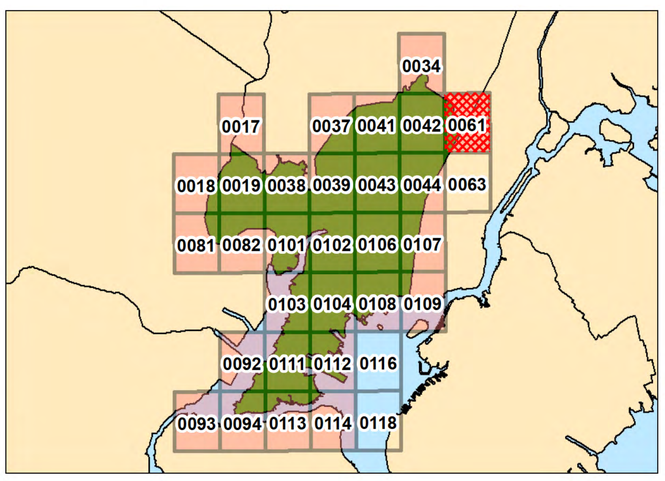
Risk Assessment, Mapping, and Planning Partners



Hudson County, NJ
Preliminary Work Map

0 0.125 0.25 0.5 0.75 1 Miles

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary

Transect Station: AE, VE, X

Elevation: 4, 8, 12, 16

Elevation information is provided in feet NAVD88.
High water marks are provided for reference to a historical storm event. They are not intended to be used for validation of the coastal mapping and are not expected to match the coastal BFEs.

Panel 0081

This preliminary work map contains coastal flood hazard information only, riverine flood hazard information not included

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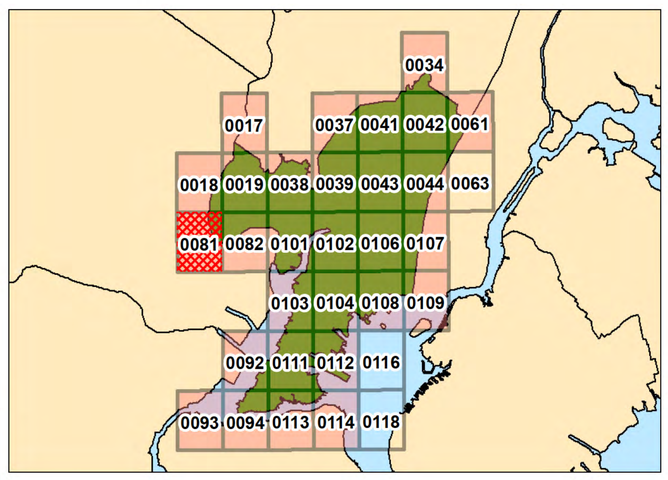
Risk Assessment, Mapping, and Planning Partners



Hudson County, NJ
Preliminary Work Map

0 0.125 0.25 0.5 0.75 1 Miles

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary
- Elevation: 4, 8, 12, 16

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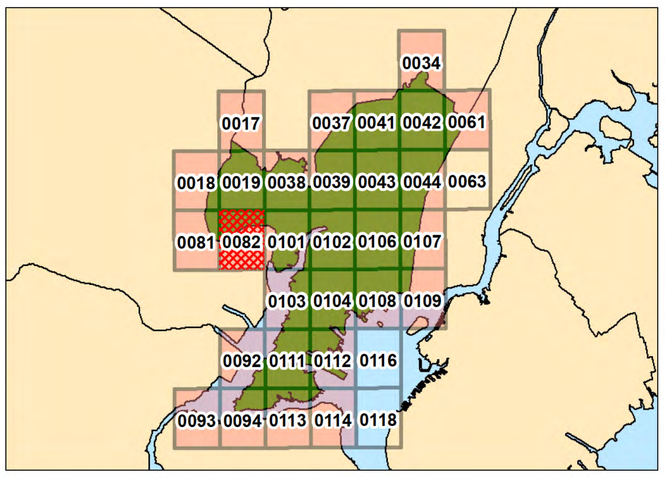
Panel 0082

This preliminary work map contains coastal flood hazard information only, riverine flood hazard information not included



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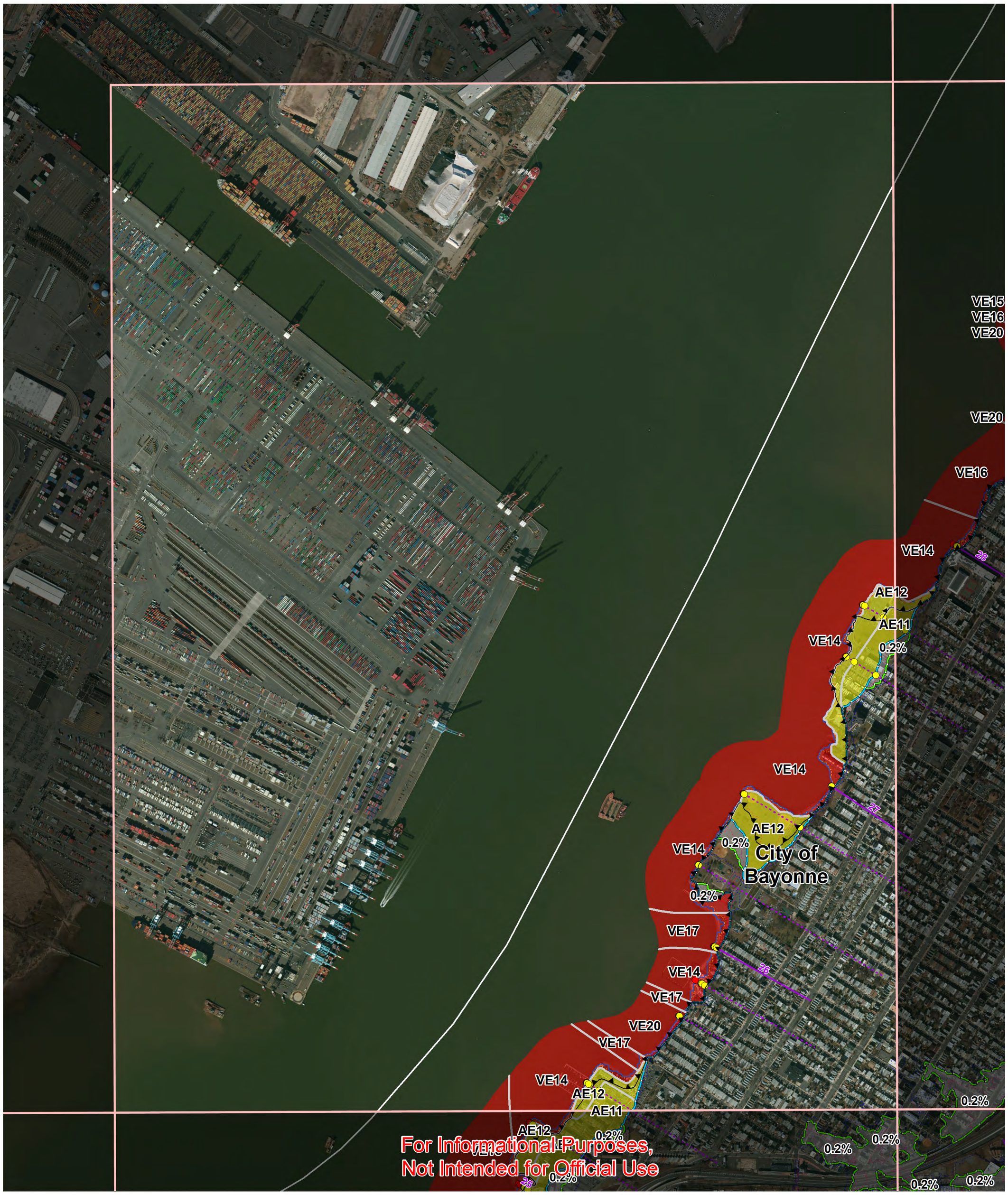
Hudson County, NJ
Preliminary Work Map



Miles

0 0.125 0.25 0.5 0.75 1

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary

Transect Station: AE, VE, X

Elevation: 4, 8, 12, 16

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Panel 0092

This preliminary work map contains coastal flood hazard information only, riverine flood hazard information not included

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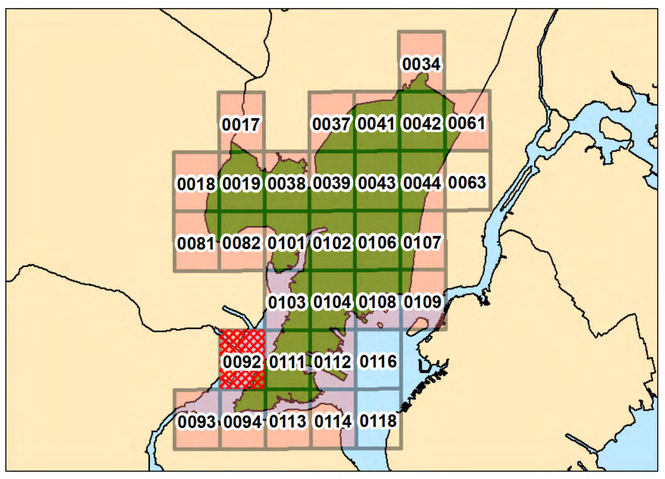

Hudson County, NJ
Preliminary Work Map

Miles

0 0.125 0.25 0.5 0.75 1

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary
- Elevation
  - AE
  - VE
  - X
  - 4
  - 8
  - 12
  - 16

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Panel 0093

This preliminary work map contains coastal flood hazard information only, riverine flood hazard information not included

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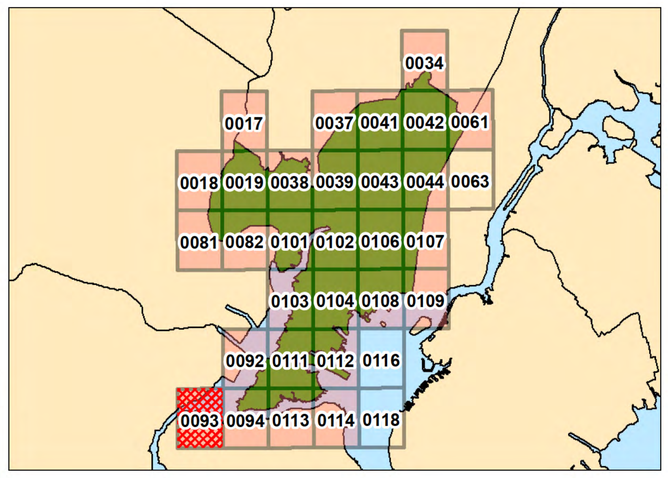
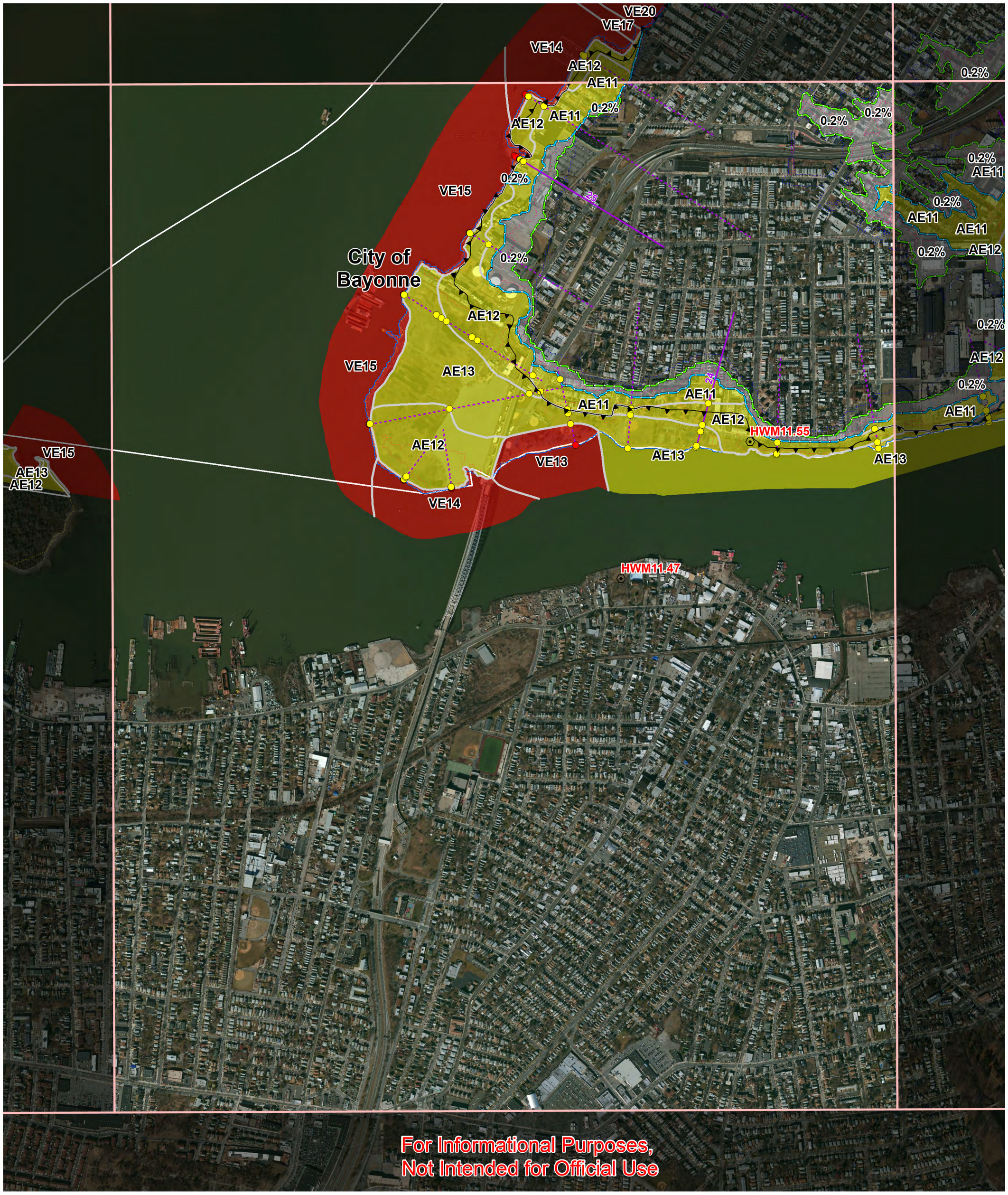


Hudson County, NJ
Preliminary Work Map



Miles

0 0.125 0.25 0.5 0.75 1

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary

Transect Station: AE, VE, X

Elevation: 4, 8, 12, 16

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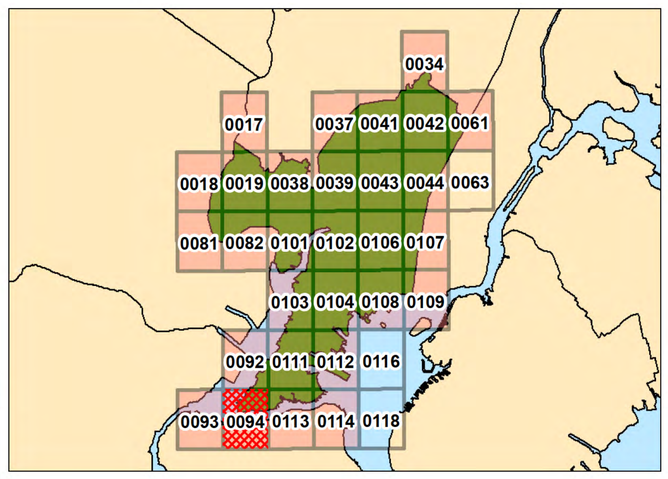
Panel 0094

This preliminary work map contains coastal flood hazard information only, riverine flood hazard information not included

N



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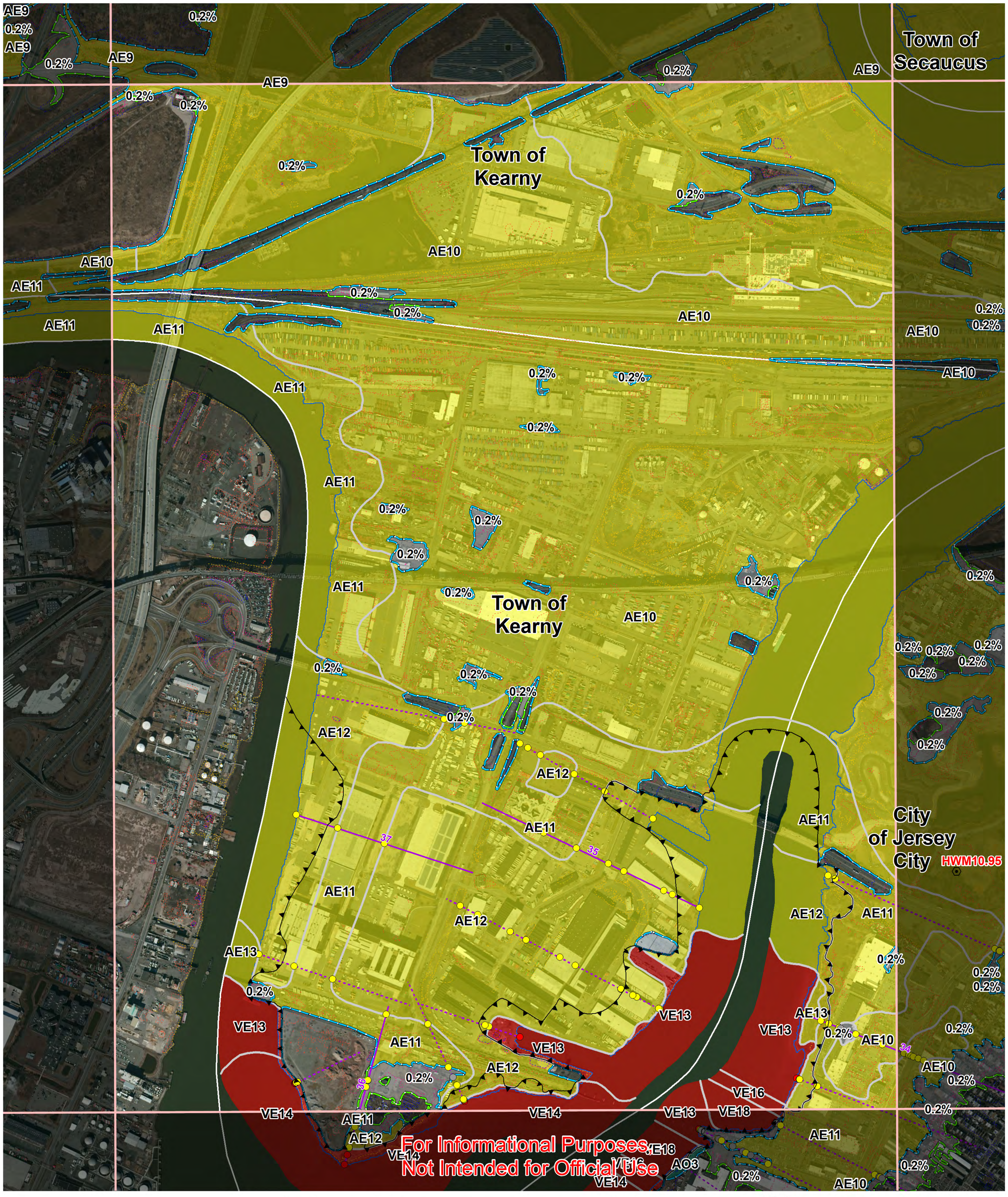
Hudson County, NJ
Preliminary Work Map



0 0.125 0.25 0.5 0.75 1 Miles

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary

Transect Station: AE, VE, X

Elevation: 4, 8, 12, 16

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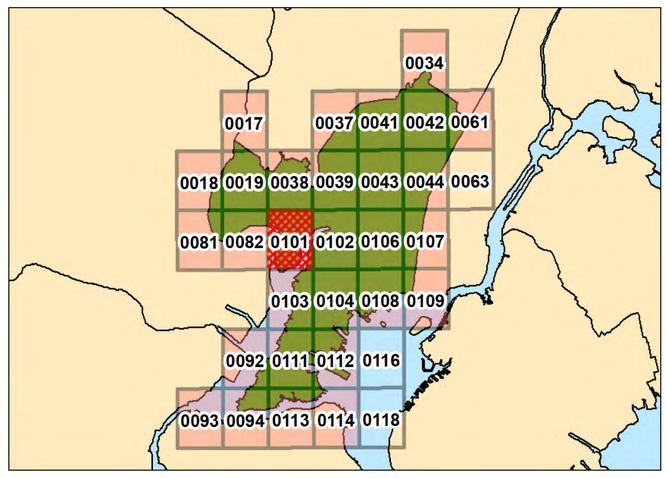
Panel 0101

This preliminary work map contains coastal flood hazard information only, riverine flood hazard information not included



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Hudson County, NJ
Preliminary Work Map

0 0.125 0.25 0.5 0.75 1 Miles

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary
- Elevation: 4, 8, 12, 16

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Panel 0102

This preliminary work map contains coastal flood hazard information only, riverine flood hazard information not included

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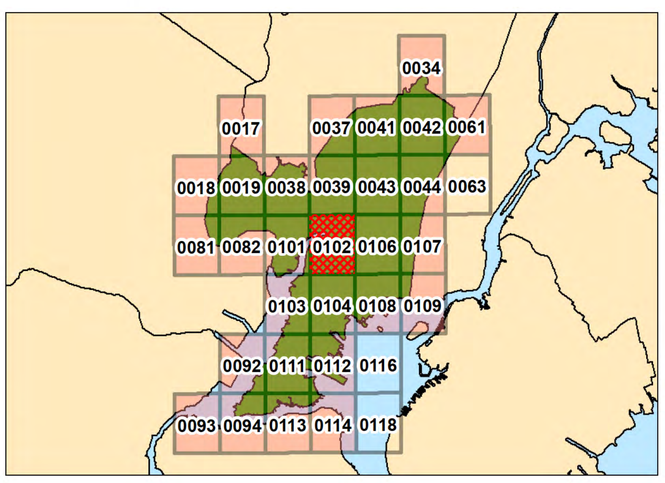
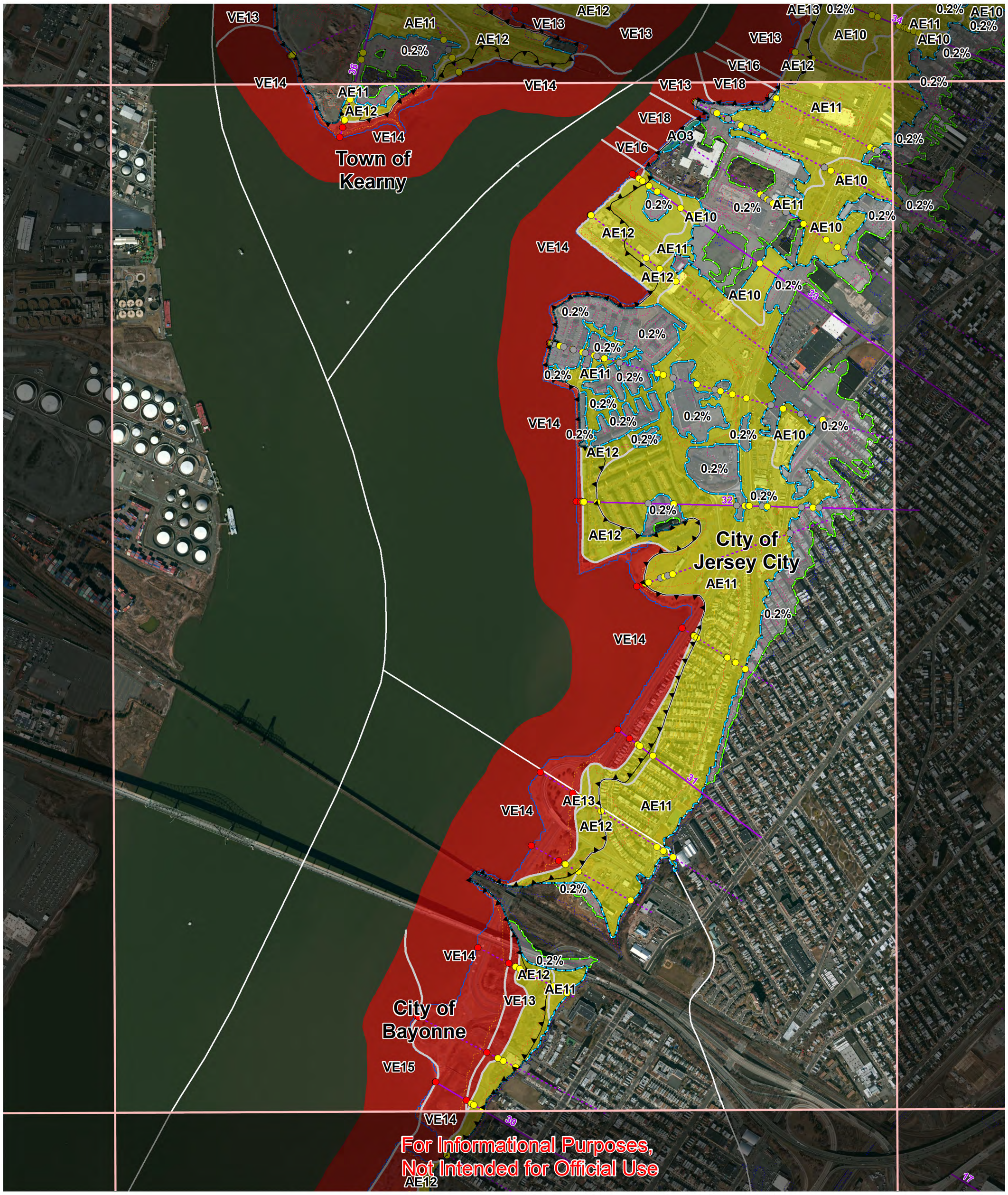


Hudson County, NJ
Preliminary Work Map



0 0.125 0.25 0.5 0.75 1 Miles

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary
- Elevation: 4, 8, 12, 16

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Panel 0103

This preliminary work map contains coastal flood hazard information only, riverine flood hazard information not included

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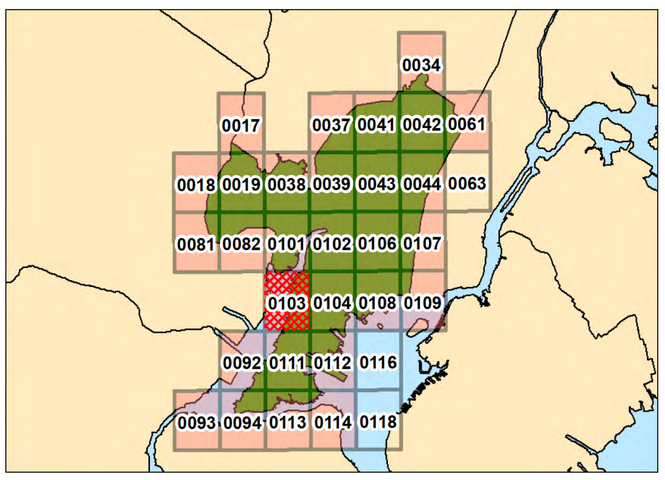

Hudson County, NJ
Preliminary Work Map

0 0.125 0.25 0.5 0.75 1 Miles

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
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- Elevation: 4, 8, 12, 16

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Panel 0104

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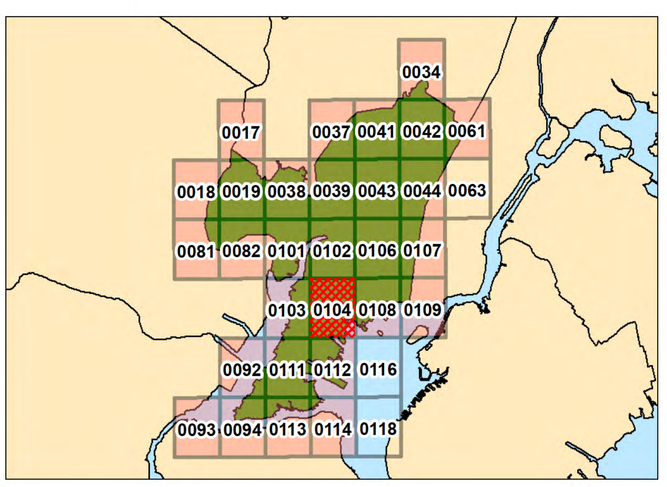

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Hudson County, NJ
Preliminary Work Map

Miles
0 0.125 0.25 0.5 0.75 1

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary
- Elevation: 4, 8, 12, 16

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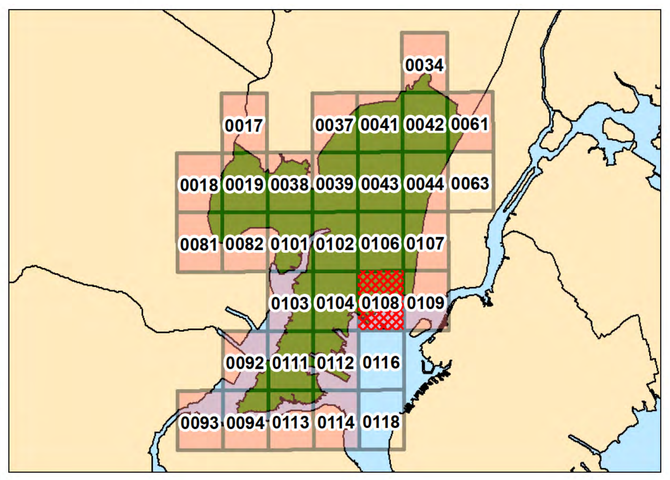
Panel 0108

This preliminary work map contains coastal flood hazard information only, riverine flood hazard information not included



FEMA

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Hudson County, NJ
Preliminary Work Map

0 0.125 0.25 0.5 0.75 1 Miles

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary
- Elevation
  - AE
  - VE
  - X
  - 4
  - 8
  - 12
  - 16

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Panel 0109

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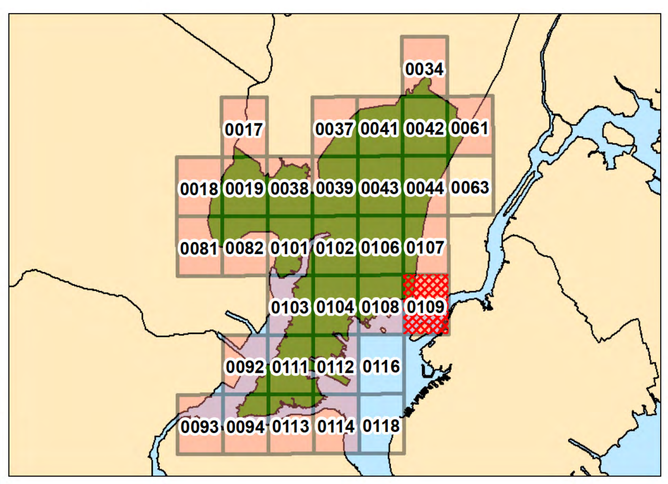

FEMA

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Hudson County, NJ
Preliminary Work Map

0 0.125 0.25 0.5 0.75 1 Miles

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary
- Elevation: 4, 8, 12, 16

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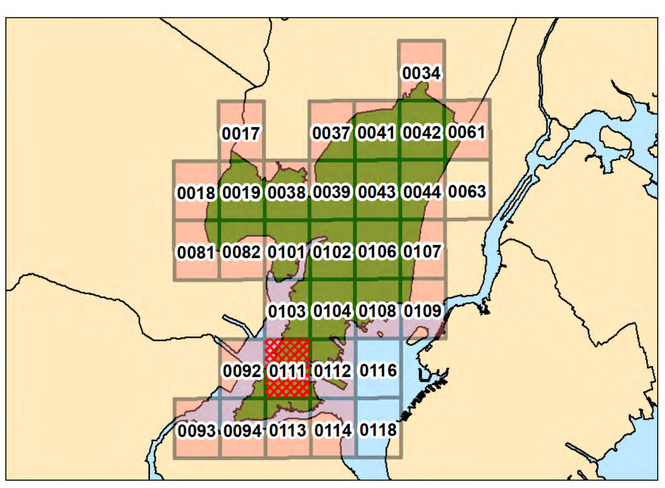
Panel 0111

This preliminary work map contains coastal flood hazard information only, riverine flood hazard information not included



FEMA

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Hudson County, NJ
Preliminary Work Map

0 0.125 0.25 0.5 0.75 1 Miles

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary
- Elevation
  - 4
  - 8
  - 12
  - 16

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Panel 0112

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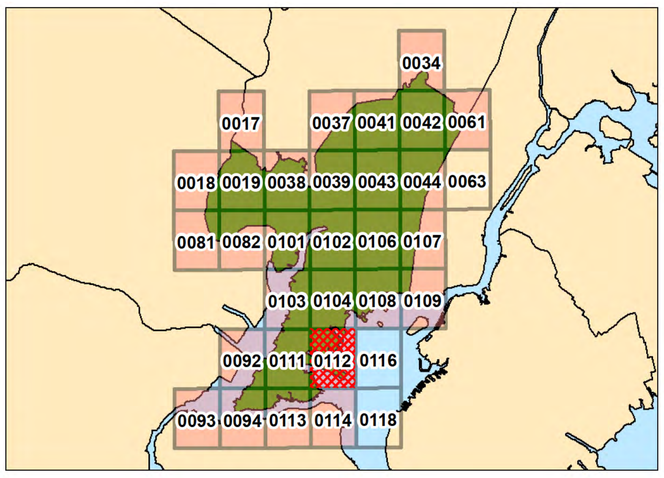

FEMA

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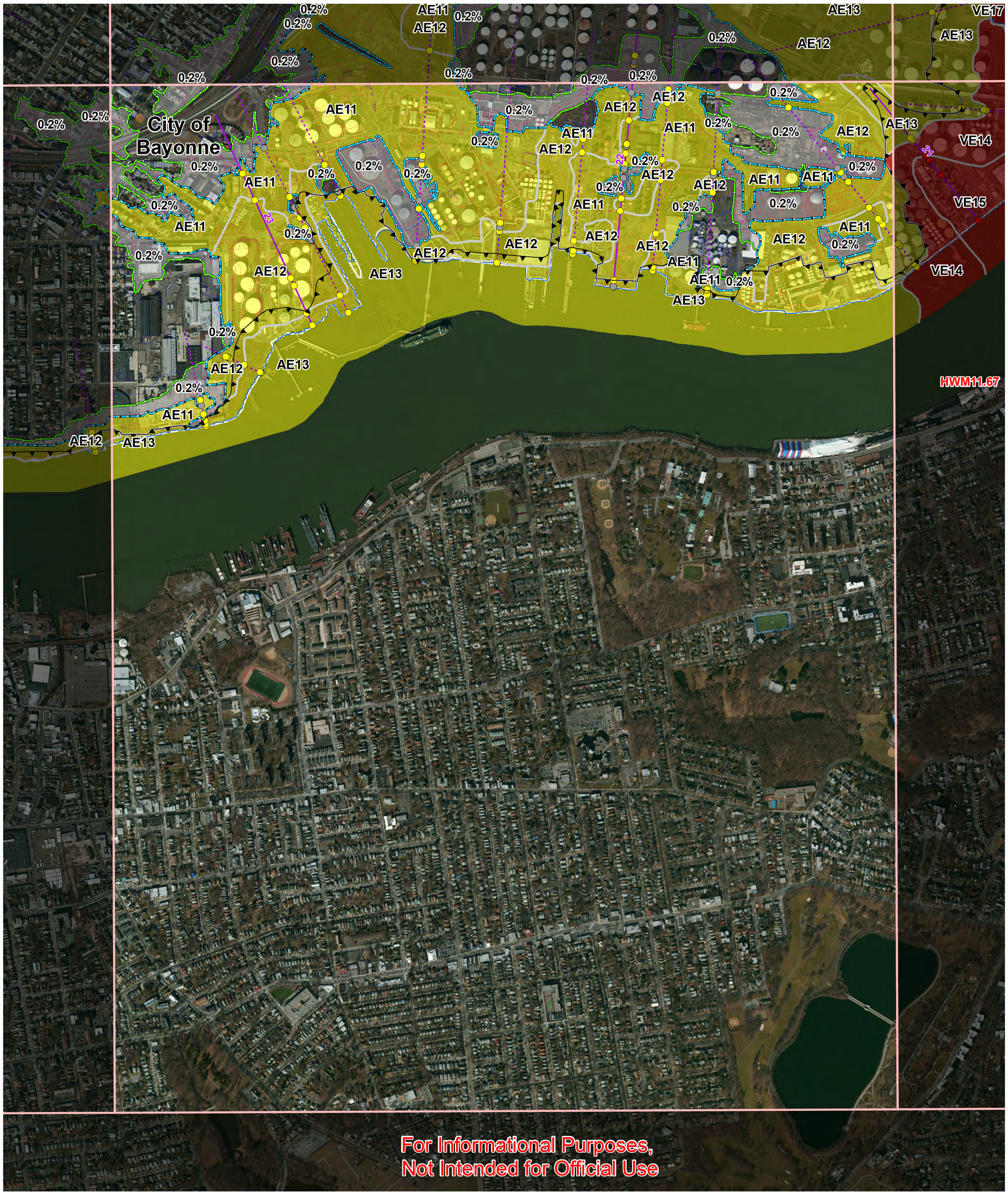
Hudson County, NJ
Preliminary Work Map



Miles
0 0.125 0.25 0.5 0.75 1

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary
- Elevation: 4, 8, 12, 16

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Panel 0113

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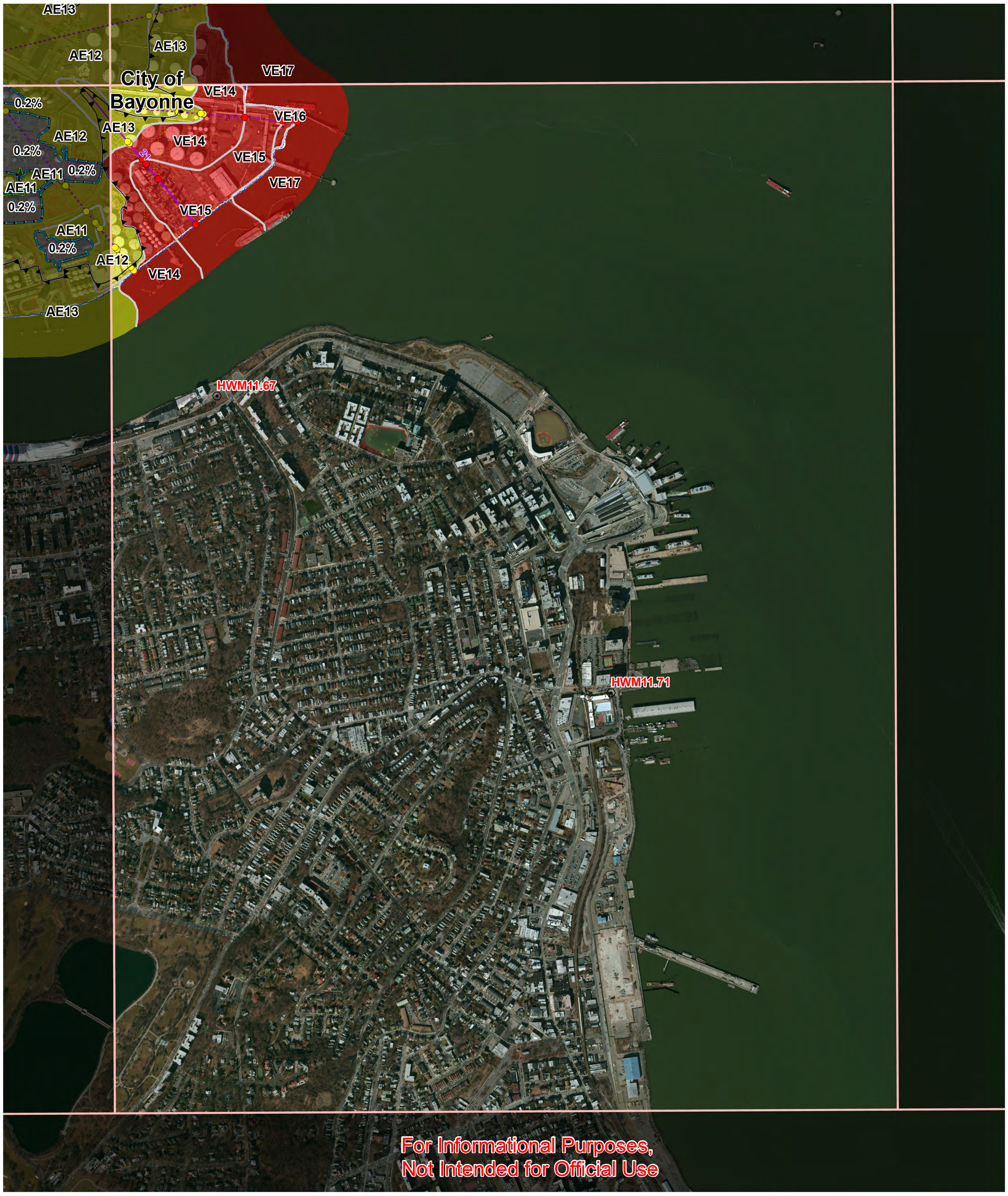
Hudson County, NJ
Preliminary Work Map



Miles

0 0.125 0.25 0.5 0.75 1

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary
- Elevation
  - AE
  - VE
  - X
  - 4
  - 8
  - 12
  - 16

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Panel 0114

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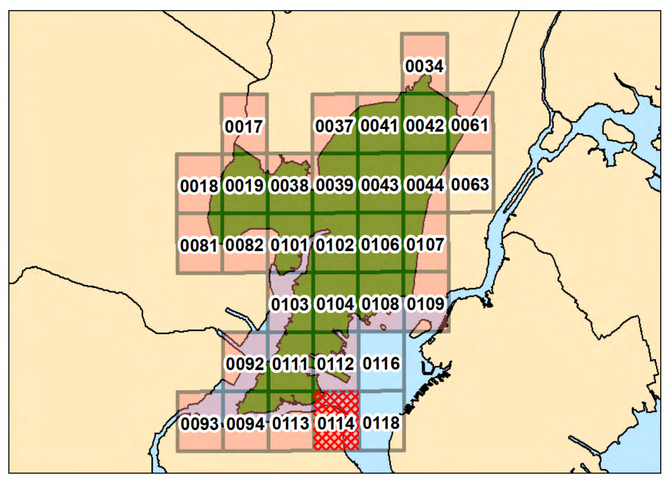

FEMA

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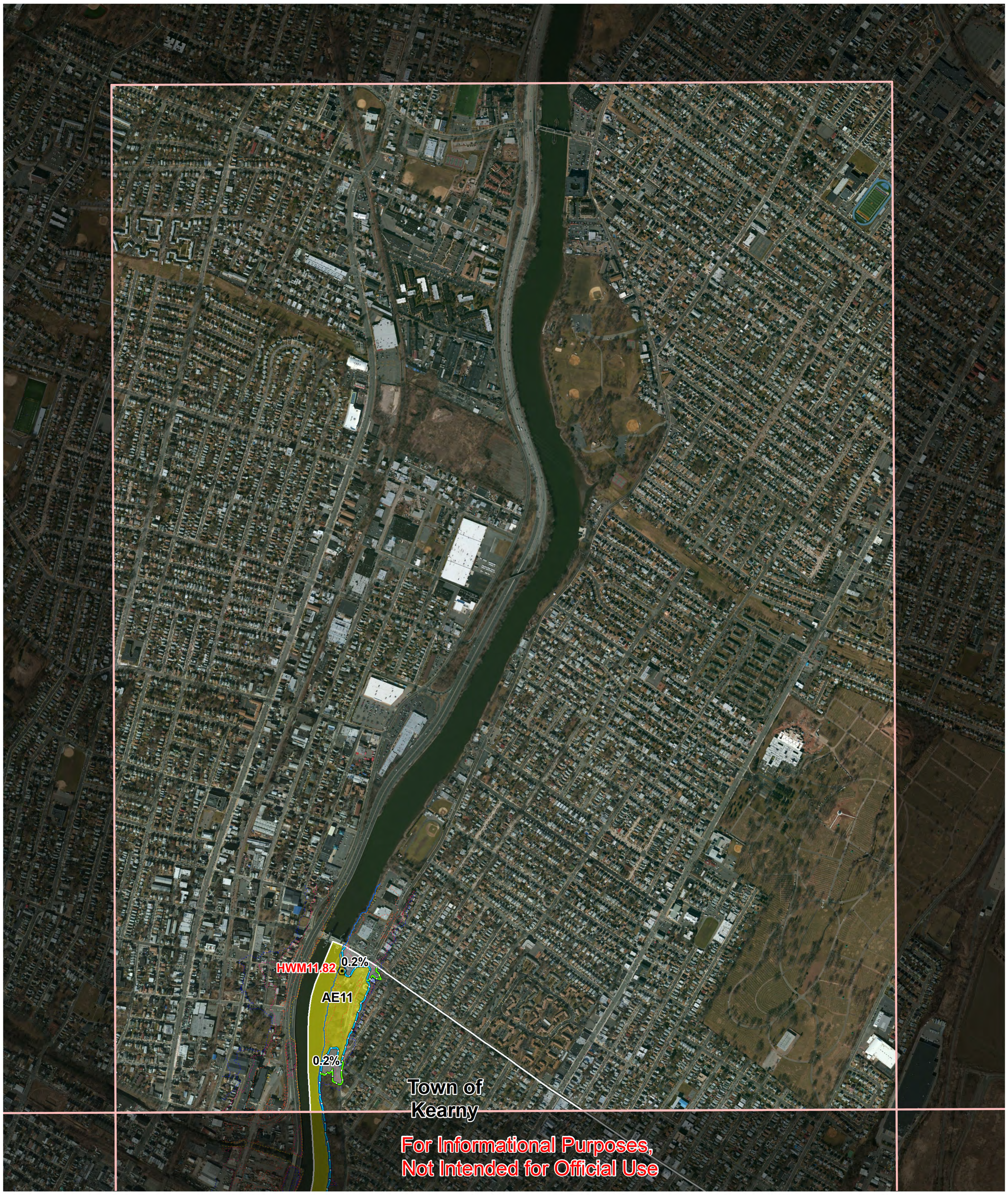
Hudson County, NJ
Preliminary Work Map



0 0.125 0.25 0.5 0.75 1 Miles

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary
- Elevation
  - AE
  - VE
  - X
  - 4
  - 8
  - 12
  - 16

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Panel 0017

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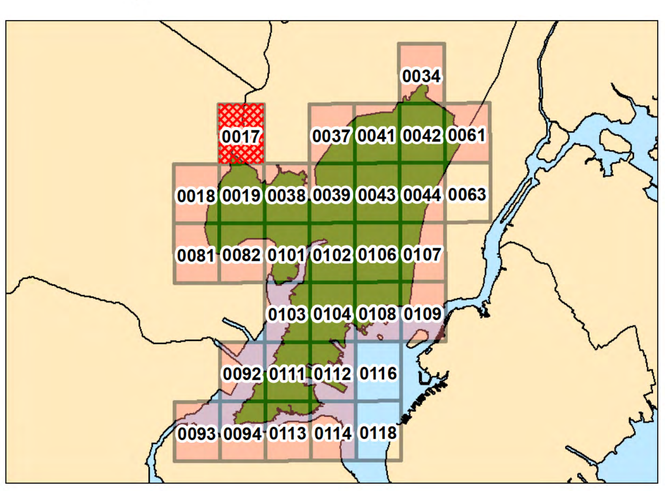

Hudson County, NJ
Preliminary Work Map

0 0.125 0.25 0.5 0.75 1 Miles

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary

Transect Station: AE, VE, X

Elevation: 4, 8, 12, 16

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Panel 0018

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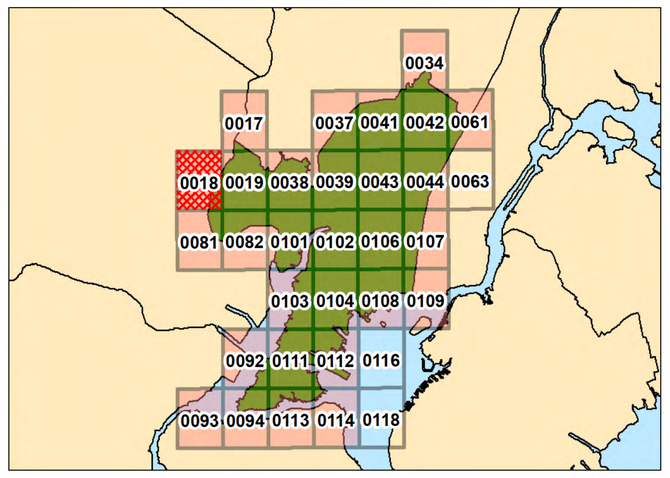

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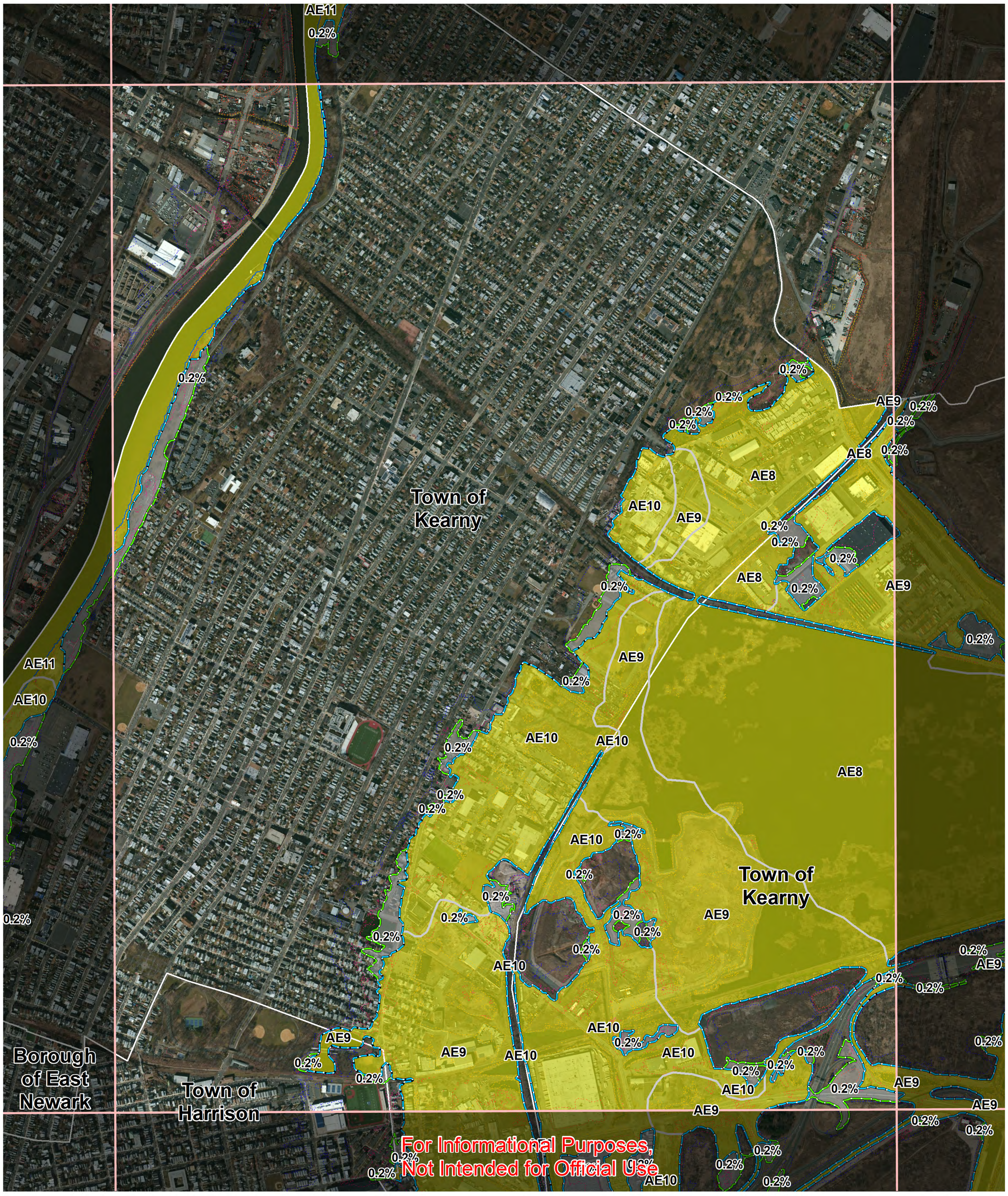
Hudson County, NJ
Preliminary Work Map



0 0.125 0.25 0.5 0.75 1 Miles

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary
- Elevation
  - 4
  - 8
  - 12
  - 16

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Panel 0019

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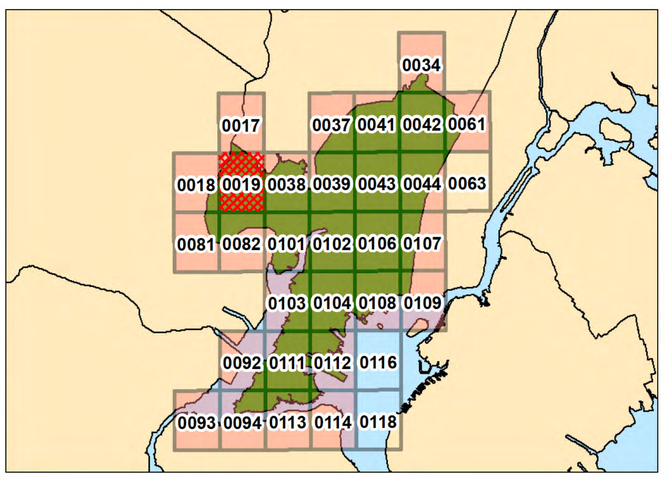

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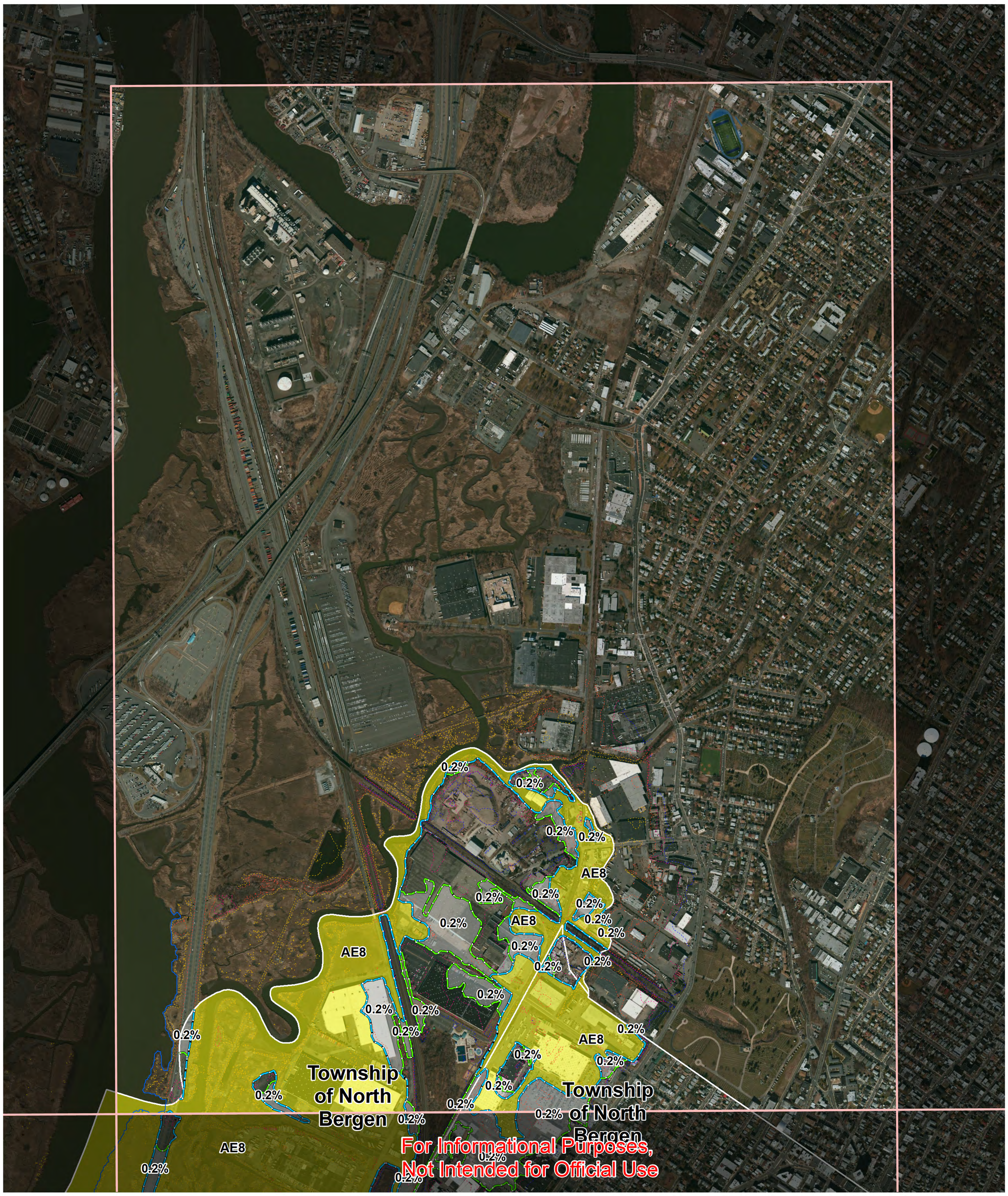
Hudson County, NJ
Preliminary Work Map



0 0.125 0.25 0.5 0.75 1 Miles

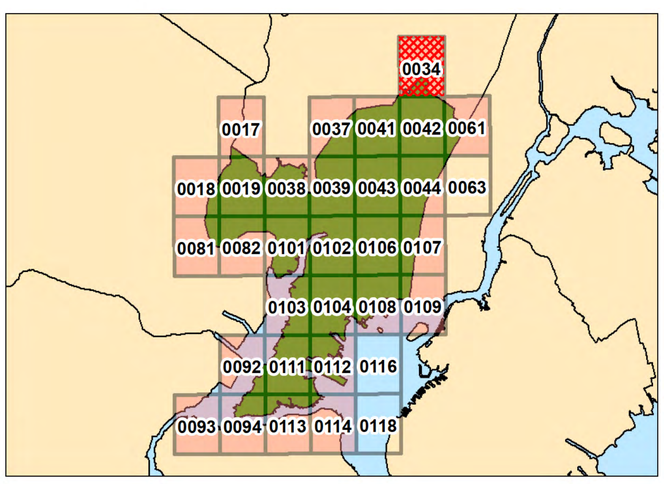
Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary
- Elevation
  - AE
  - VE
  - X
  - 4
  - 8
  - 12
  - 16

Elevation information is provided in feet NAVD88.
High water marks are provided for reference to a historical storm event. They are not intended to be used for validation of the coastal mapping and are not expected to match the coastal BFEs.

Panel 0034

This preliminary work map contains coastal flood hazard information only, riverine flood hazard information not included



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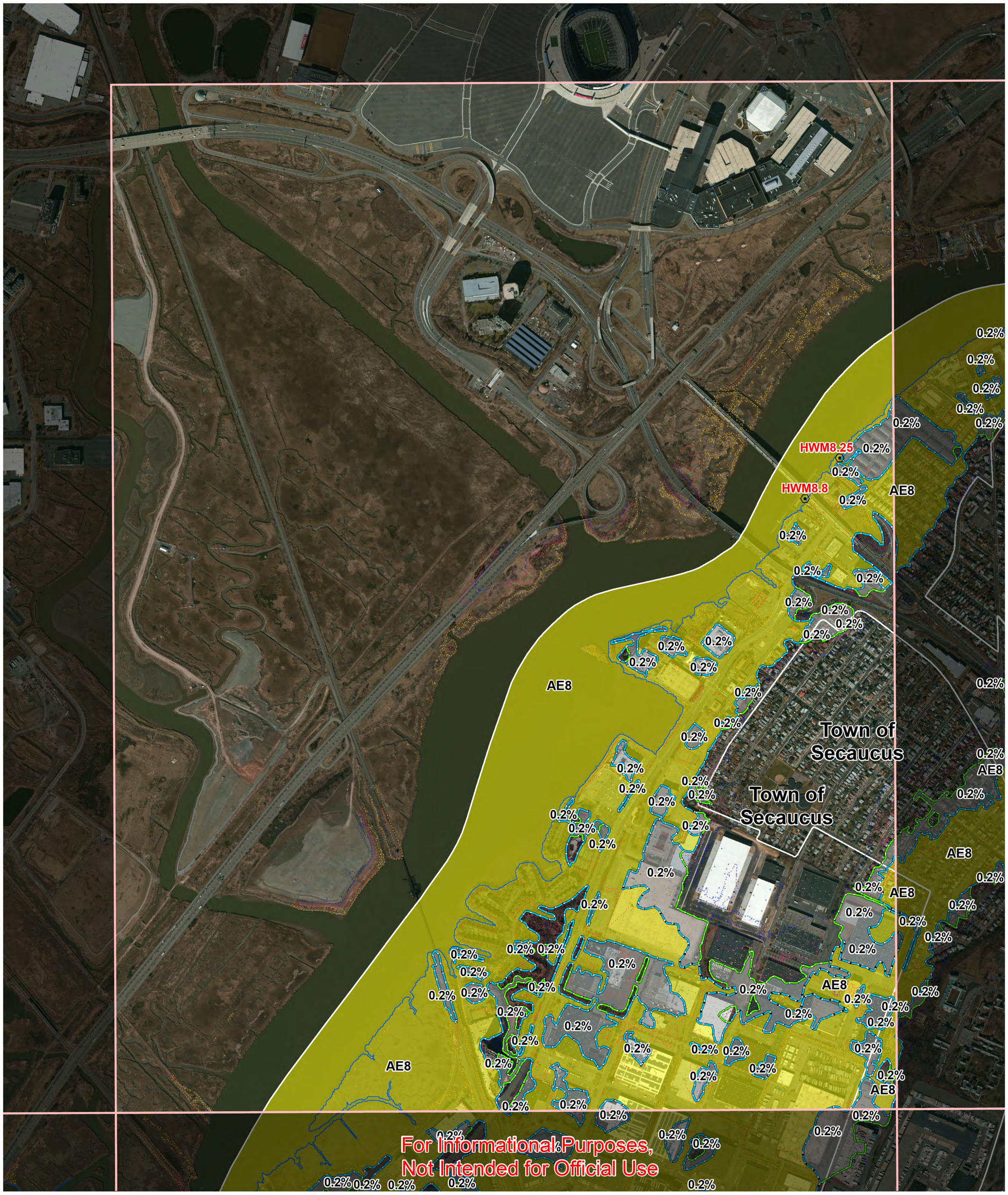
Hudson County, NJ
Preliminary Work Map



0 0.125 0.25 0.5 0.75 1 Miles

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary

Transect Station: AE, VE, X

Elevation: 4, 8, 12, 16

Elevation information is provided in feet NAVD88.
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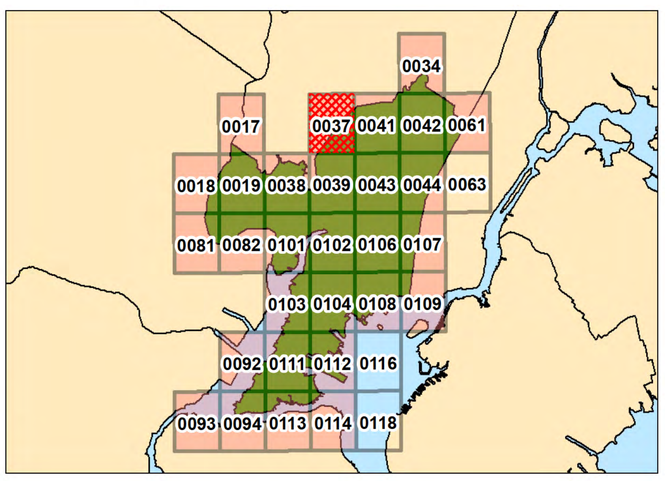
Panel 0037

This preliminary work map contains coastal flood hazard information only, riverine flood hazard information not included



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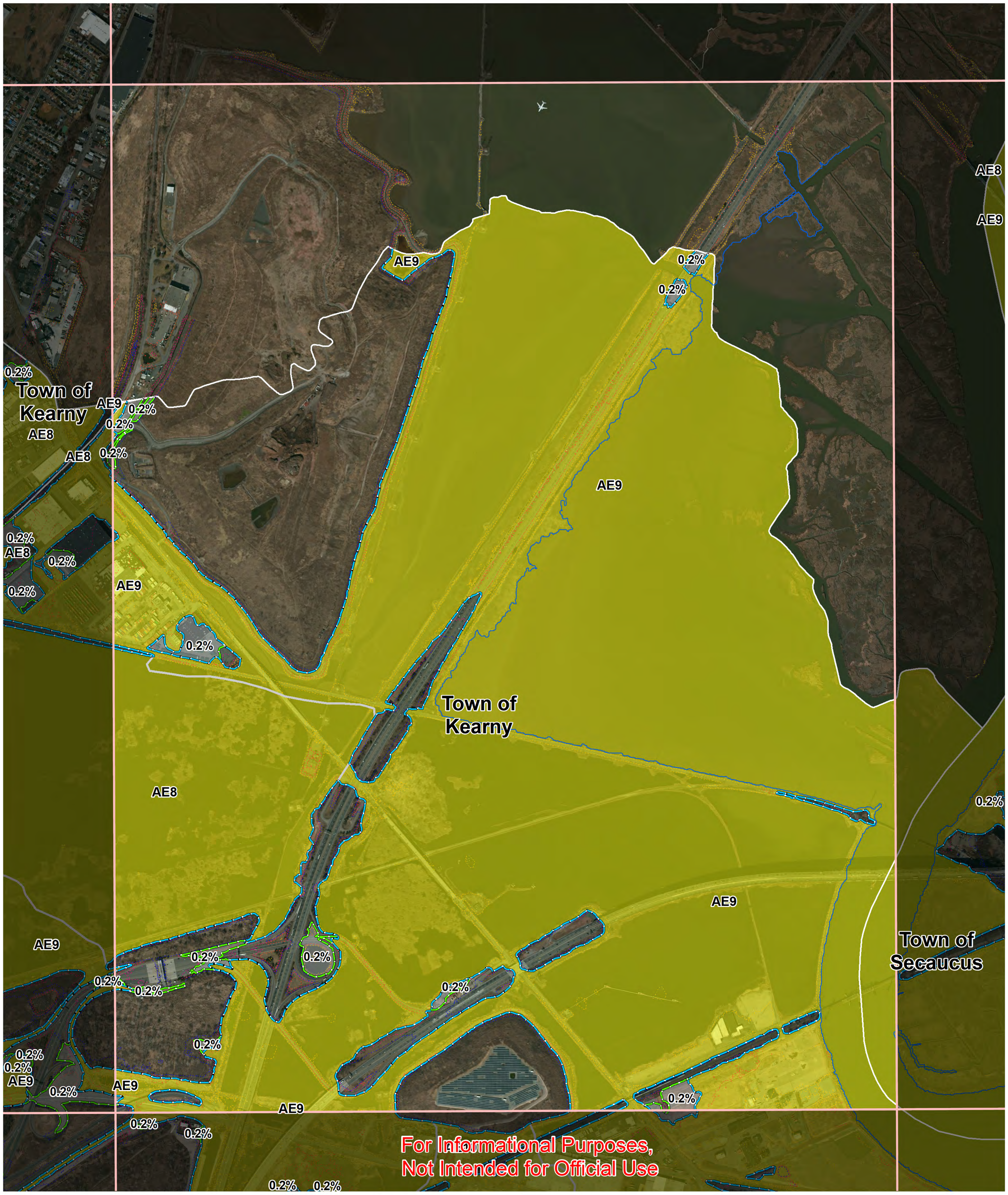
Hudson County, NJ
Preliminary Work Map



Miles

0 0.125 0.25 0.5 0.75 1

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary
- Elevation
  - AE
  - VE
  - X
  - 4
  - 8
  - 12
  - 16

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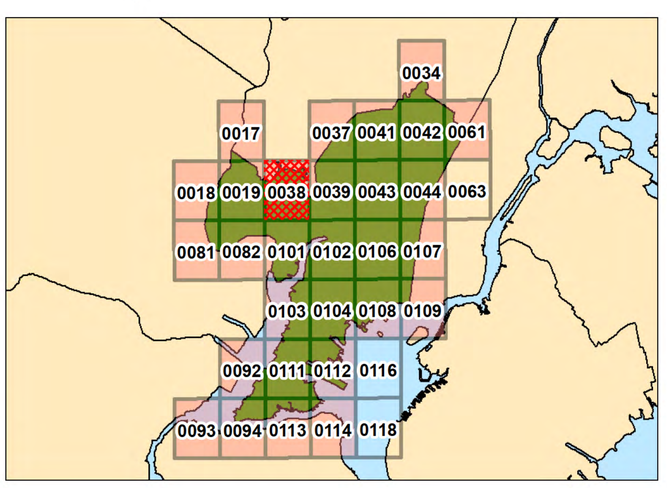
Panel 0038

This preliminary work map contains coastal flood hazard information only, riverine flood hazard information not included



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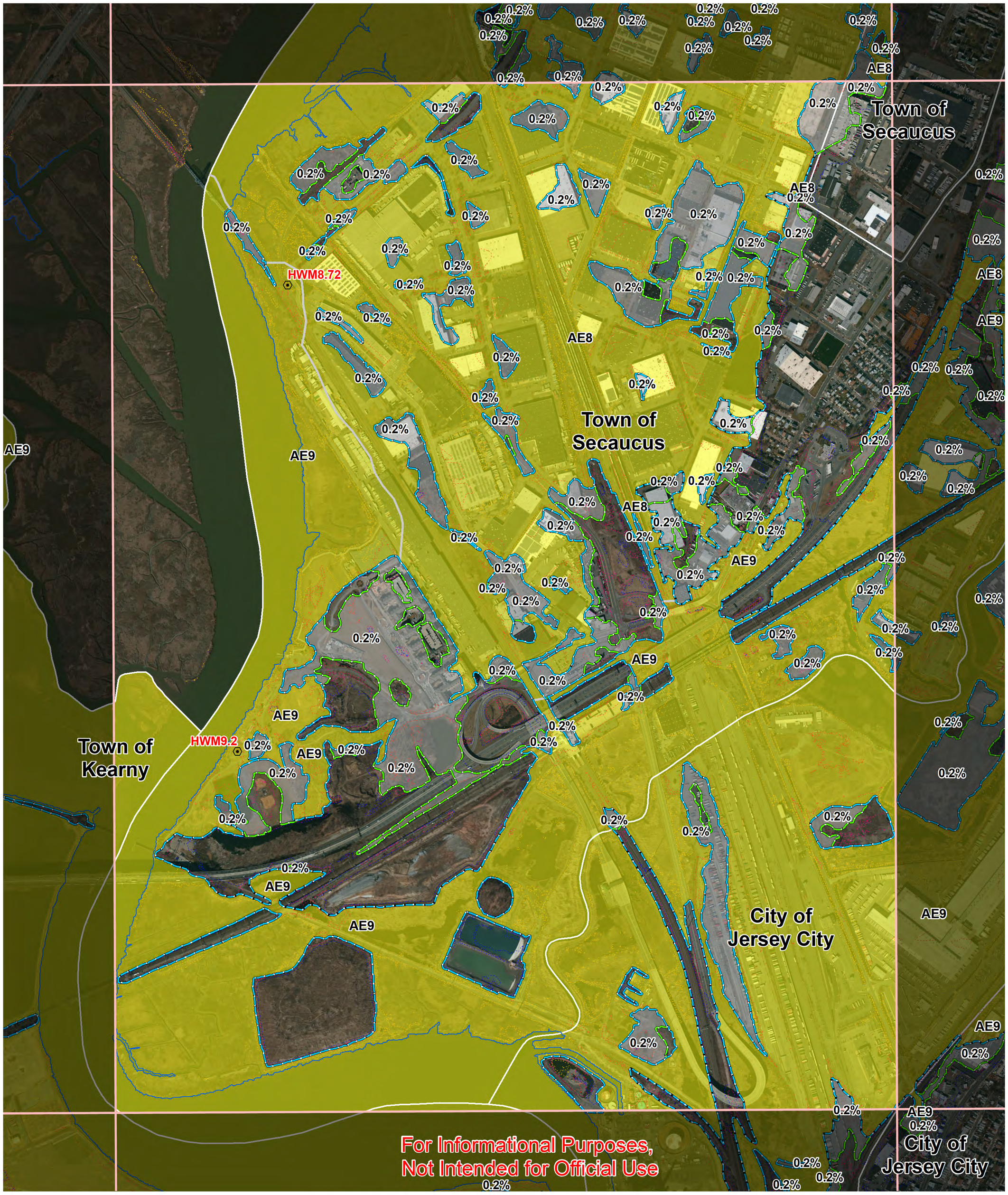
Hudson County, NJ
Preliminary Work Map



Miles
0 0.125 0.25 0.5 0.75 1

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary
- Elevation: 4, 8, 12, 16

Elevation information is provided in feet NAVD88.
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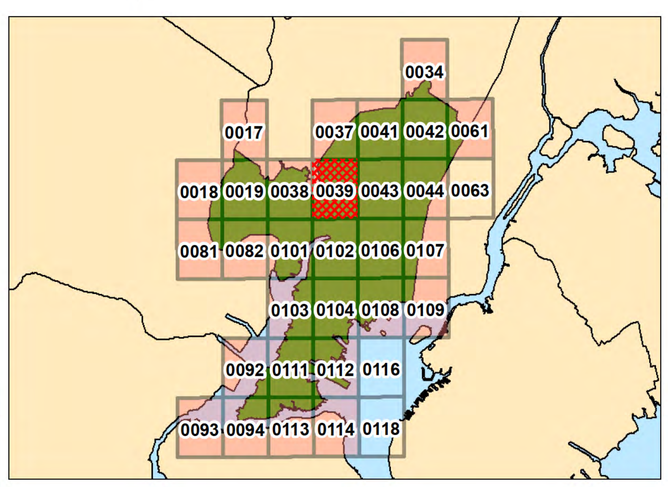
Panel 0039

This preliminary work map contains coastal flood hazard information only, riverine flood hazard information not included



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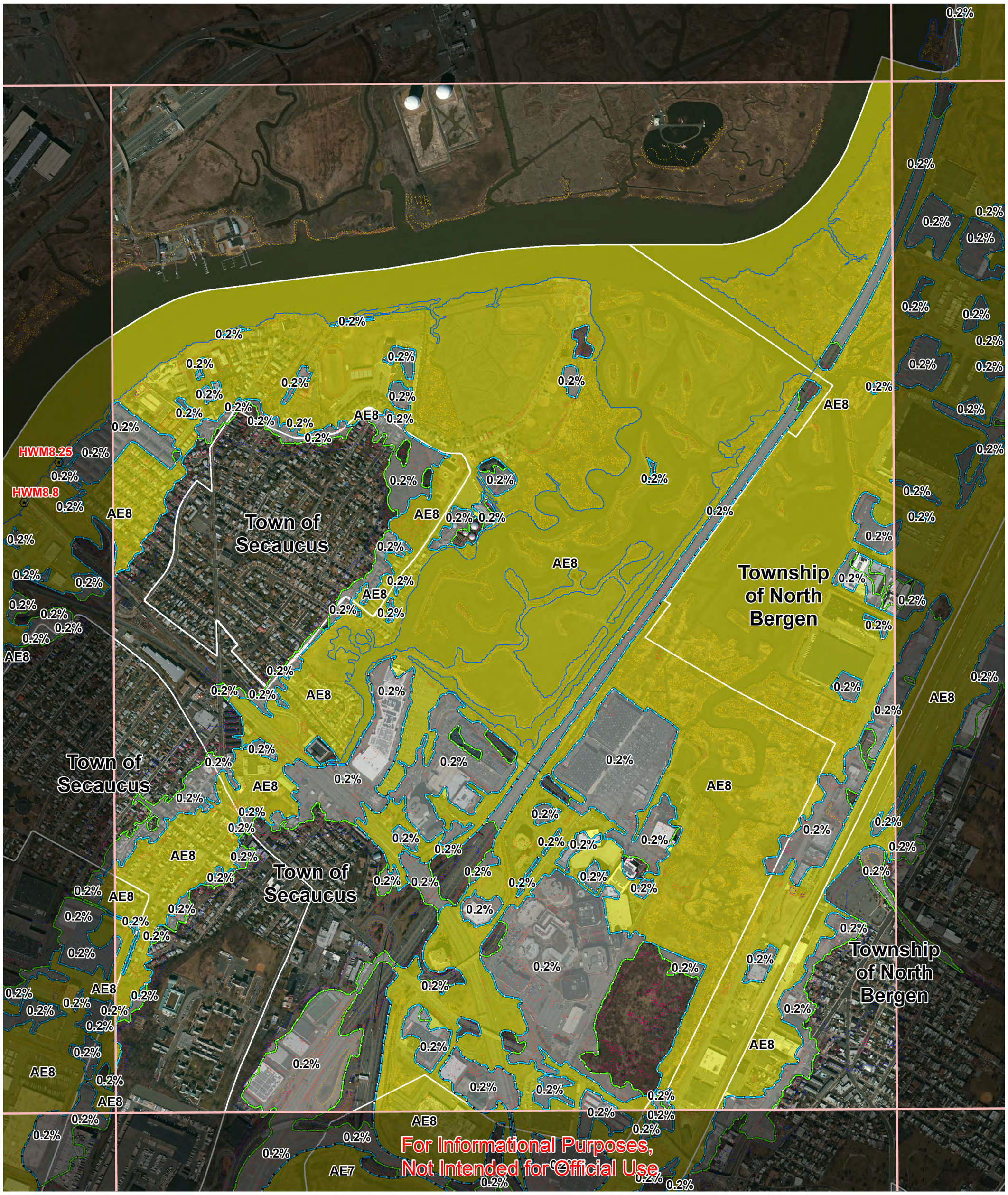
Preliminary Work Map



0 0.125 0.25 0.5 0.75 1 Miles

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary
- Elevation: 4, 8, 12, 16

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Panel 0041

This preliminary work map contains coastal flood hazard information only, riverine flood hazard information not included

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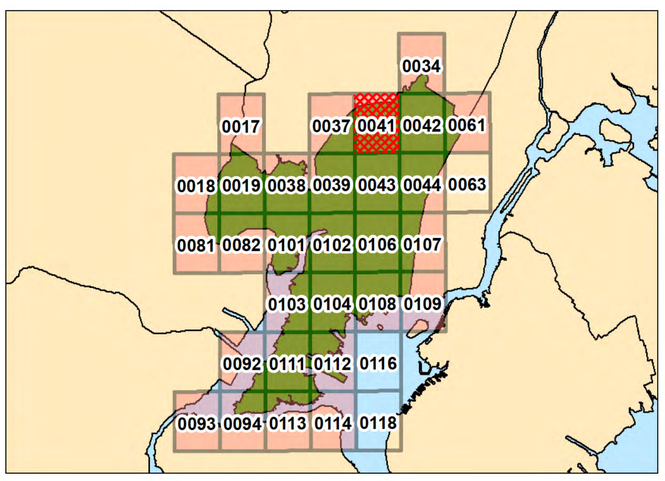
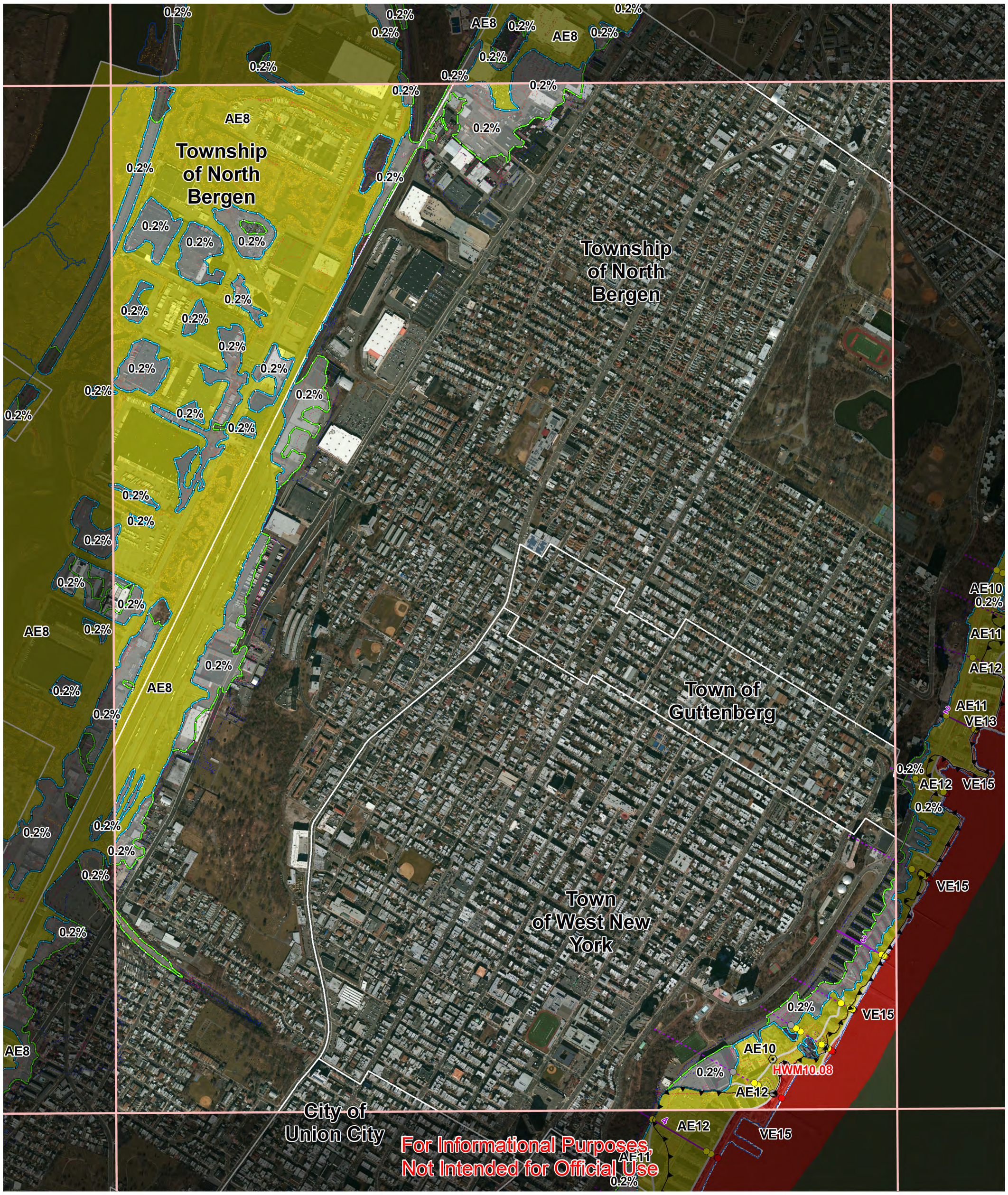


Hudson County, NJ
Preliminary Work Map



0 0.125 0.25 0.5 0.75 1 Miles

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary
- Elevation: 4, 8, 12, 16

Elevation information is provided in feet NAVD88.
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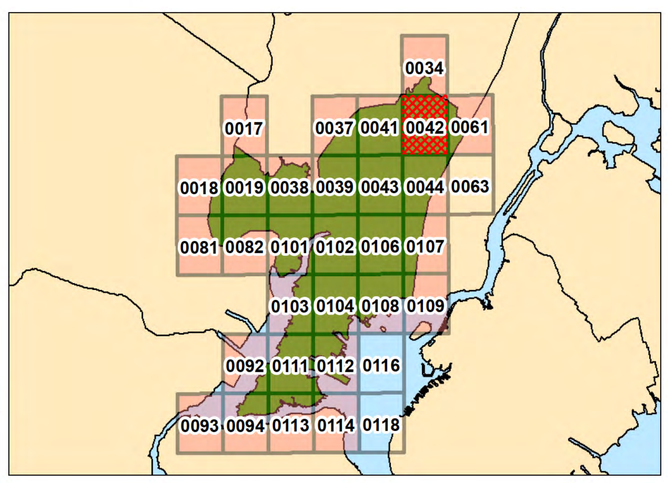
Panel 0042

This preliminary work map contains coastal flood hazard information only, riverine flood hazard information not included



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Hudson County, NJ
Preliminary Work Map

Miles

0 0.125 0.25 0.5 0.75 1

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary
- Elevation: 4, 8, 12, 16

Elevation information is provided in feet NAVD88.
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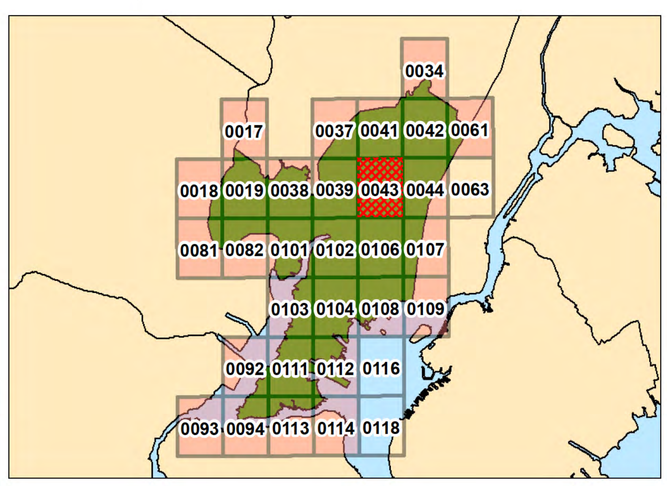
Panel 0043

This preliminary work map contains coastal flood hazard information only, riverine flood hazard information not included



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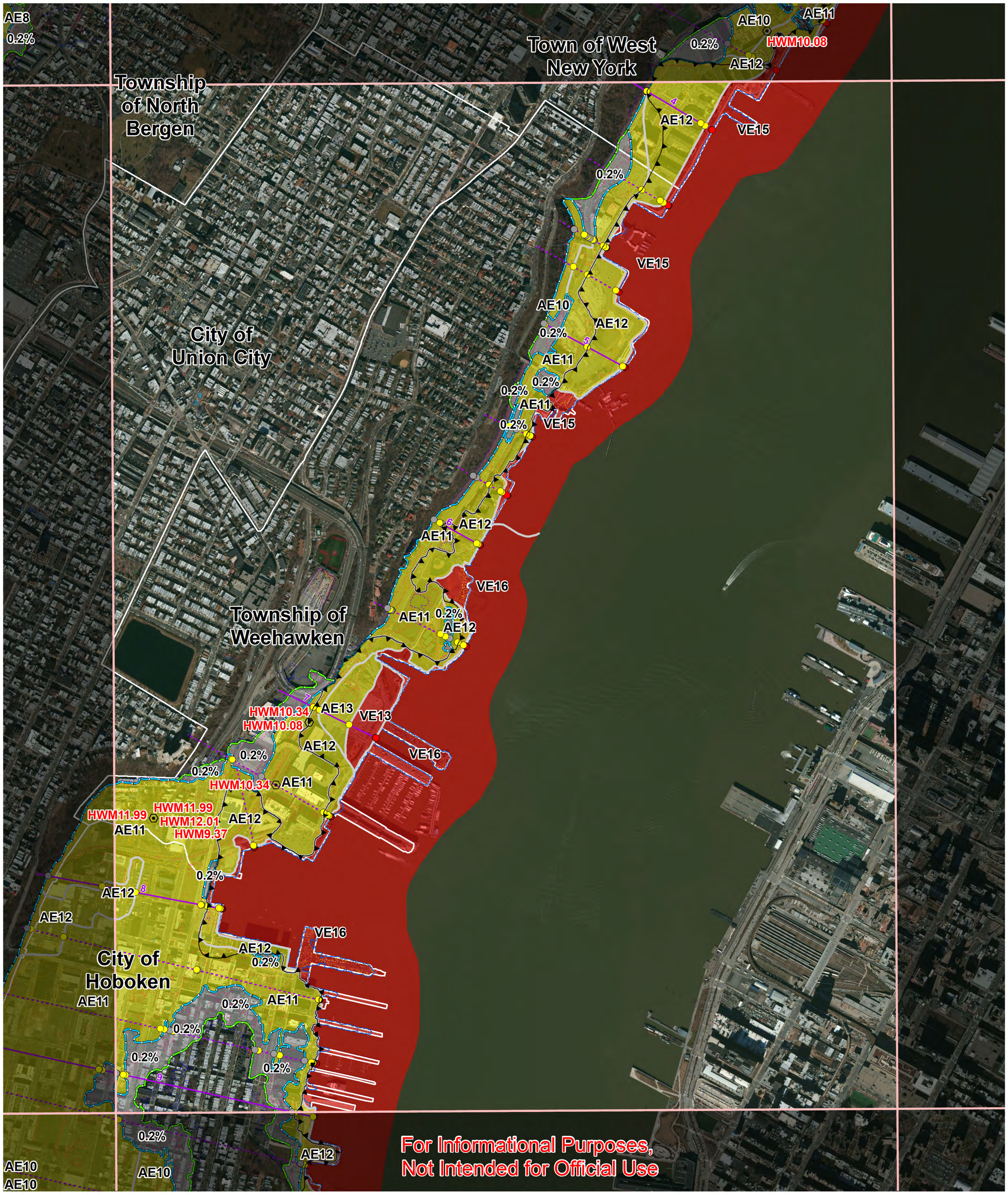
Hudson County, NJ
Preliminary Work Map



0 0.125 0.25 0.5 0.75 1 Miles

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary
- Elevation: 4, 8, 12, 16

AE
VE
X

Elevation information is provided in feet NAVD88.
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Panel 0044

This preliminary work map contains coastal flood hazard information only, riverine flood hazard information not included

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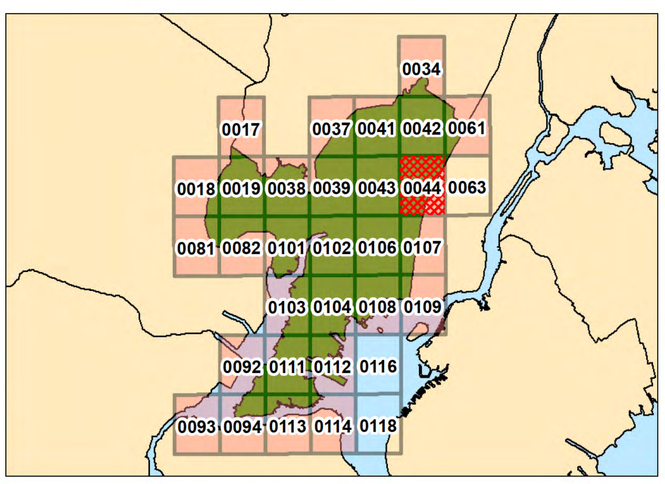
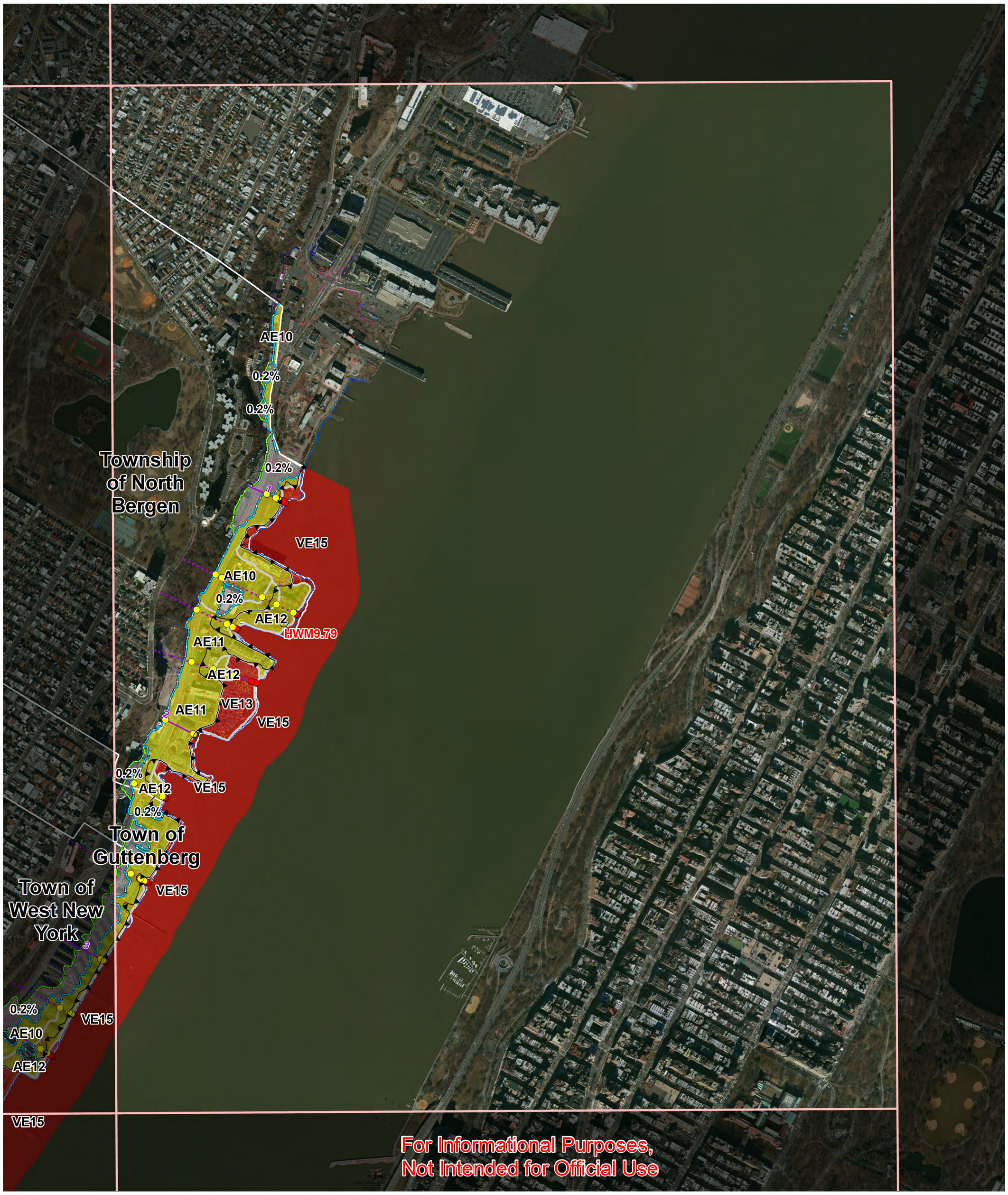


Hudson County, NJ
Preliminary Work Map



Miles

0 0.125 0.25 0.5 0.75 1

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary
- Elevation
  - AE
  - VE
  - X
  - 4
  - 8
  - 12
  - 16

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Panel 0061

This preliminary work map contains coastal flood hazard information only, riverine flood hazard information not included

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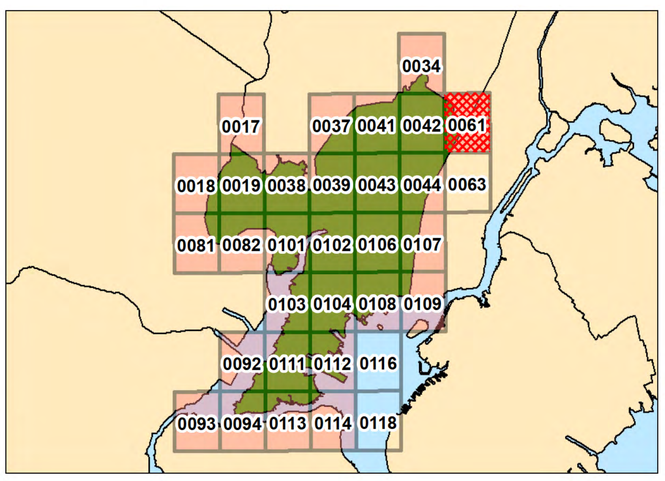

Hudson County, NJ
Preliminary Work Map

0 0.125 0.25 0.5 0.75 1 Miles

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary

Transect Station: AE, VE, X

Elevation: 4, 8, 12, 16

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Panel 0081

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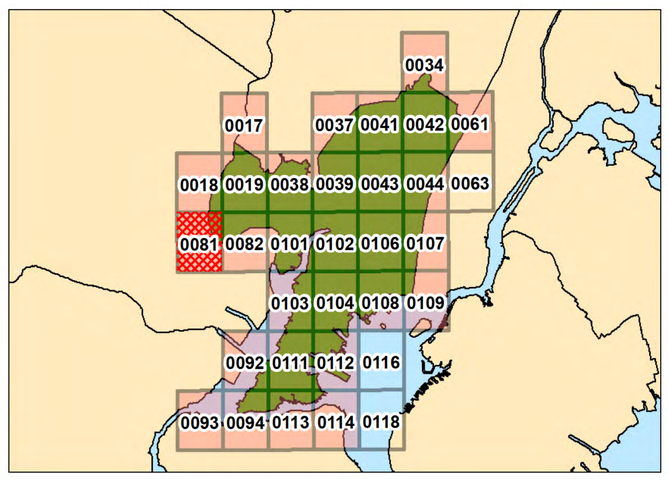

Hudson County, NJ
Preliminary Work Map

0 0.125 0.25 0.5 0.75 1 Miles

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary
- Elevation: 4, 8, 12, 16

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Panel 0082

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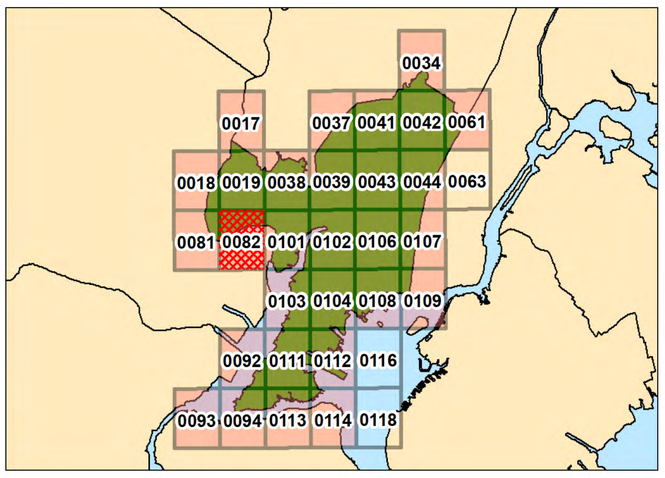

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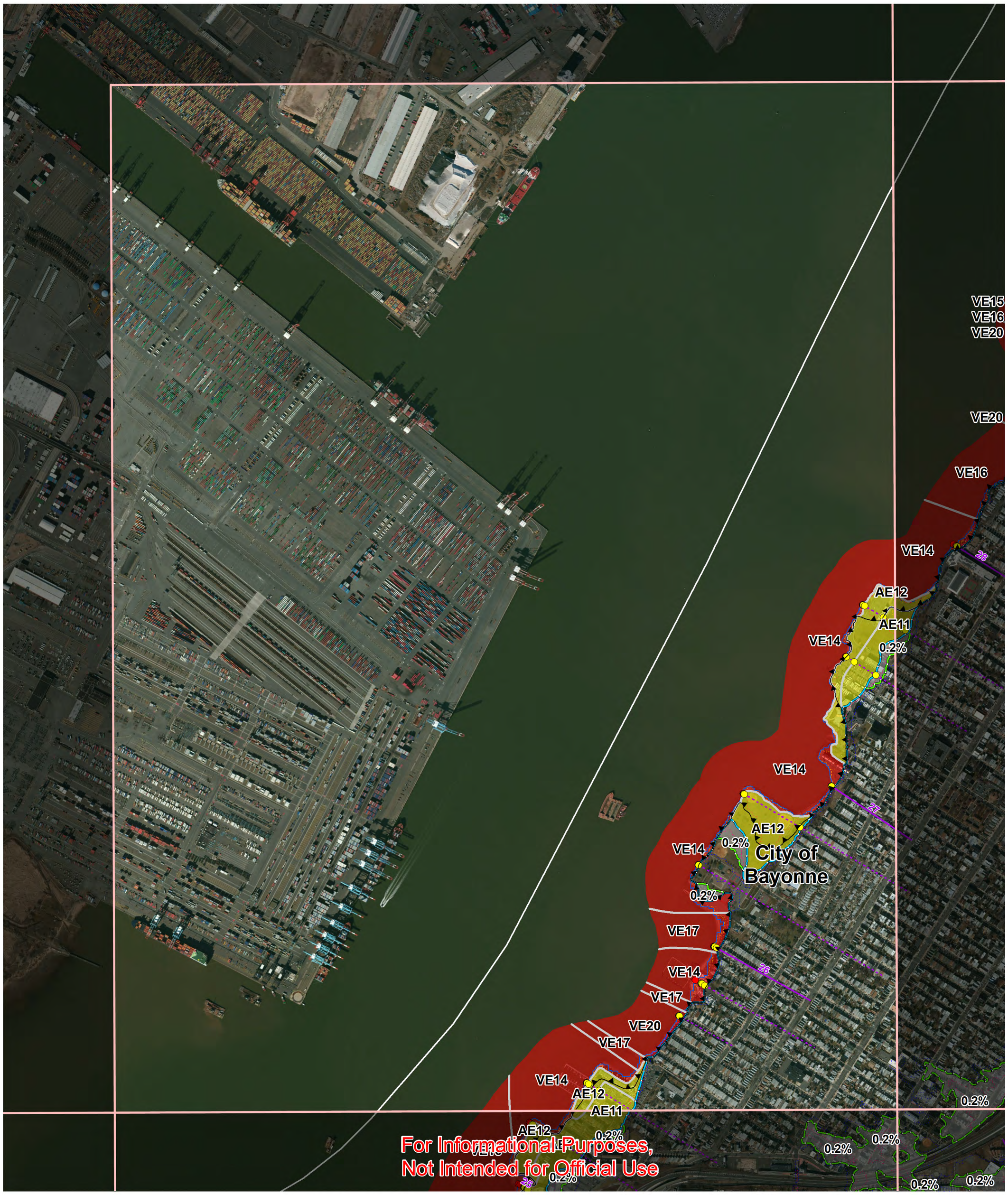
Hudson County, NJ
Preliminary Work Map



Miles

0 0.125 0.25 0.5 0.75 1

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary

Transect Station: AE, VE, X

Elevation: 4, 8, 12, 16

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Panel 0092

This preliminary work map contains coastal flood hazard information only, riverine flood hazard information not included

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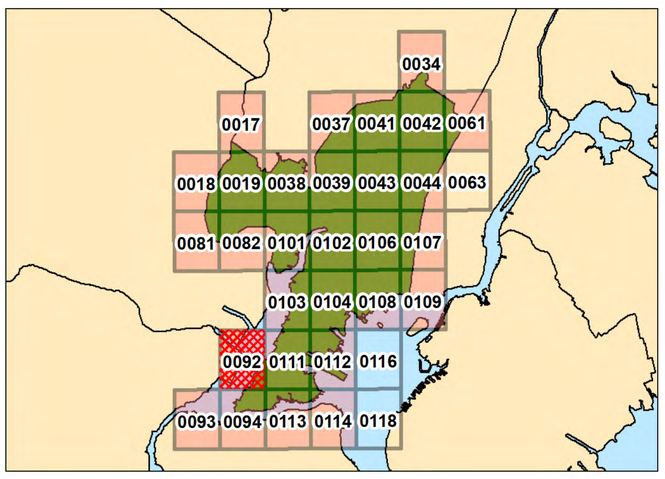

Hudson County, NJ
Preliminary Work Map

Miles

0 0.125 0.25 0.5 0.75 1

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary
- Elevation
  - AE
  - VE
  - X
  - 4
  - 8
  - 12
  - 16

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Panel 0093

This preliminary work map contains coastal flood hazard information only, riverine flood hazard information not included

FEMA

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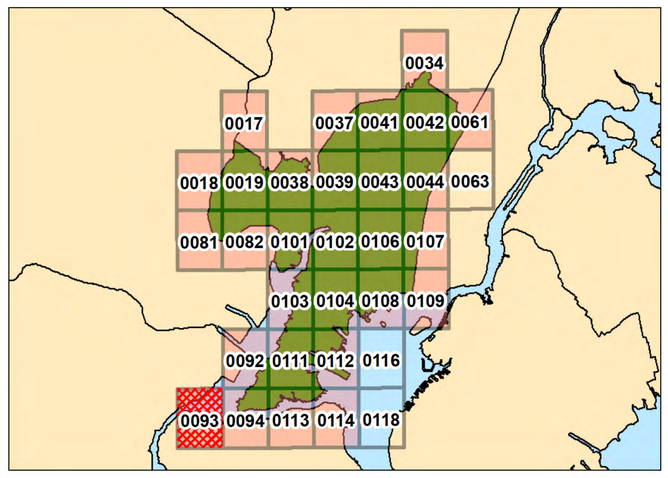
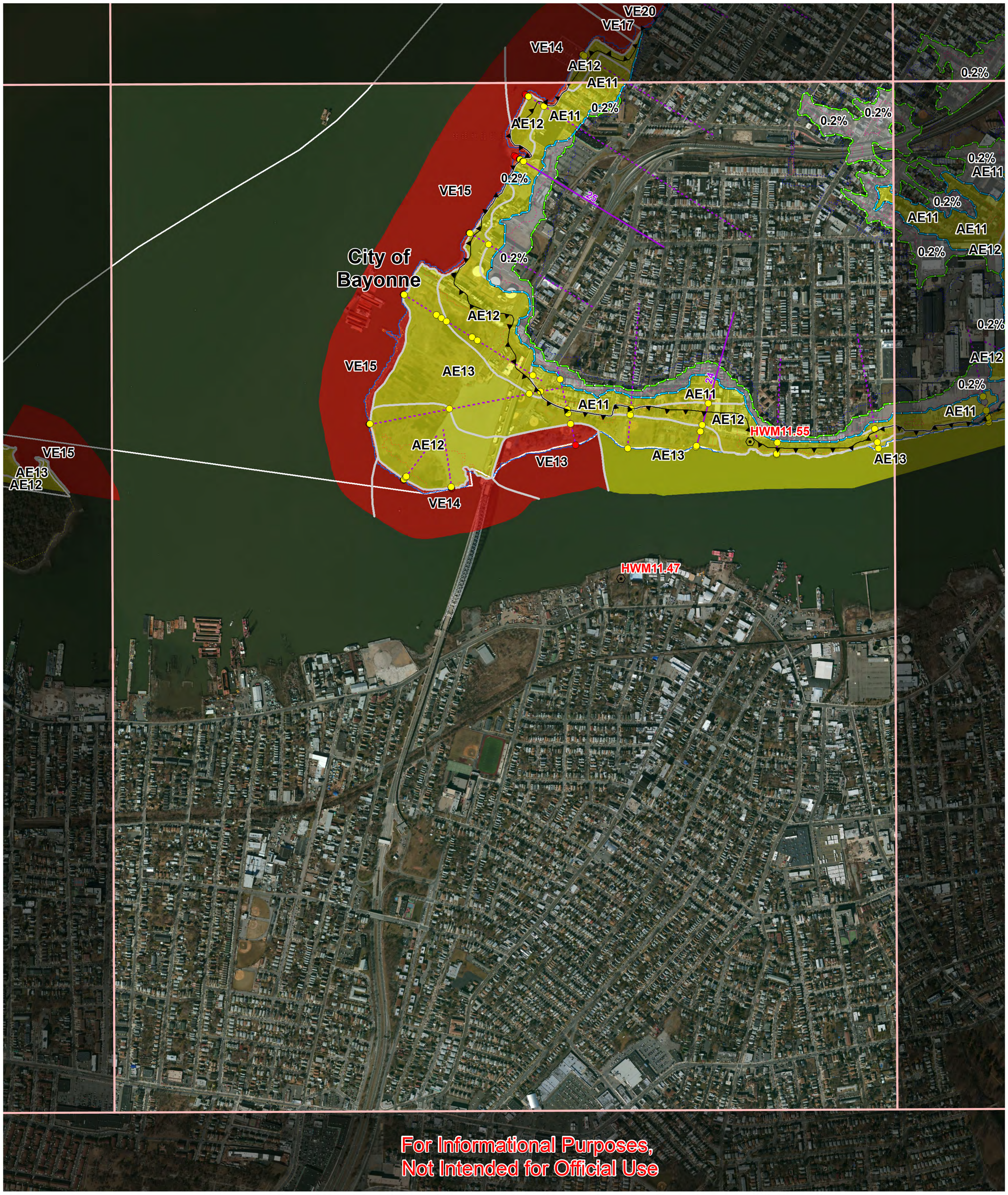


Hudson County, NJ
Preliminary Work Map



Miles

0 0.125 0.25 0.5 0.75 1

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary

Transect Station: AE, VE, X

Elevation: 4, 8, 12, 16

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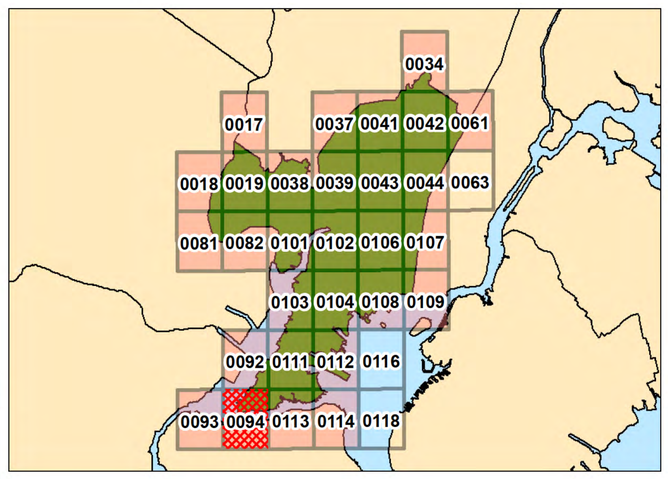
Panel 0094

This preliminary work map contains coastal flood hazard information only, riverine flood hazard information not included

N



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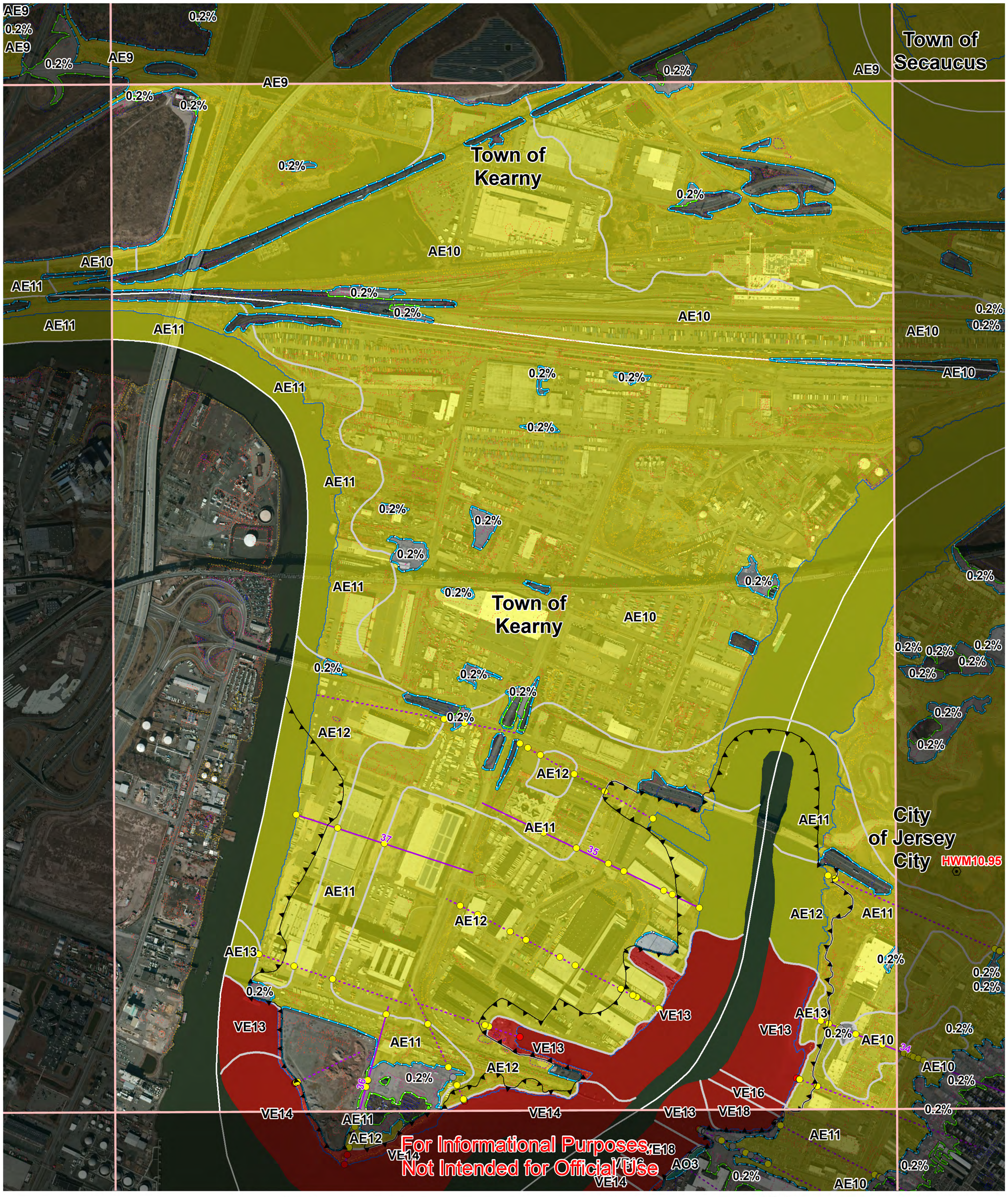
Hudson County, NJ
Preliminary Work Map



0 0.125 0.25 0.5 0.75 1 Miles

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary

Transect Station: AE, VE, X

Elevation: 4, 8, 12, 16

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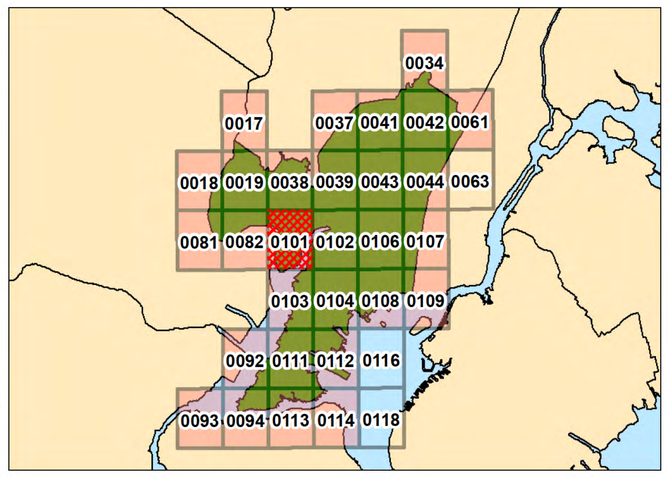
Panel 0101

This preliminary work map contains coastal flood hazard information only, riverine flood hazard information not included



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Hudson County, NJ
Preliminary Work Map

0 0.125 0.25 0.5 0.75 1 Miles

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary
- Elevation: 4, 8, 12, 16

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Panel 0102

This preliminary work map contains coastal flood hazard information only, riverine flood hazard information not included

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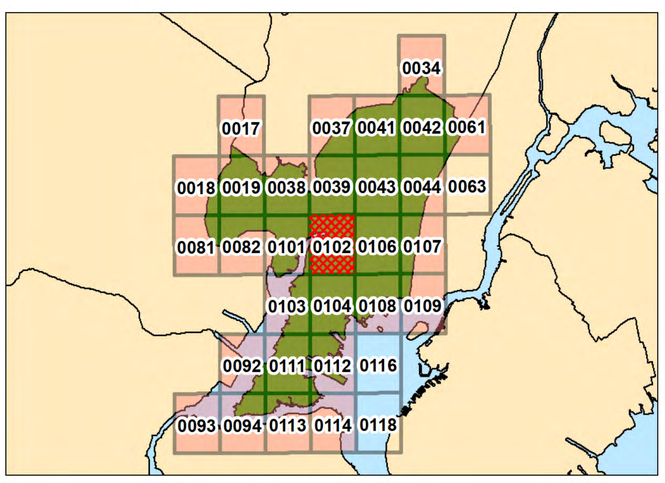
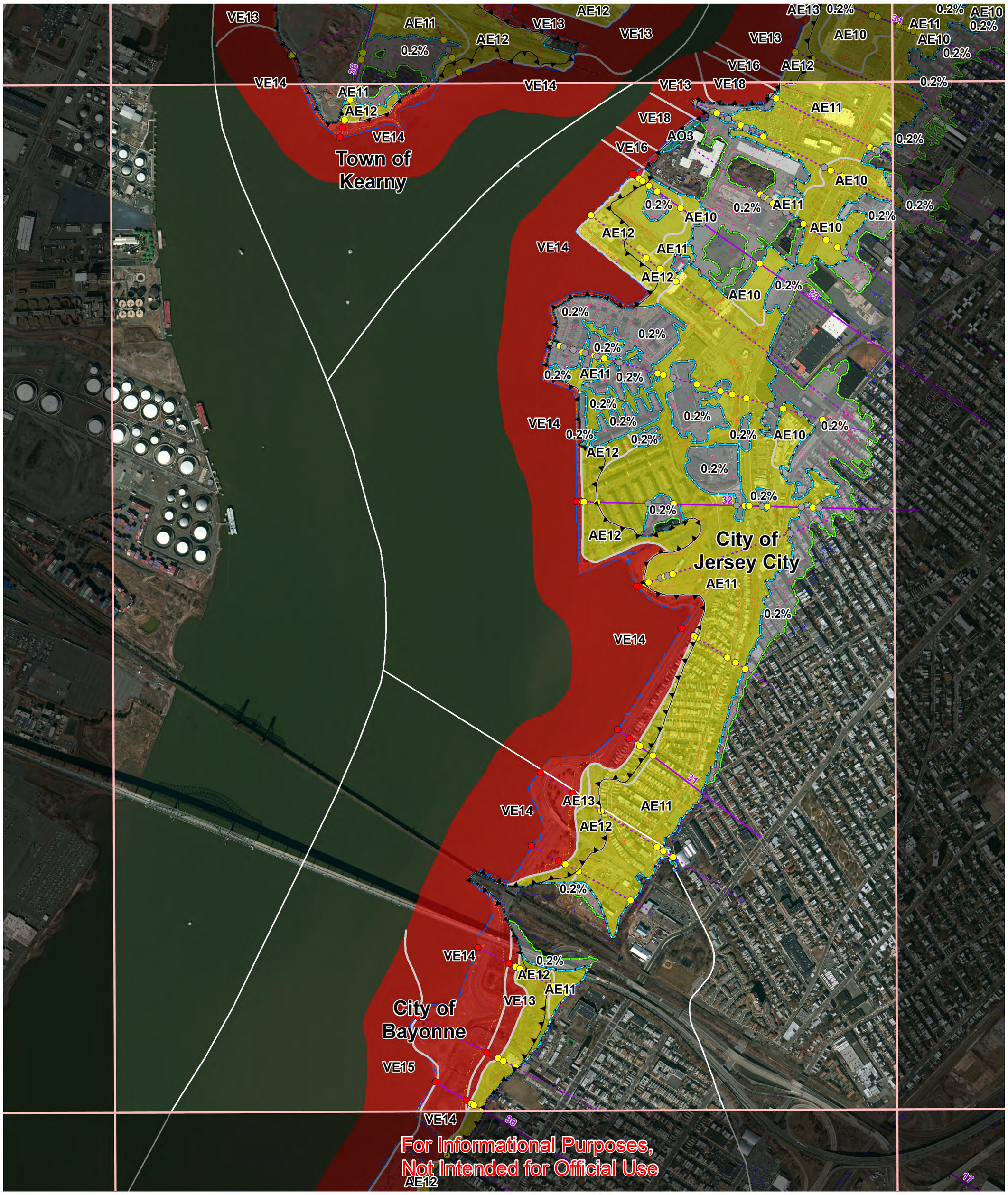


Hudson County, NJ
Preliminary Work Map



0 0.125 0.25 0.5 0.75 1 Miles

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary
- Elevation: 4, 8, 12, 16

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Panel 0103

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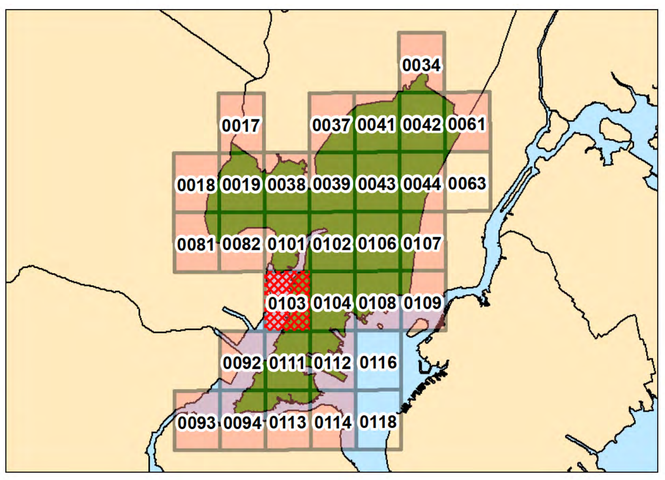


Hudson County, NJ
Preliminary Work Map

0 0.125 0.25 0.5 0.75 1 Miles

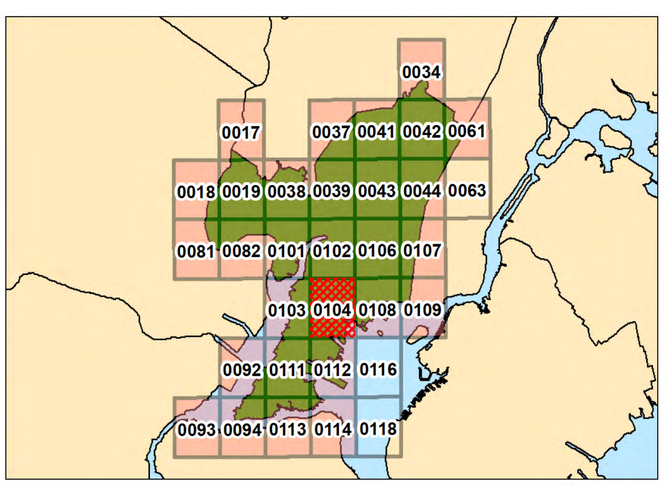
Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary
- Elevation: 4, 8, 12, 16

Elevation information is provided in feet NAVD88.
High water marks are provided for reference to a historical storm event. They are not intended to be used for validation of the coastal mapping and are not expected to match the coastal BFEs.

Panel 0104

This preliminary work map contains coastal flood hazard information only, riverine flood hazard information not included



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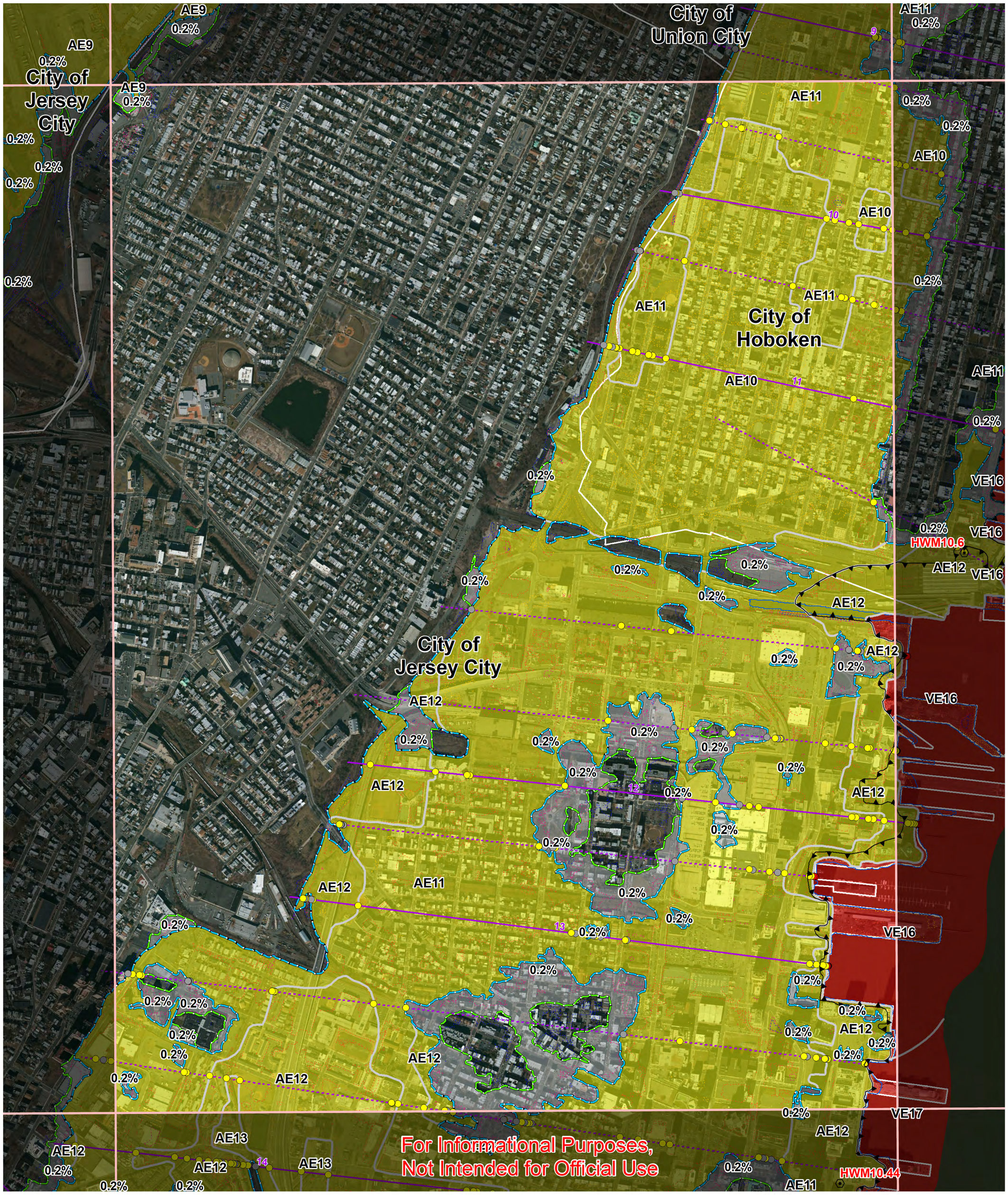
Hudson County, NJ
Preliminary Work Map



0 0.125 0.25 0.5 0.75 1 Miles

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary
- Elevation: 4, 8, 12, 16

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Panel 0106

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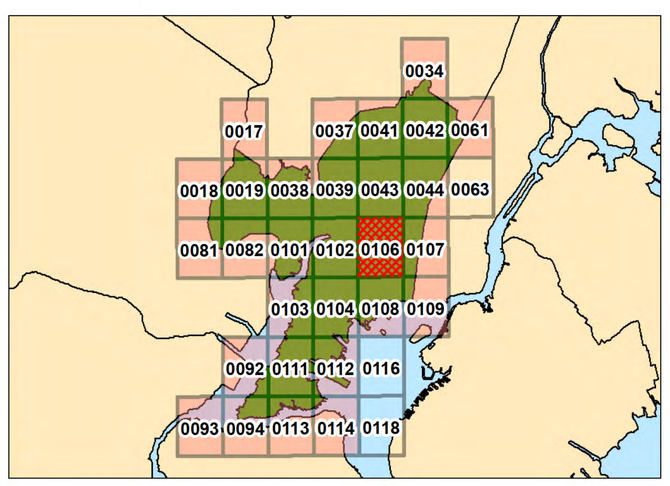

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Hudson County, NJ
Preliminary Work Map

Miles

0 0.125 0.25 0.5 0.75 1

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
- AE
- VE
- AO
- Shaded X (0.2% Floodplain)
- Hurricane Sandy High Water Mark (HWM)
- Published Transects
- Mapping Transects
- Shoreline
- Political Boundary

Transect Station: AE, VE, X

Elevation: 4, 8, 12, 16

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Panel 0107

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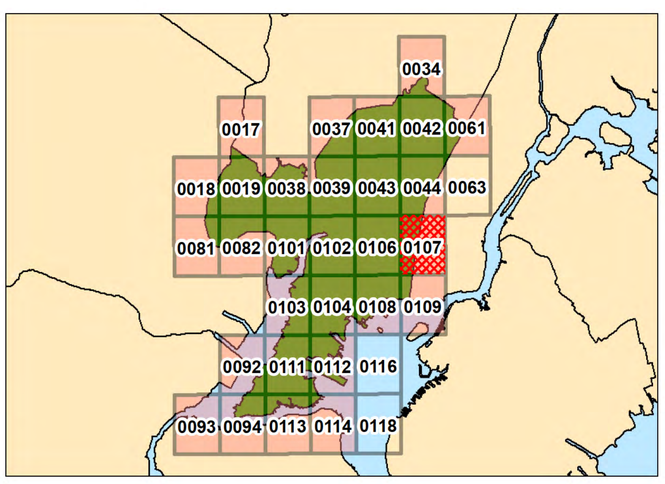

Hudson County, NJ
Preliminary Work Map

Miles
0 0.125 0.25 0.5 0.75 1

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
- LiMWA
- Transect Station
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Panel 0108

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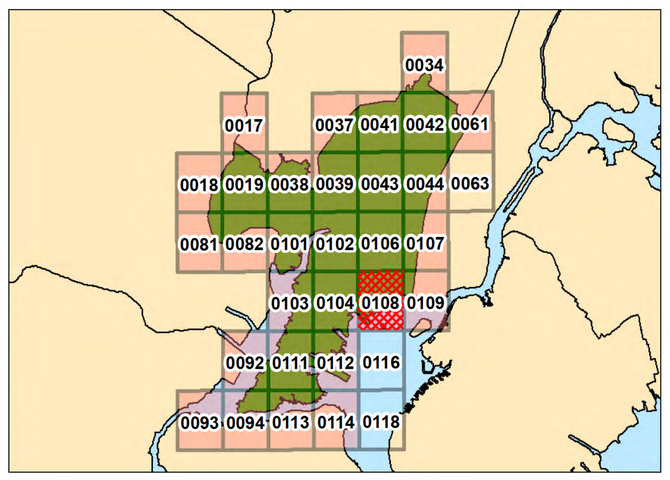

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Hudson County, NJ
Preliminary Work Map

0 0.125 0.25 0.5 0.75 1 Miles

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
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  - 16

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Panel 0109

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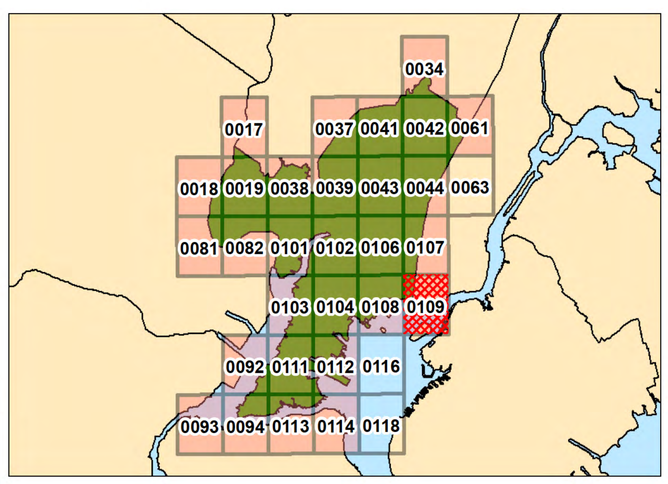

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Hudson County, NJ
Preliminary Work Map

0 0.125 0.25 0.5 0.75 1 Miles

Flood Hazard Information

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Panel 0111

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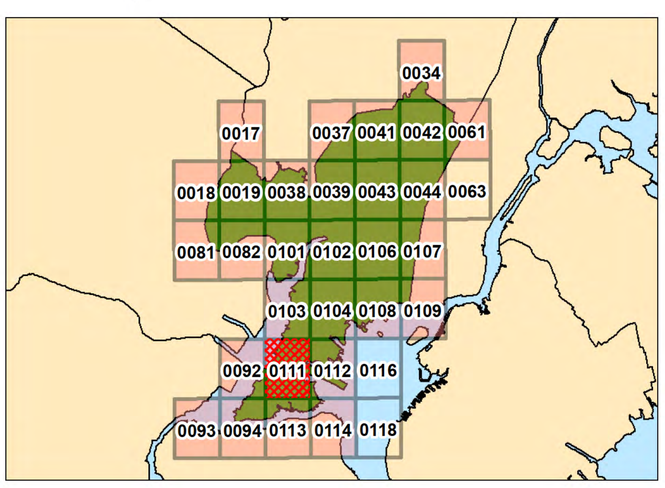

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Hudson County, NJ
Preliminary Work Map

0 0.125 0.25 0.5 0.75 1 Miles

Flood Hazard Information

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  - 16

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Panel 0112

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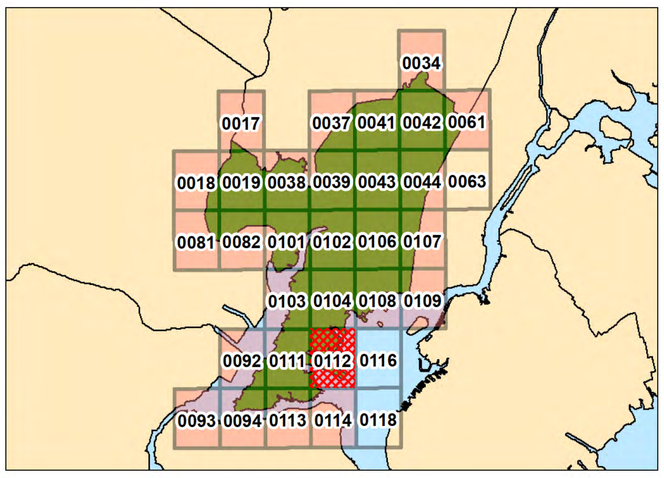

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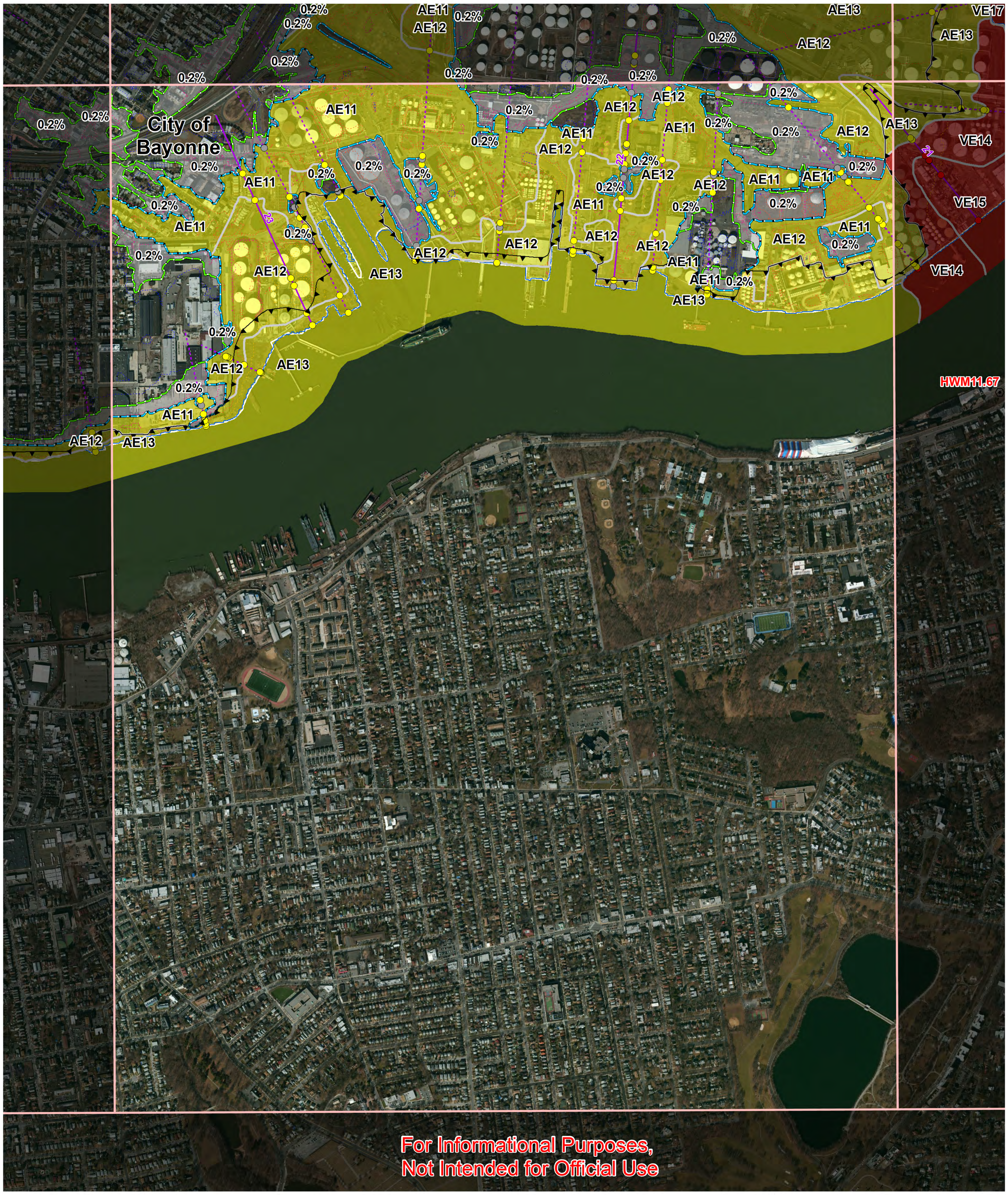
Hudson County, NJ
Preliminary Work Map



Miles
0 0.125 0.25 0.5 0.75 1

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
- PFD Line
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Panel 0113

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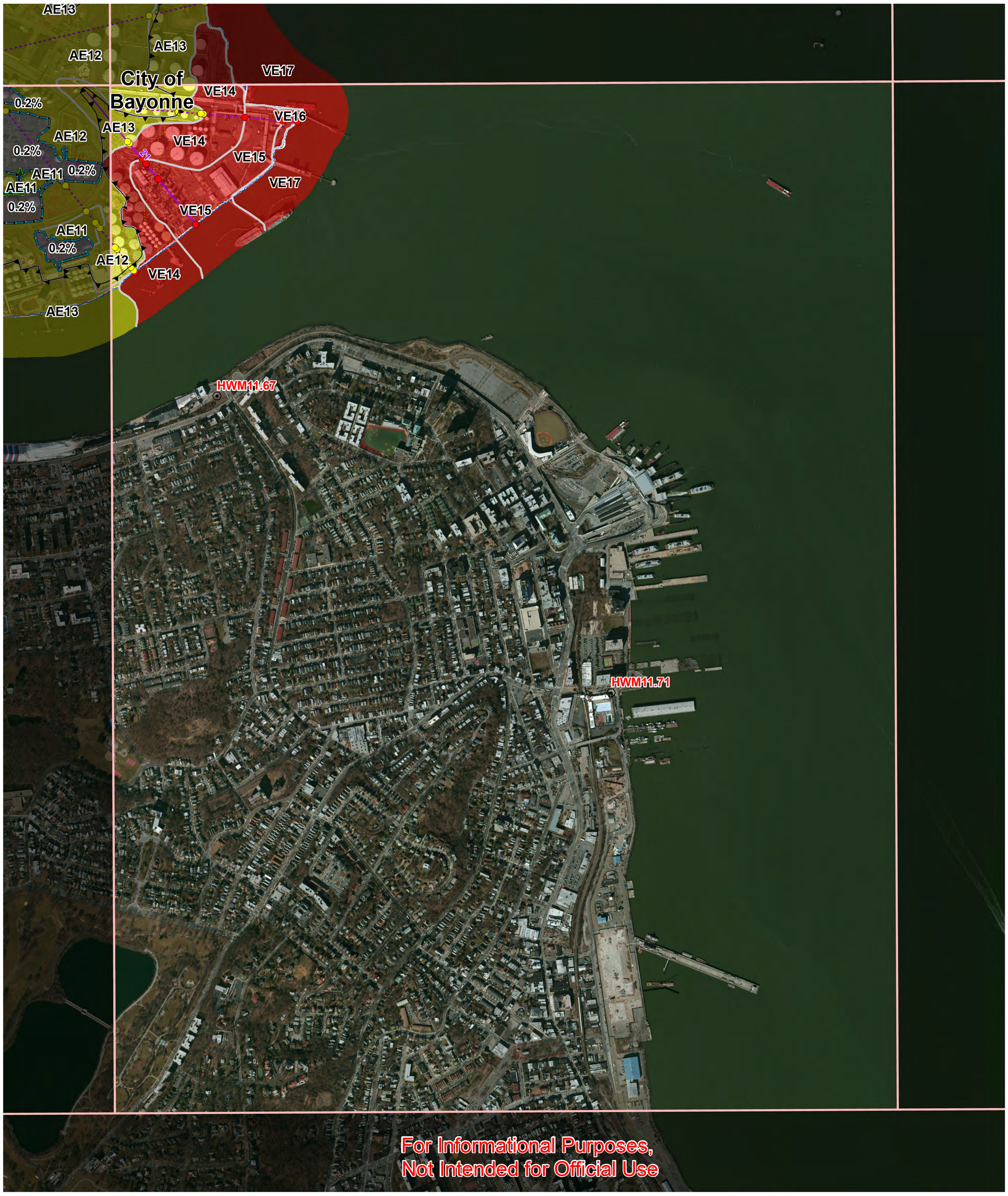
Hudson County, NJ
Preliminary Work Map



Miles

0 0.125 0.25 0.5 0.75 1

Flood Hazard Information

- 0.2% Annual Chance Boundary
- 1% Annual Chance Boundary
- Gutter Line
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Panel 0114

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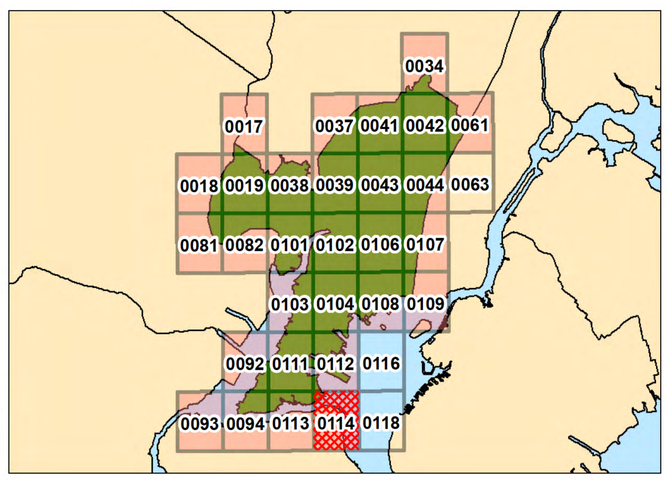

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