

U.S. Department of the Interior
National Park Service
Natural Resource Stewardship and Science Directorate
Geologic Resources Division



Gateway National Recreation Area

GRI Ancillary Map Information Document

Produced to accompany the Geologic Resources Inventory (GRI) Digital Geologic Data
for Gateway National Recreation Area

gate_geomorphology.pdf

Version: 9/16/2016

Geologic Resources Inventory Map Document for Gateway National Recreation Area

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Geologic Resources Inventory Map Document



Gateway National Recreation Area, New York and New Jersey

Document to Accompany Digital Geologic-GIS Data

[gate_geomorphology.pdf](#)

Version: 9/16/2016

This document has been developed to accompany the digital geologic-GIS data developed by the Geologic Resources Inventory (GRI) program for Gateway National Recreation Area, New York and New Jersey (GATE).

Attempts have been made to reproduce all aspects of the original source products, including the geologic units and their descriptions, geologic cross sections, the geologic report, references and all other pertinent images and information contained in the original publication.

This document contains the following information:

- 1). **About the NPS Geologic Resources Inventory Program** – A brief summary of the Geologic Resources Inventory (GRI) Program and its products. Included are web links to the GRI GIS data model, and to the GRI products page where digital geologic-GIS datasets, scoping reports and geology reports are available for download. In addition, web links to the NPS Data Store and GRI program home page, as well as contact information for the GRI coordinator, are also present.
- 2). **GRI Digital Maps and Source Citations** – A listing of all GRI digital geologic-GIS maps produced for this project along with sources used in their completion. In addition, a brief explanation of how each source map was used is provided.
- 3). **Index Map of Geomorphological Data** - An index map showing geomorphologic data coverage.
- 4). **Post-Hurricane Sandy Geomorphological Map**
 - a) **Map Unit Listing** – A listing of all geomorphic map units present on the post-Hurricane Sandy map.
 - b) **Map Unit Descriptions** – Descriptions for all geomorphic map units that are present on the post-Hurricane Sandy map.
 - c) **Ancillary Source Map Information** – Additional source map information present on post-Hurricane Sandy source map.

5). Pre-Hurricane Sandy Geomorphological Map

a) **Map Unit Listing** – A listing of all geomorphic map units present on the pre-Hurricane Sandy map.

b) **Map Unit Descriptions** – Descriptions for all geomorphic map units that are present on the pre-Hurricane Sandy map.

c) **Ancillary Source Map Information** – Additional source map information present on pre-Hurricane Sandy source map.

6). New York Harbor Islands Geomorphological Map

a) **Map Unit Listing** – A listing of all geomorphic map units present on the New York Harbor Islands map.

b) **Map Unit Descriptions** – Descriptions for all geomorphic map units that are present on the New York Harbor Islands map.

c) **Ancillary Source Map Information** – Additional source map information present on New York Harbor Islands map.

7). **GRI Source Map Information** – Additional source map information presented by source map. For each source map this may include a stratigraphic column, index map, map legend and/or map notes.

a) **Geomorphologic Maps of Gateway National Recreation Area**

8). **GRI Digital Data Credits** – GRI digital geologic-GIS data and ancillary map information document production credits.

For information about using GRI digital geologic-GIS data contact:

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About the NPS Geologic Resources Inventory Program

Background

Recognizing the interrelationships between the physical (geology, air, and water) and biological (plants and animals) components of the Earth is vital to understanding, managing, and protecting natural resources. The Geologic Resources Inventory (GRI) helps make this connection by providing information on the role of geology and geologic resource management in parks.

Geologic resources for management consideration include both the processes that act upon the Earth and the features formed as a result of these processes. Geologic processes include: erosion and sedimentation; seismic, volcanic, and geothermal activity; glaciation, rockfalls, landslides, and shoreline change. Geologic features include mountains, canyons, natural arches and bridges, minerals, rocks, fossils, cave and karst systems, beaches, dunes, glaciers, volcanoes, and faults.

The Geologic Resources Inventory aims to raise awareness of geology and the role it plays in the environment, and to provide natural resource managers and staff, park planners, interpreters, researchers, and other NPS personnel with information that can help them make informed management decisions.

The GRI team, working closely with the Colorado State University (CSU) Department of Geosciences and a variety of other partners, provides more than 270 parks with a geologic scoping meeting, digital geologic-GIS map data, and a park-specific geologic report.

Products

Scoping Meetings: These park-specific meetings bring together local geologic experts and park staff to inventory and review available geologic data and discuss geologic resource management issues. A summary document is prepared for each meeting that identifies a plan to provide digital map data for the park.

Digital Geologic Maps: Digital geologic maps reproduce all aspects of traditional paper maps, including notes, legend, and cross sections. Bedrock, surficial, and special purpose maps such as coastal or geologic hazard maps may be used by the GRI to create digital Geographic Information Systems (GIS) data and meet park needs. These digital GIS data allow geologic information to be easily viewed and analyzed in conjunction with a wide range of other resource management information data.

For detailed information regarding GIS parameters such as data attribute field definitions, attribute field codes, value definitions, and rules that govern relationships found in the data, refer to the NPS Geology-GIS Data Model document available at: <http://science.nature.nps.gov/im/inventory/geology/GeologyGISDataModel.cfm>

Geologic Reports: Park-specific geologic reports identify geologic resource management issues as well as features and processes that are important to park ecosystems. In addition, these reports present a brief geologic history of the park and address specific properties of geologic units present in the park.

For a complete listing of Geologic Resource Inventory products and direct links to the download site visit the GRI publications webpage http://www.nature.nps.gov/geology/inventory/gre_publications.cfm

GRI geologic-GIS data is also available online at the NPS Data Store Search Application: <http://irma.nps.gov/App/Reference/Search>. To find GRI data for a specific park or parks select the appropriate park

(s), enter "GRI" as a Search Text term, and then select the Search Button.

For more information about the Geologic Resources Inventory Program visit the GRI webpage: <http://www.nature.nps.gov/geology/inventory>, or contact:

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The Geologic Resources Inventory (GRI) program is funded by the National Park Service (NPS) Inventory and Monitoring (I&M) Division.

GRI Digital Maps and Source Map Citations

The GRI digital geomorphological-GIS maps for Gateway National Recreation Area, New York and New Jersey (GATE):

Digital Post-Hurricane Sandy Geomorphological-GIS Maps of the Sandy Hook, Jamaica Bay and Staten Island Units, Gateway NRA, New Jersey and New York (GRI MapCode GATE_post-sandy)

The source map (listed below) depicts "post-Hurricane Sandy" geomorphology, and was produced using 2012 ("post-Hurricane Sandy") images and LiDAR data. The GRI used the full extent of the source digital GIS data, and incorporated prominent components of the provided source map and report (e.g., unit colors and unit descriptions) into the GRI digital geologic-GIS product.

Source Map:

Psuty, N.P., Schmelz, W., Greenberg, J., and Spahn, A., 2015, Geomorphological Map for Gateway National Recreation Area (Post-Hurricane Sandy): Rutgers University, Institute of Marine and Coastal Sciences, unpublished digital data and map, scale 1:6,000. (*GRI Source Map ID 76053*) ([post-Hurricane Sandy Geomorphologic Maps of Gateway National Recreation Area, New York and New Jersey](#)).

The following 3 maps are extracts from the above source map.

Digital Post-Hurricane Sandy Geomorphological-GIS Map of the Jamaica Bay Unit, Gateway NRA, New York (GRI MapCode JABA_post-sandy)

Digital Post-Hurricane Sandy Geomorphological-GIS Map of the Staten Island Unit, Gateway NRA, New York (GRI MapCode STIS_post-sandy)

Digital Post-Hurricane Sandy Geomorphological-GIS Map of the Sandy Hook Unit, Gateway NRA, New Jersey (GRI MapCode SAHO_post-sandy)

Digital Pre-Hurricane Sandy Geomorphological-GIS Maps of the Sandy Hook, Jamaica Bay and Staten Island Units, Gateway NRA, New Jersey and New York (GRI MapCode GATE_pre-sandy)

This dataset supersedes the previous GRI Geomorphologic-GIS dataset for Gateway National Recreation Area. The source map (listed below) depicts "pre-Hurricane Sandy" geomorphology, and was produced using 2011 ("pre-Hurricane Sandy") images and LiDAR data. The GRI used the full extent of the source digital GIS data, and incorporated prominent components of the provided source map and report (e.g., unit colors and unit descriptions) into the GRI digital geologic-GIS product.

Source Map:

Psuty, N.P., McLoughlin, S.M., Schmelz, W., and Spahn, A., 2014, Geomorphological Map of Gateway National Recreation Area (Pre-Hurricane Sandy), New York and New Jersey: Rutgers University, Institute of Marine and Coastal Sciences, unpublished digital data and map, scale 1:6,000. (*GRI Source Map ID 75949*) ([pre-Hurricane Sandy Geomorphologic Maps of Gateway National Recreation Area, New York and New Jersey](#)).

The following 3 maps are extracts from the above source map.

Digital Pre-Hurricane Sandy Geomorphological-GIS Map of the Jamaica Bay Unit, Gateway

NRA, New York (*GRI MapCode JABA_pre-sandy*)

Digital Pre-Hurricane Sandy Geomorphological-GIS Map of the Staten Island Unit, Gateway NRA, New York (*GRI MapCode STIS_pre-sandy*)

Digital Pre-Hurricane Sandy Geomorphological-GIS Map of the Sandy Hook Unit, Gateway NRA, New Jersey (*GRI MapCode SAHO_pre-sandy*)

Digital Geomorphological-GIS Map of the New York Harbor Islands (Governors Island, Ellis Island, and Liberty Island Units), New York (*GRI MapCode NYIS*)

Per communication with source map authors, no significant change in the geomorphology of the New York Harbor Islands from Hurricane Sandy was recorded. Pre- and post-Hurricane Sandy versions were not required.

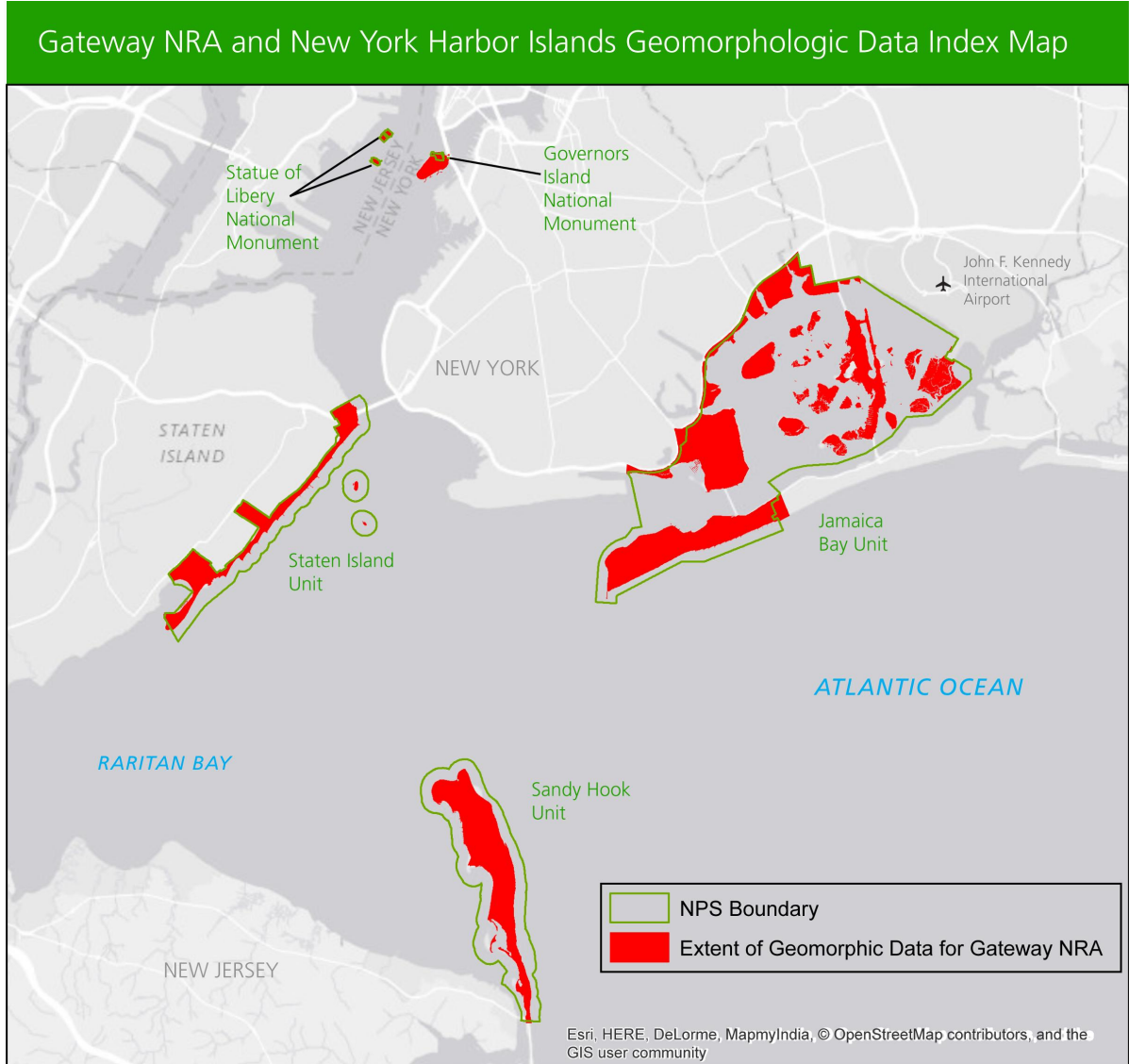
Source Map:

Psuty, N.P., Hudacek, W., Schmelz, W., and Spahn, A., 2015, Geomorphological Map for Governors Island, Ellis Island, and Liberty Island Upper New York Bay: Rutgers University, Institute of Marine and Coastal Sciences, unpublished digital data and map, scale 1:12,000. (*GRI Source Map ID 76080*) ([Geomorphologic Map of New York Harbor Islands, New York](#)).

Additional information pertaining to each source map is also presented in the GRI Source Map Information (GATEMAP) table included with the GRI geology-GIS data.

Index Map of Geomorphologic Data

Index map showing extent of geomorphological data coverage:



Map graphic produced by the James Winter (Colorado State University).

Post-Hurricane Sandy Geomorphological Map

Map Unit List (post-Hurricane Sandy)

The post-Hurricane Sandy geomorphologic units present in the digital geologic-GIS data produced for Gateway National Recreation Area, New York and New Jersey (GATE) are listed below. Units are listed with their assigned unit symbol and unit name (e.g., Rps - Artificial planar surface). Units are generally listed from youngest to oldest. No description for water is provided. Information about each geologic unit is also presented in the GRI Geomorphologic Unit Information (GATEUNIT) table included with the GRI geology-GIS data. Some source unit symbols, names and/or ages may have been changed in this document and in the GRI digital geologic-GIS data. This was done if a unit was considered to be the same unit as one or more units on other source maps used for this project, and these unit symbols, names and/or ages differed. In this case a single unit symbol and name, and the unit's now recognized age, was adopted. Unit symbols, names and/or ages in a unit descriptions, or on a correlation of map units or other source map figure were not edited. If a unit symbol, name or age was changed by the GRI, the unit's source map symbol, name and/or age appears with the unit's source map description.

Geomorphologic Units

Recent Deposits

Anthropogenic Features

- [Rps](#) - Artificial planar surface
- [Rsr](#) - Elevated surface/ridge
- [Rbu](#) - Bulkhead
- [Rpd](#) - Pier/dock/boardwalk
- [Rjg](#) - Jetty/groin
- [Rs](#) - Seawall
- [Rp](#) - Pond

Holocene Deposits

Active Coastline

- [Hbe](#) - Beach
- [Hfd](#) - Active foredune
- [Hsf](#) - Sand flat
- [Hwl](#) - Wetland
- [Hwo](#) - Washover

Abandoned Coastline

- [Hfda](#) - Major abandoned foredune
- [Hfdi](#) - Minor abandoned foredune
- [His](#) - Abandoned inter-ridge swale
- [Hbd](#) - Abandoned back dune slope
- [Hcb](#) - Abandoned cliff/bluff/scarp

Pleistocene Deposits

Glacial Deposits

- [PEtm](#) - Terminal moraine
- [PEop](#) - Outwash plain

Map Unit Descriptions (post-Hurricane Sandy)

Descriptions of all post-Hurricane Sandy geomorphologic map units, generally listed from youngest to oldest, are presented below.

Anthropogenic

Rps - Artificial planar surface (Recent)

Conceptual Basis

A human-made flat or planar surface that has been leveled to site a structure such as a highway or building. Underlying topography is destroyed or covered.

Physical Description and Identification

Elevation of surface is nearly or completely homogeneous and level. Abrupt interruption of adjacent naturally occurring topography. Boundary of surface is often linear and clearly visible on the orthophotos.

(GRI Source Map ID 76053) ([post-Hurricane Sandy Geomorphologic Maps of Gateway National Recreation Area, New York and New Jersey](#)).

Rsr - Elevated surface/ridge (Recent)

Conceptual Basis

Area where the land has been intentionally elevated by humans for the construction of buildings or to assist in military operations. Such features include gun and mortar batteries built into dunes or disguised as dunes, as well as sites constructed to conceal missile locations.

Physical Description and Identification

Marked by variability in elevation, and often with the appearance of a dune or large topographic high. Specific sites can be identified from orthophotos and their boundaries determined based on LiDAR. They do not display the same homogeneity in elevation that is evident with cultural planar surfaces.

(GRI Source Map ID 76053) ([post-Hurricane Sandy Geomorphologic Maps of Gateway National Recreation Area, New York and New Jersey](#)).

Rbu - Bulkhead (Recent)

Conceptual Basis

An engineered structure built to stabilize the shoreline, reduce sediment erosion, and protect any existing development. A bulkhead is a vertical wall of wood, metal, or concrete, defining an edge in the landform feature.

Physical Description and Identification

Erosion control structures are primarily identified from orthophotographs. These structures have been constructed in many parts of the barrier spit over the course of its modern use. They are usually at the water's edge and are defining the margin of a landform or an anthropogenic feature.

(GRI Source Map ID 76053) ([post-Hurricane Sandy Geomorphologic Maps of Gateway National Recreation Area, New York and New Jersey](#)).

Rpd - Pier/dock/boardwalk (Recent)

Conceptual Basis

A structure built into the water for the mooring of ships and boats, or over the land to accommodate pedestrians.

Physical Description and Identification

Projections into the water, either as single units or in groups to constitute a marina or boat basin. Elevated walkways near the beach.

(GRI Source Map ID 76053) ([post-Hurricane Sandy Geomorphologic Maps of Gateway National Recreation Area, New York and New Jersey](#)).

Rjg - Jetty/groin (Recent)

Conceptual Basis

An engineered structure built to stabilize the shoreline, reduce sediment erosion, and protect any existing development. A jetty is a hard structure at an inlet or downdrift terminus of a beach, meant to prevent sediment from entering a navigation channel. A groin is in the beach, perpendicular to shoreline, reducing alongshore transport.

Physical Description and Identification

Erosion control structures are primarily identified from orthophotographs. These structures have been constructed in many parts of the barrier spit over the course of its modern use. They are usually at the water's edge and are defining the margin of a landform or an anthropogenic feature.

(GRI Source Map ID 76053) ([post-Hurricane Sandy Geomorphologic Maps of Gateway National Recreation Area, New York and New Jersey](#)).

Rs - Seawall (Recent)

Conceptual Basis

An engineered structure built to stabilize the shoreline, reduce sediment erosion, and protect any existing development. A seawall is a dike constructed to rise above the landform and prevent storm surge from penetrating inland.

Physical Description and Identification

Erosion control structures are primarily identified from orthophotographs. These structures have been constructed in many parts of the barrier spit over the course of its modern use. They are usually at the water's edge and are defining the margin of a landform or an anthropogenic feature.

(GRI Source Map ID 76053) ([post-Hurricane Sandy Geomorphologic Maps of Gateway National Recreation Area, New York and New Jersey](#)).

Rp - Pond (Recent)

Conceptual Basis

Area of open water within the boundaries of the barrier spit or adjacent to estuarine margins. Often occurs as small water bodies within wetlands.

Physical Description and Identification

Distinctly visible on orthophotos as dark sites among topography. Only water bodies identified at map

scale are delineated in this category.

(GRI Source Map ID 76053) ([post-Hurricane Sandy Geomorphologic Maps of Gateway National Recreation Area, New York and New Jersey](#)).

Active Coastal

Hbe - Beach (Holocene)

Conceptual Basis

Wave-deposited accumulation of sediment, specifically the seaward portion of a beach profile between the low tide line and the upper limit of storm wave action.

Physical Description and Identification

Area of low, nearly planar elevation exposed to waves on oceanside and bayside margins of the barrier spits. A very prominent feature that tends to be broad, continuous, and have sparse to no vegetation. Extends from the lowest tide level to the toe of the active foredune.

(GRI Source Map ID 76053) ([post-Hurricane Sandy Geomorphologic Maps of Gateway National Recreation Area, New York and New Jersey](#)).

Hfd - Active foredune (Holocene)

Conceptual Basis

Ridge formed by wind- and water-deposited sand at the inland margin of a beach, parallel to the coastline. It is vegetated by pioneer plant species that trap sediment. The foredune is actively participating in sediment exchange with the beach.

Physical Description and Identification

A continuous, linear feature of elevated topography (positive relief) that is parallel to the shoreline and immediately inland of the oceanside or bayside beach. Foredunes may be irregular in areas of dissection by wind and/or water.

(GRI Source Map ID 76053) ([post-Hurricane Sandy Geomorphologic Maps of Gateway National Recreation Area, New York and New Jersey](#)).

Hsf - Sand flat (Holocene)

Conceptual Basis

A relatively level, low relief and low elevation sandy area formed and modified by tidal flows in protected areas, often the inter-tidal extension of beaches.

Physical Description and Identification

Subtle, planar feature that is often narrow and discontinuous, in the vicinity of the beach, and has sparse to no vegetation. Usually occurring on the bayside of the barrier spit, often forming on the margin of a wetland.

(GRI Source Map ID 76053) ([post-Hurricane Sandy Geomorphologic Maps of Gateway National Recreation Area, New York and New Jersey](#)).

Hwl - Wetland (Holocene)

Conceptual Basis

A general term describing swamps and marshes in areas of very low elevation. Often found in areas sheltered from ocean waves such as the bayside of a barrier system or on isolated islands within a bay.

Physical Description and Identification

A flat surface in the intertidal zone characterized by wetland vegetation identified through the use of vegetation maps and aerial imagery. Drainage ditches are often located in wetland areas.

(GRI Source Map ID 76053) ([post-Hurricane Sandy Geomorphologic Maps of Gateway National Recreation Area, New York and New Jersey](#)).

Abandoned Coastal

Hwo - Washover (Holocene)

Conceptual Basis

Feature caused by an episodic storm event that penetrated inland of the foredune ridge. A relatively flat blanket of sediment deposited in place of or on top of previously existing features or planar surfaces, often expressed in the landscape as fan-shaped deposit.

Physical Description and Identification

May be identified as an uncharacteristic break in continuous, shore-parallel linear features of positive relief such as the active foredune or abandoned foredune. It may be a fan-shaped positive elevation on a lower planar surface. Often visible on orthophotography as bare sand. The previously existing dunes may be retained adjacent to the washover fan as low, hummocky dune features.

(GRI Source Map ID 76053) ([post-Hurricane Sandy Geomorphologic Maps of Gateway National Recreation Area, New York and New Jersey](#)).

Hfda - Major abandoned foredune (Holocene)

Conceptual Basis

A previously active foredune that is inland of the active foredune and is no longer in active sediment exchange with the beach. Often found parallel to or adjacent to an active foredune. May have been reworked by winds into parabolic, hummocky, or dissected features.

Physical Description and Identification

A former foredune ridge that may be generally linear and intact or dissected, depending on the age of the feature and the influence of wind, waves, and human activity. Usually in relatively close proximity to the active foredune ridge; i.e. ridges not separated by a major interdune swale. A dune is considered major if its ridge has an elevation above 4 meters.

(GRI Source Map ID 76053) ([post-Hurricane Sandy Geomorphologic Maps of Gateway National Recreation Area, New York and New Jersey](#)).

Hfdi - Minor abandoned foredune (Holocene)

Conceptual Basis

A previously active foredune that is no longer in active sediment exchange with the beach. Often found parallel or adjacent to active foredune. May have been reworked by winds into parabolic, hummocky, or dissected features. A minor abandoned dune either did not fully develop before being abandoned or has

since lost elevation by the reworking of winds.

Physical Description and Identification

An inland sand ridge that may be linear and intact or dissected, depending on the age of the feature and the influence of wind and other natural and/or cultural activities. Usually in relatively close proximity to the active foredune ridge; i.e. ridges not separated by a major interdune swale. A dune is considered minor if its ridge has an elevation below 4 meters.

(GRI Source Map ID 76053) ([post-Hurricane Sandy Geomorphologic Maps of Gateway National Recreation Area, New York and New Jersey](#)).

His - Abandoned inter-ridge swale (Holocene)

Conceptual Basis

A topographical low area between shore-parallel dune ridges that forms during time of abundant sediment supply (shoreline progradation), and occupies the space between the sequential, parallel foredune ridges.

Physical Description and Identification

Swales are the continuous and low areas that occur between the sequential, parallel foredune ridges, usually parallel to the active shoreline.

(GRI Source Map ID 76053) ([post-Hurricane Sandy Geomorphologic Maps of Gateway National Recreation Area, New York and New Jersey](#)).

Hbd - Abandoned back dune slope (Holocene)

Conceptual Basis

Low area immediately inland of the leeward slope of the inlandmost dune ridge. It is related to the foundation of the dune-forming processes.

Physical Description and Identification

Located on the inland margin of a dune ridge or series of dune ridges. Elevation and slope are generally low and tend to decrease toward the bayside, i.e., slopes away from the dune ridge toward the water.

(GRI Source Map ID 76053) ([post-Hurricane Sandy Geomorphologic Maps of Gateway National Recreation Area, New York and New Jersey](#)).

Glacial Features

PEtm - Terminal moraine (Pleistocene)

Conceptual Basis

Glacial deposit at the margin of the extent of the glacial advance. Consists of unsorted till deposited on earlier landscape.

Physical Description and Identification

A large hummocky ridge, usually an abrupt change in topography, rising quickly to the greatest heights in the area.

(GRI Source Map ID 76053) ([post-Hurricane Sandy Geomorphologic Maps of Gateway National Recreation Area, New York and New Jersey](#)).

PEop - Outwash plain (Pleistocene)

Conceptual Basis

A broad surface emanating from the terminal moraine. Created by meltwaters discharging beyond the terminal moraine and depositing sediment by glacio-fluvial processes.

Physical Description and Identification

A low planar surface sloping downward beyond the margins of the terminal moraine. It is frequently fan-shaped, leading from gaps or low areas in the terminal moraine. May have kettle holes caused by stranded blocks of ice.

(GRI Source Map ID 76053) ([post-Hurricane Sandy Geomorphologic Maps of Gateway National Recreation Area, New York and New Jersey](#)).

Ancillary Source Map Information

Post-Hurricane Sandy Geomorphological Map

Psuty, N.P., Schmelz, W., Greenberg, J., and Spahn, A., 2015, Geomorphological Map for Gateway National Recreation Area (Post-Hurricane Sandy): Rutgers University, Institute of Marine and Coastal Sciences, unpublished digital data, 1:6,000 scale. (GRI Source Map ID 76053)

Map Legend

Glacial Features	Coastal Features	Back dune slope	Anthropogenic Features	
 Terminal moraine	 Beach	 Cliff/Bluff/Scarp	 Artificial planar surface	 Seawall
 Outwash plain	 Foredune	 Washover	 Elevated surface/ridge	 Jetty/Groin
	 Major abandoned foredune	 Sand flat	 Temporary surface feature	 Major road
	 Minor abandoned foredune	 Pond	 Bulkhead/Riprap	 Street
	 Inter-ridge swale	 Wetland	 Pier/Dock/Boardwalk	 Path

(GRI Source Map ID 76053) ([post-Hurricane Sandy Geomorphologic Maps of Gateway National Recreation Area, New York and New Jersey](#)).

Report

The report that accompanied the source digital data and map for Gateway NRA is presently in draft format awaiting publication as a NPS Natural Resource Report.

Psuty, N. P, W. Schmelz, J. Greenberg, and A. Spahn, 2015. Development of the Geomorphological Map for Gateway National Recreation Area (Post-Hurricane Sandy): 1. Principal Characteristics and Components; 2. Metrics of Change. Natural Resource Report NPS/NRPC/GRD/NRR—2015/____. National Park Service, Ft. Collins, Colorado.

Once published, the GRI Program plans to include this report with this document. Users can always search the NPS IRMA Data Store, <https://irma.nps.gov/DataStore/>, should the report be published, but not yet included with this document.

Pre-Hurricane Sandy Geomorphological Map

Map Unit List (pre-Hurricane Sandy)

The pre-Hurricane Sandy geomorphologic units present in the digital geologic-GIS data produced for Gateway National Recreation Area, New York and New Jersey (GATE) are listed below. Units are listed with their assigned unit symbol and unit name (e.g., Rps - Artificial planar surface). Units are generally listed from youngest to oldest. No description for water is provided. Information about each geologic unit is also presented in the GRI Geomorphologic Unit Information (GATEUNIT) table included with the GRI geology-GIS data. Some source unit symbols, names and/or ages may have been changed in this document and in the GRI digital geologic-GIS data. This was done if a unit was considered to be the same unit as one or more units on other source maps used for this project, and these unit symbols, names and/or ages differed. In this case a single unit symbol and name, and the unit's now recognized age, was adopted. Unit symbols, names and/or ages in a unit descriptions, or on a correlation of map units or other source map figure were not edited. If a unit symbol, name or age was changed by the GRI, the unit's source map symbol, name and/or age appears with the unit's source map description.

Geomorphologic Units

Recent Deposits

Anthropogenic Features

[Rps](#) - Artificial planar surface

[Rsr](#) - Elevated surface/ridge

[Rbu](#) - Bulkhead

[Rpd](#) - Pier/dock

[Rjg](#) - Jetty/groin

[Rs](#) - Seawall

[Rp](#) - Pond

Holocene Deposits

Active Coastline

[Hbe](#) - Beach

[Hfd](#) - Foredune

[Hsf](#) - Sand flat

[Hwl](#) - Wetland

Abandoned Coastline

[Hfda](#) - Major abandoned foredune

[Hfdi](#) - Minor abandoned foredune

[His](#) - Inter-ridge swale

[Hbd](#) - Back dune slope

[Hcb](#) - Cliff/bluff/scarp

Pleistocene Deposits

Glacial Deposits

[PEtm](#) - Terminal moraine

[PEop](#) - Outwash plain

Map Unit Descriptions (pre-Hurricane Sandy)

Descriptions of all pre-Hurricane Sandy geomorphologic map units, generally listed from youngest to oldest, are presented below.

Anthropogenic

Rps - Artificial planar surface (Holocene)

Conceptual Basis

A human-made flat or planar surface that has been leveled to site a structure such as a highway or building. Underlying topography is destroyed or covered up.

Physical Description and Identification

Elevation of surface is nearly or completely homogeneous and level. Abrupt interruption of adjacent naturally occurring topography. Boundary of surface is often clearly visible on the orthophotos.

(GRI Source Map ID 75949) ([pre-Hurricane Sandy Geomorphologic Maps of Gateway National Recreation Area, New York and New Jersey](#)).

Rsr - Elevated surface/ridge (Holocene)

Conceptual Basis

Area where the land has been intentionally elevated by humans for the construction of buildings or to assist in military operations. Such features include gun and mortar batteries built into dunes or disguised as dunes, as well as sites constructed to conceal missile locations.

Physical Description and Identification

Marked by variability in elevation, and often with the appearance of a dune or large topographic high. Specific sites can be identified from orthophotos and their boundaries determined based on LiDAR. They do not display the same homogeneity in elevation that is evident with cultural planar surfaces.

(GRI Source Map ID 75949) ([pre-Hurricane Sandy Geomorphologic Maps of Gateway National Recreation Area, New York and New Jersey](#)).

Rbu- Bulkhead (Holocene)

Conceptual Basis

Vertical wall of wood, metal, or concrete, defining an edge in the landform feature

Physical Description and Identification

Erosion control structures are primarily identified from orthophotographs. These structures have been constructed in many parts of the barrier spit over the course of its modern use. They are usually at the water's edge and are defining the margin of a landform or an anthropogenic feature. They are plotted in the report by Dallas et al. (2011).

(GRI Source Map ID 75949) ([pre-Hurricane Sandy Geomorphologic Maps of Gateway National Recreation Area, New York and New Jersey](#)).

Rpd - Pier/dock (Holocene)

Conceptual Basis

A structure built into the water to accommodate the mooring of ships and boats

Physical Description and Identification

Projections from the shoreline into the water, either as single units or in groups to constitute a marina or boat basin.

(GRI Source Map ID 75949) ([pre-Hurricane Sandy Geomorphologic Maps of Gateway National Recreation Area, New York and New Jersey](#)).

Rjg - Jetty/groin (Holocene)

Conceptual Basis

Jetty – hard structure at the terminus of a beach, meant to prevent sediment from entering a navigation channel;

Groin – in the beach, perpendicular to shoreline, reducing rates of alongshore transport

Physical Description and Identification

Erosion control structures are primarily identified from orthophotographs. These structures have been constructed in many parts of the barrier spit over the course of its modern use. They are usually at the water's edge and are defining the margin of a landform or an anthropogenic feature. They are plotted in the report by Dallas et al. (2013).

(GRI Source Map ID 75949) ([pre-Hurricane Sandy Geomorphologic Maps of Gateway National Recreation Area, New York and New Jersey](#)).

Rs - Seawall (Holocene)

Conceptual Basis

A dike constructed to rise above the landform and prevent storm surge from penetrating inland.

Physical Description and Identification

Erosion control structures are primarily identified from orthophotographs. These structures have been constructed in many parts of the barrier spit over the course of its modern use. They are usually at the water's edge and are defining the margin of a landform or an anthropogenic feature. They are plotted in the report by Dallas et al. (2013).

(GRI Source Map ID 75949) ([pre-Hurricane Sandy Geomorphologic Maps of Gateway National Recreation Area, New York and New Jersey](#)).

Rp - Pond (Holocene)

Conceptual Basis

Area of open water within the boundaries of the barrier spit or adjacent to estuarine margins. Often occurs as ponds within wetlands.

Physical Description and Identification

Inland water bodies are distinctly visible on orthophotos. Only water bodies visible at the map scale are delineated.

(GRI Source Map ID 75949) ([pre-Hurricane Sandy Geomorphologic Maps of Gateway National Recreation Area, New York and New Jersey](#)).

Active Coastal

Hbe - Beach (Holocene)

Conceptual Basis

Wave-deposited accumulation of sediment, specifically the bare sand area seaward of the foredune. Regularly inundated by waves during high-water phases of the tidal cycle and modest storms. Dominant direction of wave approach determines the alongshore sediment pathway.

Physical Description and Identification

Area of low, nearly planar elevation exposed to waves on oceanside and bayside margins of the barrier spits. A very prominent feature that tends to be broad, continuous, and have sparse to no vegetation. Extends from the lowest tide level to the toe of the active foredune.

(GRI Source Map ID 75949) ([pre-Hurricane Sandy Geomorphologic Maps of Gateway National Recreation Area, New York and New Jersey](#)).

Hfd - Foredune (Holocene)

Conceptual Basis

Sand ridge formed by eolian (wind-blown) and water processes at the inland margin of a beach, parallel to the coastline. Vegetated by pioneer species that help trap sediment. Dune is actively participating in seasonal sediment exchange with the beach.

Physical Description and Identification

A continuous, linear feature of elevated topography (positive relief) that is parallel to the shoreline and immediately adjacent to the beach.

(GRI Source Map ID 75949) ([pre-Hurricane Sandy Geomorphologic Maps of Gateway National Recreation Area, New York and New Jersey](#)).

Hsf - Sand flat (Holocene)

Conceptual Basis

A relatively level, low elevation (within tidal range), sandy area formed by processes other than ocean waves on beaches.

Physical Description and Identification

Subtle, linear feature that is often narrow and discontinuous, in the vicinity of the beach, and has sparse to no vegetation. Usually occurring on the bayside of the barrier spit, often forming on the margin of a wetland.

(GRI Source Map ID 75949) ([pre-Hurricane Sandy Geomorphologic Maps of Gateway National Recreation Area, New York and New Jersey](#)).

Hwl - Wetland (Holocene)

Conceptual Basis

A general term describing an area of very low elevation vegetated by saltwater, brackish water, and

freshwater plants. Often found in areas sheltered from ocean waves such as in bays, estuaries, or on the baysides of spits.

Physical Description and Identification

Wetlands are roughly approximated by areas of very low (nearly sea-level) elevation. Marsh vegetation is often distinctly visible on orthophotos. In places where the exact position of the wetland boundary is uncertain in the topography, vegetation maps may depict their extent.

(GRI Source Map ID 75949) ([pre-Hurricane Sandy Geomorphologic Maps of Gateway National Recreation Area, New York and New Jersey](#)).

Abandoned Coastal

Hfda - Major abandoned foredune (Holocene)

Conceptual Basis

A previously active foredune that is no longer in active sediment transfer with the beach. Often found parallel to or adjacent to an active foredune. May have been reworked by winds into parabolic, hummocky, or dissected features.

Physical Description and Identification

Foredune ridge may be generally linear and intact or dissected, depending on the age of the feature and the influence of wind, waves, and human activity. The original, relatively high elevation is often preserved long after the dune has been abandoned. Usually in relatively close proximity to the active foredune ridge; i.e. ridges not separated by a major interdune swale. A dune is considered major if its ridge has an elevation above 4 meters.

(GRI Source Map ID 75949) ([pre-Hurricane Sandy Geomorphologic Maps of Gateway National Recreation Area, New York and New Jersey](#)).

Hfdi - Minor abandoned foredune (Holocene)

Conceptual Basis

A previously active foredune which is no longer in active sediment transfer with the beach. Often found parallel or adjacent to active foredune. May have been reworked by winds into parabolic, hummocky, or dissected features. A minor abandoned dune either did not fully develop before being abandoned or has since lost elevation by the reworking of winds.

Physical Description and Identification

Foredune ridge may be generally linear and intact or dissected, depending on the age of the feature and the influence of wind and other natural and/or cultural activities. The original elevation is often preserved long after the dune has been abandoned. Usually in relatively close proximity to the active foredune ridge; i.e. ridges not separated by a major interdune swale. A dune is considered minor if its ridge has an elevation below 4 meters.

(GRI Source Map ID 75949) ([pre-Hurricane Sandy Geomorphologic Maps of Gateway National Recreation Area, New York and New Jersey](#)).

His - Inter-ridge swale (Holocene)

Conceptual Basis

Seaward accumulation of dune sand that forms during time of abundant sediment supply (shoreline

progradation), between the growth of sequential, parallel foredune ridges.

Physical Description and Identification

A linear hollow or topographic depression between parallel dune ridges that may be parallel to the shoreline. Swale will have lower elevation and negative relief in relationship to the adjoining dune ridges.

(GRI Source Map ID 75949) ([pre-Hurricane Sandy Geomorphologic Maps of Gateway National Recreation Area, New York and New Jersey](#)).

Hbd - Back dune slope (Holocene)**Conceptual Basis**

Area immediately inland of the inland slope of a dune system.

Physical Description and Identification

Elevation is generally low and tends to decrease toward bay side (i.e. slopes away from dune system).

(GRI Source Map ID 75949) ([pre-Hurricane Sandy Geomorphologic Maps of Gateway National Recreation Area, New York and New Jersey](#)).

Hcb - Cliff/bluff/scarp (Holocene)

No unit description available.

Glacial Features**PEtm - Terminal moraine (Quaternary and Tertiary?)****Conceptual Basis**

Glacial deposit at the margin of the extent of the glacial advance. Consists of unsorted till deposited on earlier landscape.

Physical Description and Identification

A large hummocky ridge, usually an abrupt change in topography, rising quickly to the greatest heights in the area.

(GRI Source Map ID 75949) ([pre-Hurricane Sandy Geomorphologic Maps of Gateway National Recreation Area, New York and New Jersey](#)).

PEop - Outwash plain (Quaternary and Tertiary?)**Conceptual Basis**

A broad surface emanating from the terminal moraine. Created by meltwaters discharging beyond the terminal moraine and depositing sediment by glacio-fluvial processes.

Physical Description and Identification

A low planar surface sloping downward beyond the margins of the terminal moraine. It is frequently fan-shaped, leading from gaps or low areas in the terminal moraine. May have kettle holes caused by stranded blocks of ice.

(GRI Source Map ID 75949) ([pre-Hurricane Sandy Geomorphologic Maps of Gateway National Recreation Area, New York and New Jersey](#)).

[Recreation Area, New York and New Jersey](#)).

Ancillary Source Map Information

Pre-Hurricane Sandy Geomorphological Map

Psuty, N.P., McLoughlin, S.M., Schmelz, W., and Spahn, A., 2014, Geomorphological Map of Gateway National Recreation Area, New York and New Jersey: Rutgers University, Institute of Marine and Coastal Sciences, unpublished digital data, 1:6,000 scale. (*GRI Source Map ID 75949*)

Map Legend

Glacial Features	Active Coastal Features	Abandoned Coastal Features	Anthropogenic Features
 Terminal moraine	 Beach	 Major abandoned foredune	 Artificial planar surface
 Outwash plain	 Foredune	 Minor abandoned foredune	 Elevated surface/ridge
	 Sand flat	 Inter-ridge swale	 Bulkhead/Riprap
	 Pond	 Back dune slope	 Pier/Dock/Boardwalk
	 Wetland	 Cliff/Bluff/Scarp	 Seawall
			 Major road
			 Street
			 Path
			 Jetty/Groin

(*GRI Source Map ID 75949*) ([pre-Hurricane Sandy Geomorphologic Maps of Gateway National Recreation Area, New York and New Jersey](#)).

Report

The report that accompanied the source digital data and map for Gateway NRA is presently in draft format awaiting publication as a NPS Natural Resource Report.

Psuty, N. P, S. McLoughlin, W. Schmelz, W. Robertson, and A. Spahn, 2015. Development of the Geomorphological Map for Gateway National Recreation Area: Principal Characteristics and Components. Natural Resource Report NPS/NRPC/GRD/NRR—2015/____. National Park Service, Ft. Collins, Colorado.

Once published, the GRI Program plans to include this report with this document. Users can always search the NPS IRMA Data Store, <https://irma.nps.gov/DataStore/>, should the report be published, but not yet included with this document.

New York Harbor Islands Geomorphological Map

Map Unit List (New York Harbor Islands)

The New York Harbor Islands geomorphologic units present in the digital geologic-GIS data produced for Gateway National Recreation Area, New York and New Jersey (GATE) are listed below. Units are listed with their assigned unit symbol and unit name (e.g., Rps - Artificial planar surface). Units are generally listed from youngest to oldest. No description for water is provided. Information about each geologic unit is also presented in the GRI Geomorphologic Unit Information (GATEUNIT) table included with the GRI geology-GIS data. Some source unit symbols, names and/or ages may have been changed in this document and in the GRI digital geologic-GIS data. This was done if a unit was considered to be the same unit as one or more units on other source maps used for this project, and these unit symbols, names and/or ages differed. In this case a single unit symbol and name, and the unit's now recognized age, was adopted. Unit symbols, names and/or ages in a unit descriptions, or on a correlation of map units or other source map figure were not edited. If a unit symbol, name or age was changed by the GRI, the unit's source map symbol, name and/or age appears with the unit's source map description.

Geomorphologic Units

Recent Deposits

Anthropogenic Features

[Rps](#) - Artificial planar surface

[Rbu](#) - Bulkhead

[Rpd](#) - Pier/dock

Glacial Deposits

[PEgm](#) - Ground moraine

Map Unit Descriptions (New York Harbor Islands)

Descriptions of all New York Harbor Islands geomorphologic map units, generally listed from youngest to oldest, are presented below.

Anthropogenic

Rps - Artificial planar surface (Recent)

Conceptual Basis

A human-made flat or planar surface that has been leveled to accommodate buildings, or consists of fill to enlarge the surface area of the island. Underlying topography is destroyed or covered.

Physical Description and Identification

Elevation of surface is nearly or completely homogeneous and level. It may cause an abrupt interruption of adjacent naturally occurring topography. Boundary of surface is often clearly visible on the orthophotos.

(GRI Source Map ID 76080) ([Geomorphologic Map of New York Harbor Islands, New York](#)).

Rbu - Bulkhead (Recent)

Conceptual Basis

Hardened border of the island. May be constructed of wood, metal, or concrete. Lines the entire island.

Physical Description and Identification

Straight edges of the island. Forms the boundaries of the fill as well as the ground moraine.

(GRI Source Map ID 76080) ([Geomorphologic Map of New York Harbor Islands, New York](#)).

Rpd - Pier/dock (Recent)

No unit description available.

Glacial Features

PEgm - Ground moraine (Pleistocene)

Conceptual Basis

Broad, irregular surface created by the deposits of a continental glacier atop previous topography. Deposits may be stratified or unstratified.

Physical Description and Identification

Relatively flat irregular surface sloping gradually toward the margins of the island.

(GRI Source Map ID 76080) ([Geomorphologic Map of New York Harbor Islands, New York](#)).

Ancillary Source Map Information

New York Harbor Islands Geomorphological Map

Psuty, N.P., Hudacek, W., Schmelz, W., and Spahn, A., 2015, Geomorphological Map for Governors Island, Ellis Island, and Liberty Island Upper New York Bay: Rutgers University, Institute of Marine and Coastal Sciences, unpublished digital data and map, scale 1:12,000. (GRI Source Map ID 76080)

Map Legend

Glacial Features

 Ground Moraine

Anthropogenic Features

 Artificial planar surface

 Buildings

 Pier/Dock  Roads

 Bulkhead

Extracted from: (GRI Source Map ID 76080) ([Geomorphologic Map of New York Harbor Islands, New York](#)).

Report

The report that accompanied the source digital data and map for Gateway NRA is presently in draft format awaiting publication as a NPS Natural Resource Report.

Psuty, N. P, W. Hudacek, W. Schmelz, and A. Spahn, 2015. Development of the Geomorphological Map for Governors Island, Ellis Island, and Liberty Island Upper New York Bay: Principal Characteristics and Components. Natural Resource Report NPS/NRPC/GRD/NRR—2015/____. National Park Service, Ft. Collins, Colorado.

Once published, the GRI Program plans to include this report with this document. Users can always search the NPS IRMA Data Store, <https://irma.nps.gov/DataStore/>, should the report be published, but not yet included with this document.

GRI Digital Data Credits

This document was developed and completed by James Winter (Colorado State University) for the NPS Geologic Resources Division (GRD) Geologic Resources Inventory (GRI) Program. Quality control of this document by James Chappell (Colorado State University).

The information in this document was compiled from GRI source maps, and intended to accompany the digital geologic-GIS map(s) and other digital data for Gateway National Recreation Area, New York and New Jersey (GATE) developed by James Chappell, Derek Witt, Stephanie O'Meara, James Winter and Kari Lanphier (Colorado State University) from initial work by Andrea Croskrey (National Park Service GRD). See the [GRI Digital Maps and Source Map Citations](#) section of this document for all sources used by the GRI in the completion of this document and related GRI digital geologic-GIS maps.

GRI finalization by James Chappell (Colorado State University).

GRI program coordination and scoping provided by Bruce Heise and Tim Connors (NPS GRD, Lakewood, Colorado).