Appendices

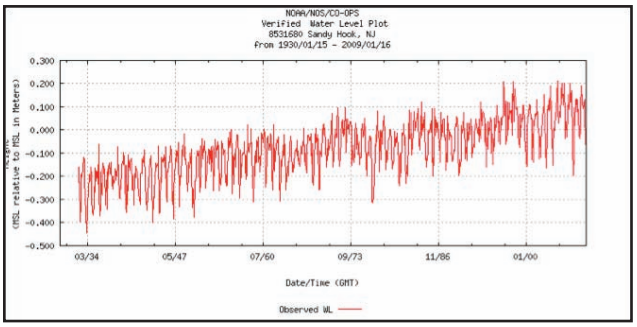
Appendix A. Water level monitoring at Gateway; Example, Sandy Hook

Water level monitoring at Gateway; Example, Sandy Hook

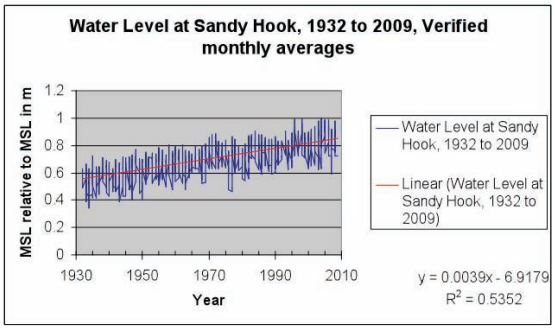
A successful monitoring network at Gateway could include tracking data from the following NOAA tidal stations:

- The Battery, Station ID 8518750
- Sandy Hook, Station ID 8531680
- Bergen Point West Reach, Station ID 8519483

This data can be used to track verified water levels over time, as well as high water levels (see Appendix: Water Level at Sandy Hook). For instance, verified mean sea level water levels at Sandy Hook from 1930 to 2009 are shown in Graph 1. Reconfiguring the data and adding a trend-line we can translate this data into Graph 2.



Graph 1. Sandy Hook sea level from 1930-2009



Graph 2. Sandy Hook trend 1930-2009

In conducting an analysis of the data trends, one finds a 3.9 mm average annual increase in sea level at Sandy Hook over 77 years. Based solely on current trends, this suggests an increase in sea level of 35.5 cm at Sandy Hook by 2100. By continuing to monitor these trends for sharp or sudden increases (outliers from the above data set), GNRA will be alerted to heightened threats of erosion or beach-loss.

Mean sea level relative to mean sea level is the most common statistic for measuring water level. However, due to the high-cost in potential damages caused by extreme water levels, Gateway should also monitor "monthly highest sea level." This data is available from NOAA tidal stations and would allow Gateway to understand the frequency and level of extreme high waters. The IPCC emphasizes the need for this data, noting that "extra-tropical storms… are likely to become more intense, but perhaps less frequent, leading to extreme wave heights in the mid latitudes" (Meehl et al., 2007, Section 10.3.6.4). Taylor et al. argue that "preparing for such events should be a priority" for all communities, and suggest appropriate preparatory actions, including "updating and revising (as required) design criteria, codes and standards for structures and facilities such as culverts, bridges, and water treatment plants as well as community disaster management planning" (2006, iii). These intense weather events will surge water levels, so tracking water level highs is crucial information in adaptation planning.

Appendix B. Gateway Ecosystem Maps

- Figure 7. Ecosystems at Sandy Hook Unit
- Figure 8. Ecosystems at Staten Island Unit
- Figure 9. Ecosystems at Jamaica Bay Unit

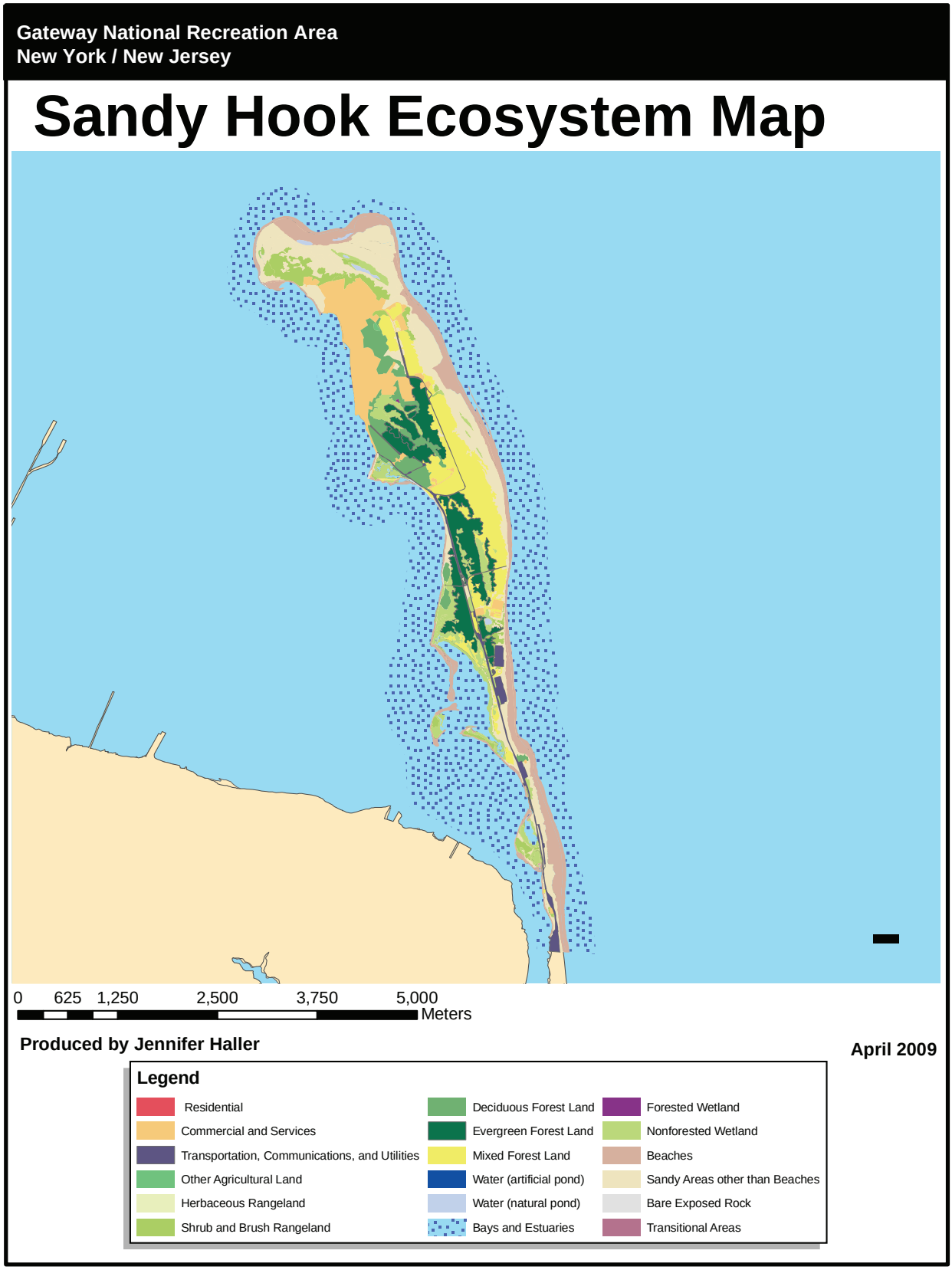


Figure 7. Ecosystems at Sandy Hook Unit

Gateway National Recreation Area
New York / New Jersey

Staten Island Ecosystem Map

0 750 1,500 3,000 4,500 6,000 Meters

Produced by Jennifer Haller

April 2009

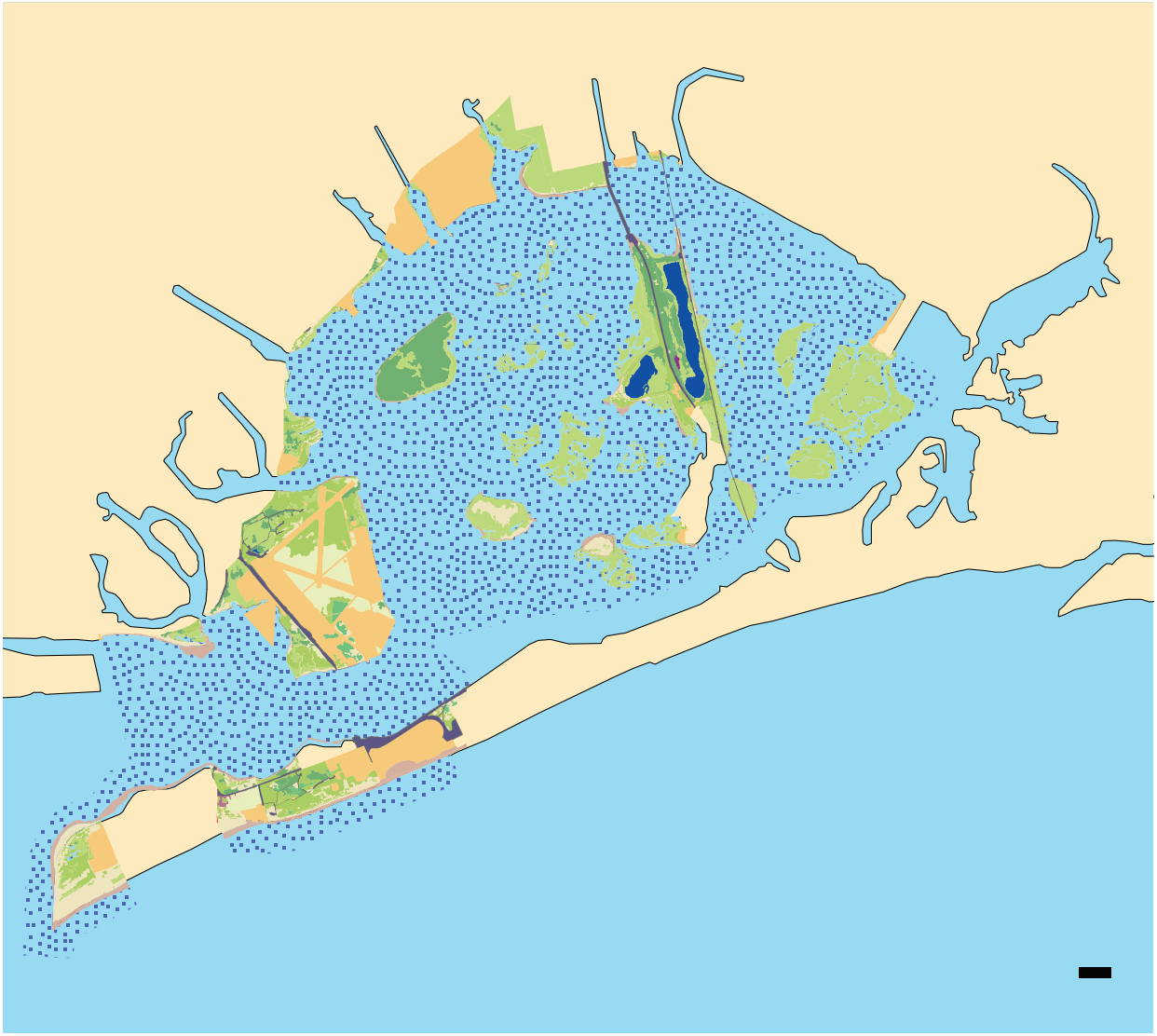
Legend

- Residential
- Commercial and Services
- Transportation, Communications, and Utilities
- Other Agricultural Land
- Herbaceous Rangeland
- Shrub and Brush Rangeland
- Deciduous Forest Land
- Evergreen Forest Land
- Mixed Forest Land
- Water (artificial pond)
- Water (natural pond)
- Bays and Estuaries
- Forested Wetland
- Nonforested Wetland
- Beaches
- Sandy Areas other than Beaches
- Bare Exposed Rock
- Transitional Areas

Figure 8. Ecosystems at Staten Island Unit

Gateway National Recreation Area
New York / New Jersey

Jamaica Bay Ecosystem Map



0 1,000 2,000 4,000 6,000 8,000
Meters

Produced by Jennifer Haller

April 2009

Legend

Residential	Deciduous Forest Land	Forested Wetland
Commercial and Services	Evergreen Forest Land	Nonforested Wetland
Transportation, Communications, and Utilities	Mixed Forest Land	Beaches
Other Agricultural Land	Water (artificial pond)	Sandy Areas other than Beaches
Herbaceous Rangeland	Water (natural pond)	Bare Exposed Rock
Shrub and Brush Rangeland	Bays and Estuaries	Transitional Areas

Figure 9. Ecosystems at Jamaica Bay Unit

Appendix C. Overview of Climate Change Adaptation Best Practices

In response to warming temperatures and extreme weather events, cities, states and countries realize the need to plan for climate change. Across the globe, community leaders are developing and implementing climate change adaptation plans. The overview of global adaptation plans provided here focuses on policies with elements relevant to Gateway, including ecosystem management and habitat, wetlands and coastline protection. Identifying climate change adaptation best-practices can assist Gateway in developing a sound adaptation strategy.

Australia: City of Melbourne

The City of Melbourne, Australia Climate Change Adaptation Strategy addresses climate change impacts on the city. Melbourne's plan identifies four key climate change risks, along with adaptation strategies to counter each risk. These risks are: drought and reduced rainfall; intense rainfall and wind events; extreme heat wave and bushfire; and sea level rise.

Strategies are divided into short term and long-term measures. Understanding climate change risks, then implementing response strategies and measuring their results, provides a useful format for an overall adaptation strategy. The report notes that all stakeholders have a shared responsibility, and that cooperation is critical. Many adaptation options address multiple risks, generating synergies. Some of the specific adaptation strategies proposed are:

- Develop stormwater harvesting and re-use to counter more frequent drought.
- Develop and Implement a Heatwave Response Action Plan.
- Future proof planning, incorporate sensible precautions and contingencies for proposed future developments, or potentially restricting certain types of development in areas with a high risk of natural attrition due to sea level rise.
- Better protection for existing, low-lying developments.
- Better flood control through revised drainage planning.
- Measures to improve resilience to exposed infrastructure.

The Melbourne Plan uses a detailed planning model called 'the concentric circles of consequences.' This tool enables managers to visualize links between cause and effect, ensuring that critical climate change impacts are not overlooked. This tool could prove useful to Gateway planners in identifying climate change risks and corresponding impacts upon the park.

Canada: The Great Lakes

The Natural Resources Canada report, entitled *Coastal Zone and Climate Change on the Great Lakes* focuses on the impacts of climate change on the Great Lakes region, to include analysis of impacts on national and provincial parks. Long Point Biosphere Reserve, along Lake Erie, is especially relevant to Gateway since it is a major staging area for waterfowl and has extensive submerged wetland vegetation. The report contains innovative options that could be applied at Gateway, including:

- Using ecological indicators to monitor overall park health and ecosystems' responses to climatic changes (Example from Pukaskwa National Park).
- Recognizing the Great Lakes as a unified watershed comprised of many different political and social actors, species and ecosystems. This approach helps foster broad, coordinated planning.
- Considering multiple climate change impacts facing the Great Lakes communities. These impacts are traced out into their second, third, and fourth order effects.

European Union: Project Safecoast: A Collaboration of Five North Sea Countries

Five North Sea countries established Project Safecoast to share knowledge and information on coastal flood and erosion risk management. Through this process, two types of coastal protection measures were identified: soft and hard measures. According to this report, hard protection strategies:

- Often disrupt ecosystems.
- Require extensive planning, coordination, and financial resources.
- May ultimately provide the only suitable measure to protect coastal resources.

According to this report, soft protection strategies:

- Can be applied faster, usually with more cost-effective results.
- Act like buffer zones to protect the land from the sea.
- Support natural dune formation through passive drainage (Ash, Baarse, Roode and Salado, 2008).

European Union: Natura 2000 and the BRANCH Project

Communication on Halting the Loss of Biodiversity by 2010 – and Beyond delineates key policy areas, including ecosystem conservation and biodiversity protection, in a changing climate. The report recommends adopting policy measures to:

- Ensure adequate financing.
- Strengthen decision-making.
- Increase partnerships and public education.

The Natura 2000 Network is the world's largest network of protected areas. The Network attempts to implement sustainable management, share best practices, provide information to government agencies, and support conservation programs.

To assist species in climate change adaptation, Nature 2000 endeavors to foster ecosystem resilience and to enhance the connectivity among core biodiversity areas (Jones, Silva, Eldridge, Murphy & Goss, 2008). This issue is being handled by the BRANCH (Biodiversity Requires Adaptation in Northwest under a Changing Climate) project. The BRANCH project has developed research and best practices experiments on wildlife climate change, making use of spatial planning and land-use systems. Some of these best practices could be implemented at Gateway.

United States: Maryland

The Living Shores Program, adopted by Maryland and replicated in Virginia and North Carolina, addresses erosion, coastal flooding and bluff failure. This program combines soft and hard measures to protect coastlines. Living Shores projects pay particular attention to wave energy along the coast. High wave energy coastal areas may require harder measures to prevent erosion, or offshore reefs to slow waves.

The Living Shores project introduces several innovative coastal protection measures which may be useful at Gateway, including:

- Emplace rock fill below mean sea level to provide a stable foundation for coastline reconstruction. These rock fills are built upon using natural vegetation, sand fill and other natural materials to reconstruct a natural habitat and coast.
- Partially connect marshy island systems to the mainland, creating a series of protected coves. These areas of low wave energy provide ideal habitat for terrapin nesting and promote the growth of submerged aquatic plants. (See the Horsehead Wetlands shoreline restoration project in Queen Anne's County).

Reduce wave energy further away from the shore by creating a system of offshore oyster bars using stone rumble. Use barrier rings or "stone sills." Moderate wave energy gradually eroded a high bank shoreline. In response, coastal managers constructed a stone sill in a semi-circle around the eroded area, filling the ring's interior with a fringe marsh habitat. The sill reshaped the shoreline's contours, improving protection against wave action while still allowing water flow to the marsh (See the London Town Public House and Garden in Anne Arundel County).

The Living Shores program can potentially be replicated at Gateway because of its emphasis on using natural material and barriers to protect the coast. The design measures and principles of this traditional coastal management program should serve equally well as climate adaptation measures.

Appendix D: Land Acquisition and Partnerships

Gateway's location within the New York harbor area creates a complicated land-use dynamic. The city's air, noise, and water pollution have real and significant impacts upon the park. The park lacks a substantial buffer zone between its natural systems and urban areas. Partnerships with neighboring stakeholders and agencies could be developed to address land use of adjacent areas in order to reduce negative impacts on the park. Under ideal conditions, these partnerships could present options to acquire land to expand the park or create a suitable buffer zone.

Key Potential Partners for Gateway could be:

Federal:
- Army Corps of Engineers (responsible for major habitat restoration)
- U.S. Coast Guard (possesses neighboring facilities)
- U.S. Navy (possesses neighboring facilities)
- U.S. Fish and Wildlife Service

State:
- New York Department of Environmental Conservation
- New Jersey Department of Environmental Protection
- New York, New Jersey Port Authority

City:
- New York City Department of Parks and Recreation (possesses neighboring facilities)

The following legislation could support the land acquisition program:

Federal Level:
- Section 404 of the Clean Water Act (CWA): Federal wetland credit program to convert acquired sub-prime land into functioning wetland (Shabman, Leonard and Scodari, Paul 2004), and enhance state level legislations (Zinn and Copeland, 2001).
- NOAA Coastal and Estuarine Land Conservation Program (CELCP): To support state preservation through federal Coastal Zone Management Program (CZMP).
- Coastal Zone Management Act (CZMA): To fund state restoration and protection efforts of coastal lands.
- Water Resource Development Act (WRDA): To regulate dredging and landfill projects as well as restoration and protection of aquatic habitats by the USACE.

State level:

- New Jersey Freshwater Wetlands Protection Act, N.J.S.A. 13:9B: To preserve wetlands from unnecessary disturbance.
- New Jersey Coastal Management Program (NJCMP): To ensure that coastal resources are conserved though cooperation with other state programs and nonprofit organizations (NJCMP, 2009).
- The New Jersey Wildlife Action Plan (WAP) : To coordinate wildlife research and management and provide for research into climate change impacts on wildlife and adaptation strategies (Division of Fish and Wildlife, 2008).
- The NJ Landscape Project: to protect the habitats and imperiled species on ecosystem level.

Municipal level:

- New York City Administrative Code - Title 24 (PlaNYC 2030): To open 90% of waterways for recreation by reducing water pollution and to preserve natural areas (City of New York, 2007).
- Waterfront Revitalization Program (WRP): Designates "Special Natural Waterfront Areas" as natural areas having connection with any waterfront activity.
- NYC Local Law 83: Inventories City-owned wetlands located within New York boundaries and looks at transferring these properties to the protection and jurisdiction of the NYDPR (New York City, 2005).