COASTAL PROTECTION STUDY
CITY OF LONG BEACH, NY

Bayside Flood Protection Plan

Prepared for:

City of Long Beach, New York

Prepared by:

Coastal Planning & Engineering, Inc.

November 2009

COASTAL PROTECTION STUDY
CITY OF LONG BEACH, NY

Bayside Flood Protection Plan

Table of Contents

I. Introduction 1
II. Background 1
III. Local Revitalization Plan 3
IV. Existing Conditions Assessment 6
V. Flood Potential 17
VI. Nassau County Hazard Mitigation Plan 27
VII. FEMA Grant Programs 29
VIII. FEMA Hazard Mitigation Assistance Grant Applications 38
IX. U.S. Army Corps of Engineers 44
X. Conclusions and Recommendations 44
XI. References 46

List of Figures

Figure No.

1 Location Map 2
2 Community Structure from City of Long Beach Comprehensive Plan 4
3 Tide Flex valves on outfalls through bulkhead 7
4 Improvements underway to a City-owned bulkhead in the canal area 9
5 Example of low bulkhead in canal area at high tide 9
6 City bulkhead at street end adjacent to two lower residential bulkheads 10
7 Open area and unrepaired bulkhead damages 11
8 Differing bulkhead elevations at canal entrance 11
9 Holes observed in sheet pile bulkhead fronting the medical center 12
10 Street end of Monroe Blvd. with no bulkhead for flood protection 13
11 Commercial area west of the bridge 14
12 Riprap of mixed materials fronting major infrastructure 14
13 Steel sheet pile bulkhead along the public park west of the bridge 15
14 Removal of debris from Tide Flex valve 15
15 Discontinuous bulkhead elevations at street ends in western residential area 16
16 Holes at top of sheet pile bulkheads reduce level of flood protection 17
17 Mean Sea Level Trend for Sandy Hook, New Jersey 18
18 Mean Sea Level Trend in New York City 18
19 FEMA Base Flood Elevations 21
20 Repetitive Loss Properties City of Long Beach 23
21 Inflatable rubber dam diagram 25

COASTAL PROTECTION STUDY
CITY OF LONG BEACH, NY

Bayside Flood Protection Plan

Table of Contents
(cont'd)

List of Figures

Figure No.

22 Sumito electric rubber dam in Norway 26
23 Dams on the Salt River in Tempe, Arizona 26

List of Tables

Table No.

1 Bay Stage Levels for Nassau County, NY 19
2 FEMA Grant Program Supported Activities 37

List of Appendices

Appendix No.

A FEMA Flood Insurance Rate Maps (FIRMs)
B Supplemental Flood Gate Information
C Grant Application Information
D U.S. House of Representatives Resolution

EXECUTIVE SUMMARY

The City of Long Beach is subject to flooding from both sides of the barrier island during storms and unusual high tides. The bayfront shoreline consists of a mix of residential and commercial property with bulkheads that are discontinuous and variable in elevation. In addition, the stormwater outfalls that normally drain into the bay tend to backflow with seawater during times of high water, which results in flooding of streets and other low lying areas. Although the City has made improvements to some of the outfalls by installing check valves and has raised a number of City-owned bulkheads, there are points in the system that allow flooding to occur. Sea level rise and recent updates to the FEMA flood maps further underscore the need for a bayside flood protection project in the City of Long Beach.

To address storm surge and tidal flooding from the bayside of the island, it is recommended that the City implement vital improvements and seek federal funding for major projects. A detailed inspection of all stormwater outfalls and existing bulkheads is needed to identify specific issues that need to be addressed. Existing bulkheads should be raised/repaired to a minimum of +9-ft NGVD and new bulkheads should be installed in areas where they are currently lacking or have been destroyed. Tide Flex, or similar, valves should be installed on all storm drain outfalls to eliminate backflow issues through the existing drainage system. A basic maintenance plan should be implemented to periodically inspect storm drains/outfalls and bulkheads to ensure they remain fully functional at all times. At the junction between the canal entrances and the bay, a site-specific solution may be feasible that can be temporarily put in place prior to the onset of a storm tide.

The City may be eligible for Project Grants under the Flood Mitigation Assistance (FMA) and Pre Disaster Mitigation (PDM) Programs, which are under the FEMA Hazard Mitigation Assistance Program. Eligible project types include floodwall construction and upgrades, drainage and outfall improvements, and small flood control projects costing less than $1 million each. Multiple applications may be submitted and specific projects should be identified for consideration. The City should also contact the Nassau County Hazard Mitigation Coordinator in order to initiate update/maintenance of the Multi-Jurisdiction Hazard Mitigation Plan to include the measures listed herein.

There is a standing directive from the U.S. House of Representatives for the Army to evaluate the need for a bayside storm protection project in Long Beach. Based on this directive, the Corps could commence a reconnaissance level study to determine the level of federal interest in such a project. However, pursuing a Corps' project on the bayside should proceed in a parallel but separate track from the ocean side study to avoid delaying either project. The Corps should be contacted to determine what is needed to commence the reconnaissance study for the bayside.

I. INTRODUCTION

The purpose of this report is to provide planning guidance to the City of Long Beach for addressing bayside flooding problems. When winter storms and tropical systems impact the area, the storm surge enters the bay through the inlets that border Long Beach Island to the east and west. Due to the low elevation of the island, the resulting increase in bay water levels can overtop bulkheads and seawalls, flooding roads and properties along the bay shoreline. In addition, heavy rains cause localized flooding of low lying areas due to drainage issues. These issues and options for addressing them are identified in this report.

The Federal Emergency Management Agency (FEMA) funds grant programs to protect individuals and property from natural hazards while reducing reliance on post-storm Federal Disaster funds. A description of these programs and their potential application to the City of Long Beach is provided. Potential projects that may be sought to address current issues include new/upgraded storm drains, check valves on outflow pipes, elevated/upgraded bulkheads, and other localized flood reduction measures. Assistance from the U.S. Army Corps of Engineers may also be feasible and is discussed in this report.

II. BACKGROUND

The barrier island of Long Beach is located on the Atlantic Coast of Long Island, New York, between Jones Inlet and East Rockaway Inlet (Figure 1). There are five communities on the barrier island: Point Lookout, Lido Beach, City of Long Beach, East Atlantic Beach, and Atlantic Beach. All unincorporated areas on the island are under the jurisdiction of the Town of Hempstead, Nassau County, New York. For the purposes of this report, the barrier island is referred to as “Long Beach Island” and the City of Long Beach as the “City.”

The nine mile long barrier island varies in width from 1,500 to 4,000 feet, and is bounded on the east by Jones Inlet, on the south by the Atlantic Ocean, on the west by East Rockaway Inlet, and on the north by Reynolds Channel. Development on the island is primarily residential with extensive recreational areas and facilities. Beach clubs, apartment houses, condominium complexes and hotels dominate the Atlantic shore, while the north shore (bayfront) is primarily occupied by private homes and public facilities. The terrain is low-lying and flat, with elevations generally less than 10 feet above National Geodetic Vertical Datum (NGVD).

The bayfront shoreline consists of a mix of residential and commercial property. In general, the eastern half of the City has bulkheads along the entire bay front and is primarily residential except for the section of shoreline fronting the Long Beach Medical Center. The western half of the City contains a commercial/industrial area without any bulkheads, while the remainder of the bayfront is comprised of a public park and residential areas with bulkheads. The barrier island provides protection against wave attack to the Long Island mainland surrounding Hempstead Bay, but is subject to flooding from both sides of the island during storms.

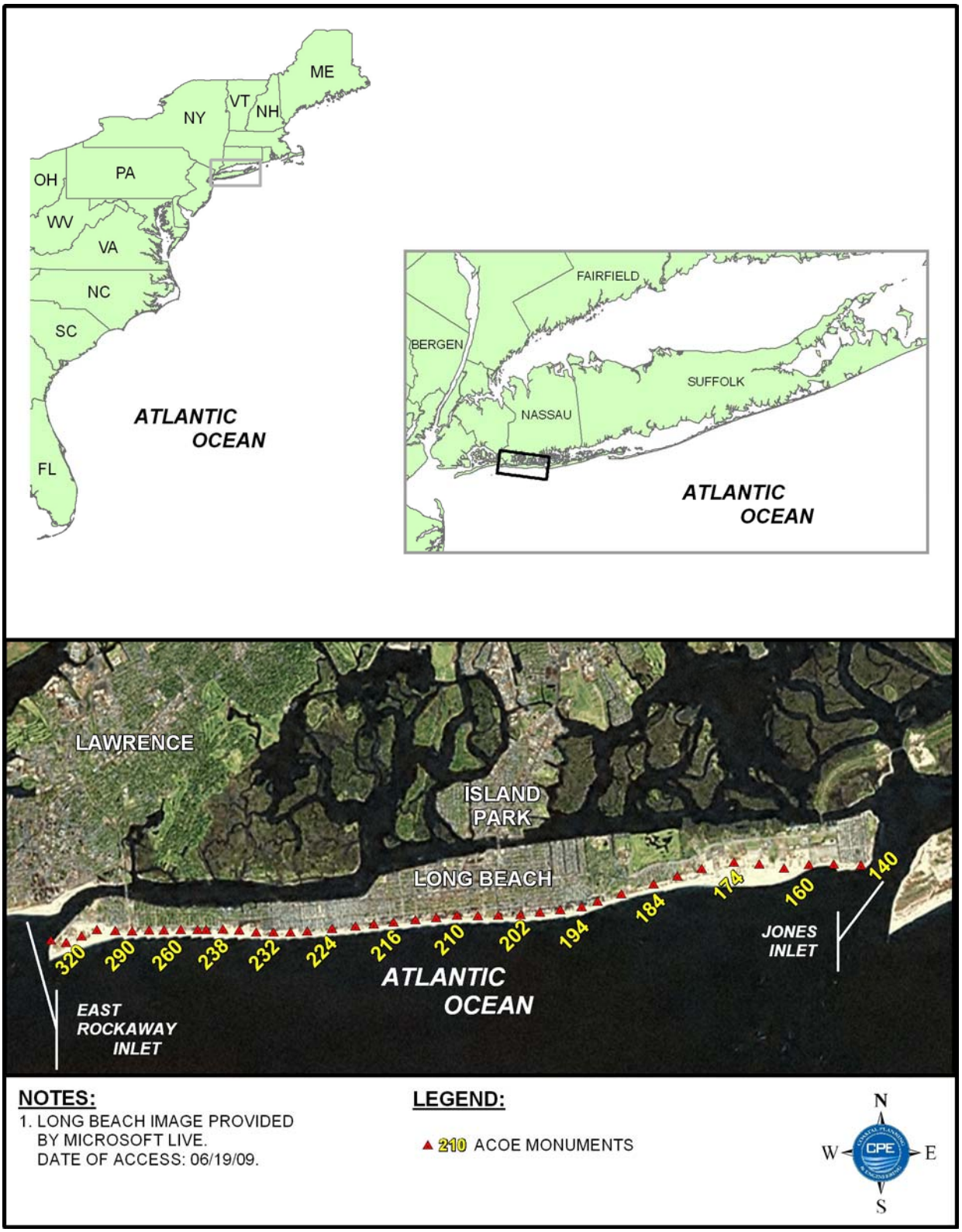


Figure 1. Location Map

Various measures have been under consideration to increase protection against oceanfront inundation, but these improvements will not lessen the storm water inundation from the bayside. The bayside flooding is primary from the bay, over or through the existing bulkheads and from backflow through existing storm drains. Bulkhead elevations are variable along the bayfront and canals, and the lower areas create vulnerability to flooding during minor storm events.

The proposed oceanside protection measures are estimated to provide protection against inundation for ocean surges from 100 year storm events. Since the City also experiences flooding from the bayside, improvements to the existing bulkheads and drainage system should be consistent with the level of protection from a 100 year storm.

III. LOCAL REVITALIZATION PLAN

In 2005, the City of Long Beach commissioned a comprehensive local revitalization plan to identify opportunities to improve the City's planning and economic development. The study is entitled "*City of Long Beach Comprehensive Plan Technical Memorandum – Existing Conditions, Issues, and Opportunities*" (Saccardi & Schiff, Inc., 2005). Principal defining natural features identified in the study for the City of Long Beach are the Reynolds channel bayfront and Atlantic Ocean beachfront (Figure 2). Manmade features of significance are the grid street pattern laid out on a generally flat topography with high density residential infrastructure, along with two prominent features: the boardwalk and the Long Island Rail Road. Public facilities, industry and institutions define the central portion of the City's bayfront, while the eastern and western portions are primarily private residences.

The study included some discussion of flooding problems and bayside land use, including redevelopment opportunities. Portions of the bayfront area were identified as presenting large scale redevelopment opportunities that would have a restorative effect on the City and its economic development. This study is referenced here only for consideration during the development of flood proofing measures the City implements in the future. A summary of the pertinent portions of the study is provided below.

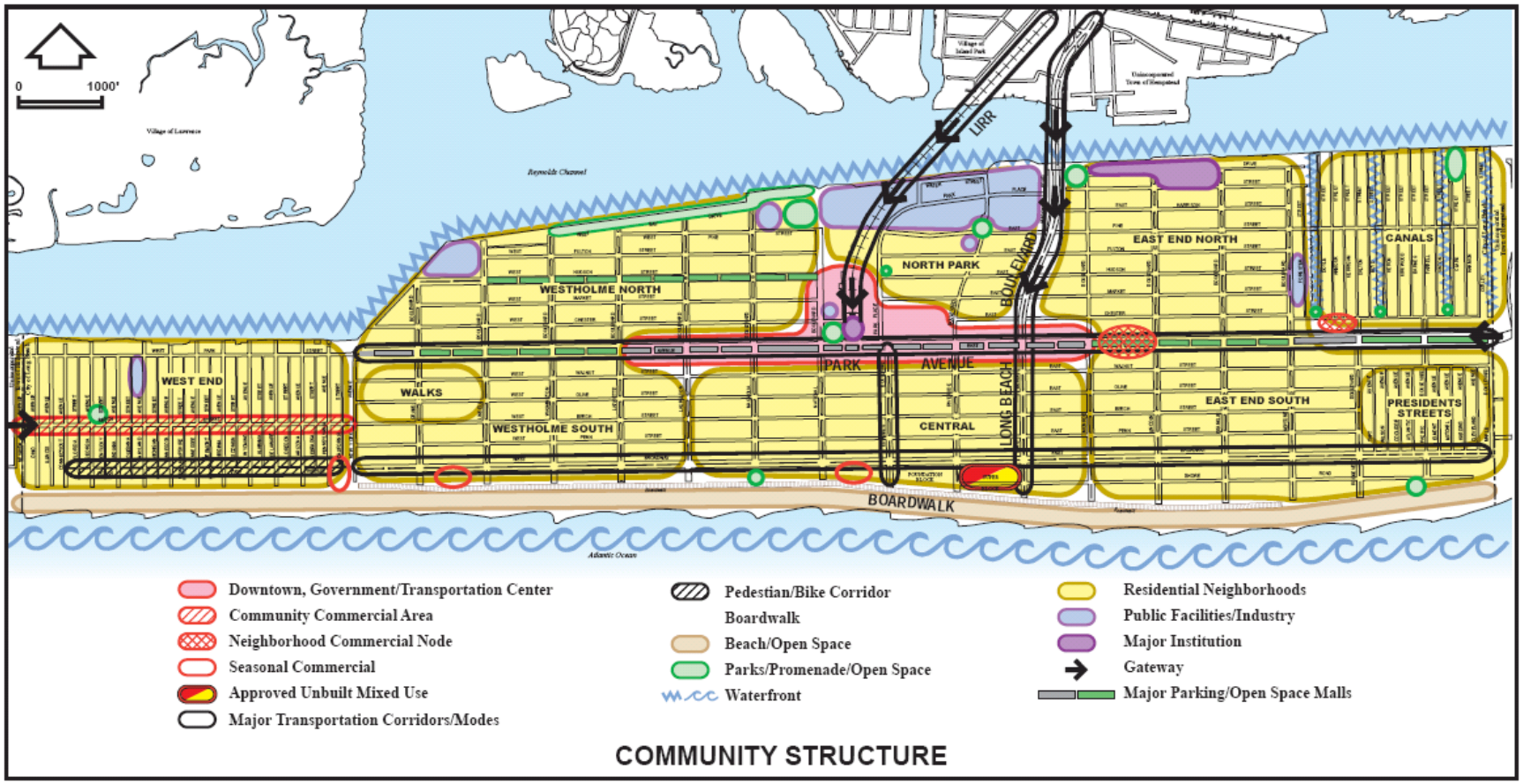


Figure 2. Community Structure from City of Long Beach Comprehensive Plan (Saccardi & Schiff, Inc., 2007)

Bayfront Land Use

The City's bayfront stretches for over 3.5 miles and is primarily lined with bulkheads, homes and private docks. Waterfront homes can also be found in an area called the Canals, in the eastern part of the City. Man-made extensions were created when canals were dug connecting areas of Long Beach to the bay. No home is more than a few hundred yards from the water, as Long Beach is only ½ mile wide at its widest point. While it is not as publicly accessible as the ocean beach, the bayfront offers some opportunities for public recreation. Bayside esplanades run the length of Veteran's Memorial Park and along West Bay Drive from Magnolia Boulevard to Washington Boulevard. Public access is also available behind the tennis bubbles located at the northern terminus of Monroe Boulevard. A fishing pier at the terminus of Magnolia Boulevard and a boat ramp comprise the water dependent uses along the bayfront. Redevelopment focused on water related and water enhanced uses such as marinas or restaurants could provide employment opportunities and additional amenities within the City.

Bayfront Redevelopment

There are areas along the bayfront that currently have some vacant, underutilized or unused parcels occupying a valuable waterfront corridor. Several parcels along the bayfront, from Magnolia Boulevard to Monroe Boulevard are owned by the City, public utilities companies and the Town of Hempstead. These properties are currently used for a variety of municipal functions including a park and recreation center, wastewater treatment plant, water storage facilities, electrical substations, handball and tennis courts, animal shelter, private industries, and a gun range. While the majority of this waterfront property has active uses, many of the uses could be consolidated and/or relocated to create a large swath of developable waterfront property. Opportunities for passive recreation and beautification of open space also exist along the open spaces at the end of the canals. Any flood management plans to be implemented should consider the future use of these spaces if the City intends to redevelop portions of the bayfront.

Boundary Issues and Maintenance

Based on the Local Waterfront Revitalization Program (LWRP, Saccardi & Schiff, Inc., 2007), the northern boundary of the City of Long Beach extends into the center of Reynolds Channel. However, installation of new bulkheads along the bayfront, especially in areas where none currently exist (i.e. immediately west of the Long Beach Boulevard Bridge), will require some determination of submerged land rights with the Town of Hempstead for permitting and easement purposes. A survey of the current bayside shoreline position may be needed to define the land/water boundary where new bulkheads would be able to be installed.

Along the canals, individual property owners encroach on both City land at the canal edge and within the waterways. Homeowners are permitted to have docks and boats that take up one-third of the canal, however, some private properties may encroach further than permitted. Closer enforcement may be needed to maintain the public character of these waterways. Finally, the responsibility for maintenance of bulkhead repairs in the canals lies upon the party that owns the respective property. Raising all the existing bulkheads to a sufficient flood protection elevation will involve both City and residential bulkheads.

All streets in the City are City-owned with the exception of portions of Park Avenue and Long Beach Boulevard, and their maintenance and repair is the responsibility of the City Department of Public Works. Park Avenue, between Long Beach and Maple Boulevards, and Long Beach Boulevard, between Park Avenue and the Long Beach Bridge, and the Long Beach Bridge are owned and maintained by Nassau County.

IV. EXISTING CONDITIONS ASSESSMENT

Floods can be caused by unusually high tides, storm surge, heavy precipitation, or a combination of these factors. In the City of Long Beach, flooding occurs most often along bayfront parcels and street ends, which have elevations of only 4.5 to 6 feet NGVD in some areas. The most widespread flooding in the study area is caused by storm surge, which is the rise in water levels above normal tidal fluctuations caused by wind/wave setup and low atmospheric pressure. Storm surge can be created by any large low-pressure system, such as Nor'easters, but the most severe storm surge is created by hurricanes. The worst case conditions for flooding occur when the storm surge is sustained for a long period and coincides with multiple high tide events.

Storm surge can cause water level in the bay to rise above the level of bulkheads, causing overtopping as well as backflows through the storm water drainage system into the streets. Records provided by a local resident (Frederick S. Peters Jr., January 2, 2009) indicate that between December 2004 and October 2008, Farrell Street, in the Canal section of the City, was flooded on 88 days, which is typical of the low lying streets in this area. The 1992 Nor'easter was of sufficient severity for a Presidential Disaster Declaration for a number of counties including Nassau County, and over $94 million in claims were reported County-wide.

Site Visit

Onsite observations of the bayfront along the City of Long Beach were completed on June 22, 2009 by Coastal Planning & Engineering, Inc. (CPE) and City staff. The main objective of the site visit was to view persistent flooding areas, categorize the probable causes of common problems, and identify potential solutions. Ongoing City efforts to raise bulkheads at street ends were also observed.

The observations took place from the water utilizing a City police boat starting in the east at the canal neighborhood and progressing west to the boundary of East Atlantic Beach. Along the way, photographs were taken of the various types of bulkheads and storm drains. The tide was high during the visit, which prevented viewing of all the storm drains, but highlighted areas with low or nonexistent bulkheads. Attendees of the site visit included Tom Pierro (CPE), Kevin Mulligan and Joe Febrizio (City of Long Beach), and a police lieutenant who captained the boat. The results of the site visit are discussed in the sections below.

Stormwater System

The City's stormwater management system is a combination of older open street gutter systems and new underground piped systems discharging directly to the bay. The Local Waterfront

Revitalization Program draft report (Saccardi & Schiff, Inc., 2007) includes a map of all the outfall locations in the City. According to that report, approximately 60% of rainfall is discharged directly to the bay and about 40% percolates into the sand in unpaved areas. The street system is established such that every other boulevard is a watershed, e.g., all water from Lindell and New York Avenues will flow to the system on Grand Avenue. Whenever streets are repaved, paved gutters and piped stormwater systems are installed to convey water to the bay.

The effectiveness of the City's stormwater management system is influenced by several factors. The network of gutters can become blocked by homeowners who extend their driveways further into the street to avoid driving over the gutter channel. This causes obstructions in the system that can lead to flooding. Outfall structures on the bayshore are often submerged during high tides and storm surges, causing backflooding into the streets. Improvements to the old water and drainage lines throughout the City is ongoing, but such repairs or replacement may be difficult since the lines may be buried beneath private backyards and houses in some areas (Saccardi & Schiff, Inc., 2007).

An innovation to improve the stormwater flow and reduce inundation from the bay was the addition of "Tide Flex" valves on the end of outfall pipes that carry water to the bay. These check valves allow flow in one direction only and prevent backflow during high tides or storm surge. An example of one of the types of existing installations of Tide Flex valves along the City's bayfront is shown in Figure 3. In order for this type of system to be effective, valves need to be installed on every outflow pipe. Since these pipes are often inter-connected, any open-ended outflow can allow bay water to backflow though the system to the streets.

Figure 3. Tide Flex valves on outfalls through bulkhead

The addition of Tide Flex, or similar, valves on all storm drains should alleviate backflow issues, but a maintenance plan is needed to ensure they remain functional. These valves generally require less maintenance than the "flap gate" type valves, but do require some upkeep. They can become encrusted with marine life, clogged by seaweed and algae, or held open by debris that washes down the storm drains. Most of the valves are secured by collars with bolts that can be

removed during low tide for cleaning. A basic maintenance plan to inspect and clean the valves on a regular basis would improve the functionality of the system.

Existing Bulkheads

Bulkheads are located along most of the bayfront and the canals, but they are not designed as a system and are not continuous. Therefore, the existing system is not effective in preventing flood waters from inundating low lying areas. The Local Waterfront Revitalization Program draft report (Saccardi & Schiff, Inc., 2007) includes a map of the City-owned bulkhead locations and types. Over time, the City has continued efforts to improve the bulkheads they own, but there needs to be combined effort among all bulkhead owners to solve the problem.

The City has found that replacing or upgrading the existing bulkheads with bulkheads at elevation +9.0 ft-NGVD has helped reduce this flooding. However, in order for the system to be effective during storm tides, all bulkheads fronting the bay need to be consistent. In addition, the canals pose a particular problem of being comprised of various types of bulkheads with varying elevations, many of which are privately owned.

For the purposes of this report, the bayfront was categorized into five areas from east to west: the canals, the residential area east of the bridge, the commercial area east of the bridge, the commercial area west of the bridge (includes the city park), and the residential area west of the bridge. Observations and photographs from the June 22, 2009 site visit are summarized below according to these areas.

<u>Canals</u>

The bulkheads along the canals are comprised of various types of materials with differing elevations. The City has been elevating bulkheads at street ends and along the canal areas that fall under City jurisdiction (Figure 4). Some homeowners appear to have improved and elevated their bulkheads recently, but there are many that are in poor condition or are simply too low to prevent overtopping. For example, during a (non-storm) tidal cycle, the water level is closely approaching the top of the bulkhead shown in Figure 5. Less than one foot of freeboard remains visible at high tide before overtopping would occur, thus flooding the property. In situations such as these, neighboring properties may also be subject to flooding even if the elevation of their own bulkhead is higher.

Figure 4. Improvements underway to a City-owned bulkhead in the canal area

Figure 5. Example of low bulkhead in canal area at high tide

East Bayfront – Residential

At the seaward ends of the canals, the bayfront is lined with residential properties and private bulkheads. The City owns and maintains the bulkheads at the street ends, most of which have been elevated to +9.0 ft-NGVD. However, the heights of the adjacent bulkheads vary in many cases as shown Figure 6. Lower bulkheads can be overtopped and allow water to flow around and behind the higher structures. The height of the bulkhead in front of the street will not provide protection if the adjacent bulkheads are at lower elevations susceptible to flooding. In addition, areas where bulkheads have been damaged or are non-existent provide weak points in the flood protection system where water can easily flow into the residential areas (Figure 7).

Figure 8 gives another example of different seawall elevations at the end of a canal. On the left side of this photo, the seawall along the street is much lower than the seawall in front of the house to the right. Due to the complexity of existing bulkheads within the canal areas, some form of a flood gate at the end of each canal may prove to be a viable option. However, all bulkheads along the bayfront would still need to be elevated to a uniform level.

Figure 6. City bulkhead at street end adjacent to two lower residential bulkheads

Figure 7. Open area and unrepaired bulkhead damages

Figure 8. Differing bulkhead elevations at canal entrance

East Bayfront – Commercial

Immediately west of the easternmost residential area is a portion of commercial bayfront area directly east of the bridge. The major institution in this area is the Long Beach Medical Center, which has a steel sheet pile bulkhead along its entire length (Figure 9). Holes at the top of the sheet pile were observed along the entire bulkhead, which may have been used as lifting holes during installation of the sheet pile. Even though the bulkhead extends a foot or more above the location of the holes, the flood protection elevation of the wall is compromised. Storm surge elevates the water level for extended periods of time, which can allow for a large volume of water to pour through the openings. Simply repairing the bulkheads by closing the holes and other openings in the steel sheet pile will provide additional protection from flooding in this area.

Figure 9. Holes observed in sheet pile bulkhead fronting the medical center

Immediately west of the medical center, adjacent to the bridge, is the street end of Monroe Blvd, which has a drainage pipe and no bulkhead. As shown in Figure 10, the concrete support for the drainage pipe at the end of this street is visible among various pieces of concrete and debris. The actual road end is also visible on the right side of the photo. In this condition, there is basically no protection from flooding in this area and bay water could flow directly onto the street during times of storm tides.

Figure 10. Street end of Monroe Blvd. with no bulkhead for flood protection

West Bayfront – Commercial

The area immediately west of the bridge is mainly commercial properties that are not protected by bulkheads. The land elevation in this area may be slightly higher than the eastern properties and appears to be stabilized in areas by rip-rap and other materials. Flooding issues have not been reported here, which may be due to the industrial nature of the area rather than an actual lack of flooding. As shown in Figures 11 and 12, the area contains major commercial infrastructure including a wastewater treatment plant, water storage facilities, and electric substations. Some form of a revetment or bulkhead in this area would greatly improve the protection of these important facilities.

Further to the west, there is a City-owned park and boat ramp. The continuous seawall in front of the city park also has holes (possible remnant lifting eyes) where water can leak in almost a foot below the top elevation of the bulkhead (Figure 13). Tide Flex valves were also observed in this area, which are a positive addition to the drainage system. However, some debris (plastic bottles) were observed and removed from the valves (Figure 14), which identifies the need for a basic maintenance plan.

Figure 11. Commercial area west of the bridge

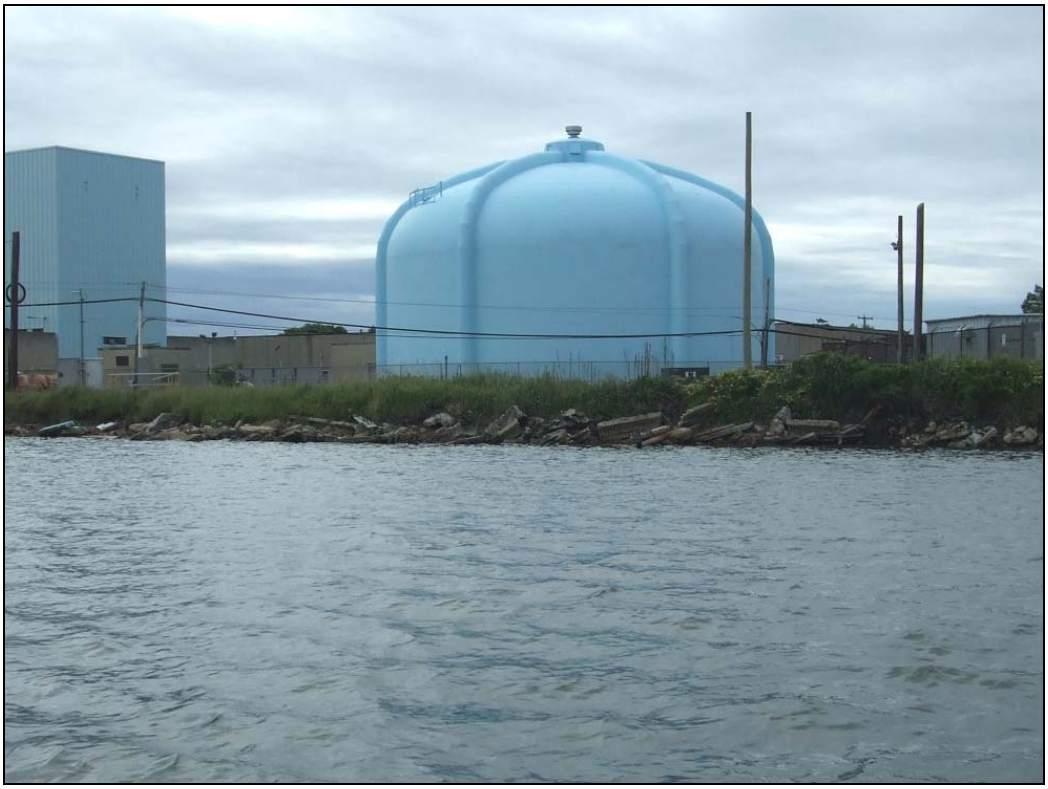


Figure 12. Riprap of mixed materials fronting major infrastructure

Figure 13. Steel sheet pile bulkhead along the public park west of the bridge

Figure 14. Removal of debris from Tide Flex valve

West Bayfront – Residential

Along the residential area of the western bayfront, there are more examples of varying bulkhead elevations in front of residential and City properties which are similar to the discontinuous bulkhead elevations in the canals neighborhood. As shown in Figure 15, the bulkhead at the street end (middle) was constructed to an elevation of +9.0 ft-NGVD feet by the City to prevent flooding of the street. However, this height is not met by the adjacent residential bulkheads, which provide flooding pathways around the street end bulkhead.

Figure 15. Discontinuous bulkhead elevations at street ends in western residential area

Similar to the steel sheet piles fronting the medical center and public park, there are bulkheads in this area that have holes along the top of the sheet piles (Figure 16). The holes need to be sealed up in order to prevent bay water from entering during elevated tide levels. Although the holes are small, a large amount of water can flow through them over a period of time. Closing the holes and repairing any other void space in the bulkheads would increase the level of flood protection to the full potential of the walls.

Figure 16. Holes at top of sheet pile bulkheads reduce level of flood protection

V. FLOOD POTENTIAL

The topography of the City of Long Beach is low-lying and relatively flat, with elevations generally less than 10 feet above National Geodetic Vertical Datum (NGVD). The barrier island provides protection against wave attack to the Long Island mainland, but is subject to flooding from both sides of the island during storms. Bayside flooding primarily occurs over or through the existing bulkheads and from backflow through existing storm drains. Bulkhead elevations are variable along the bayfront and canals, and the lower areas create vulnerability to flooding during minor storm events. Heavy rains can exacerbate the problem. Improvements to the existing system should be consistent with the level of protection from a 100 year storm being considered for the oceanside. For this study, sea level rise, storm surge potential and the FEMA flood maps have been reviewed from this perspective and are summarized below.

Sea Level Rise

Sea level rise is the phenomenon by which the average water level of the world's oceans is rising over time due to a combination of man-induced and natural causes. While there is widespread agreement that global sea level is rising, the magnitudes of the predictions vary and are site specific. NOAA (National Oceanic and Atmospheric Administration) maintains two tide gages near the project area, approximately 15 miles away: Sandy Hook, NJ and The Battery, NY. The sea level rise at Sandy Hook is 0.013 ft/yr, as shown in Figure 17. The sea level rise at The

Battery is 0.009 ft/yr, as shown in Figure 18. Tanski (2007) generally adopts the sea level trends from The Battery tide gage and approximates the sea level rise value of 1 ft/century, or 0.01 ft/yr, for Long Island coastal waters.

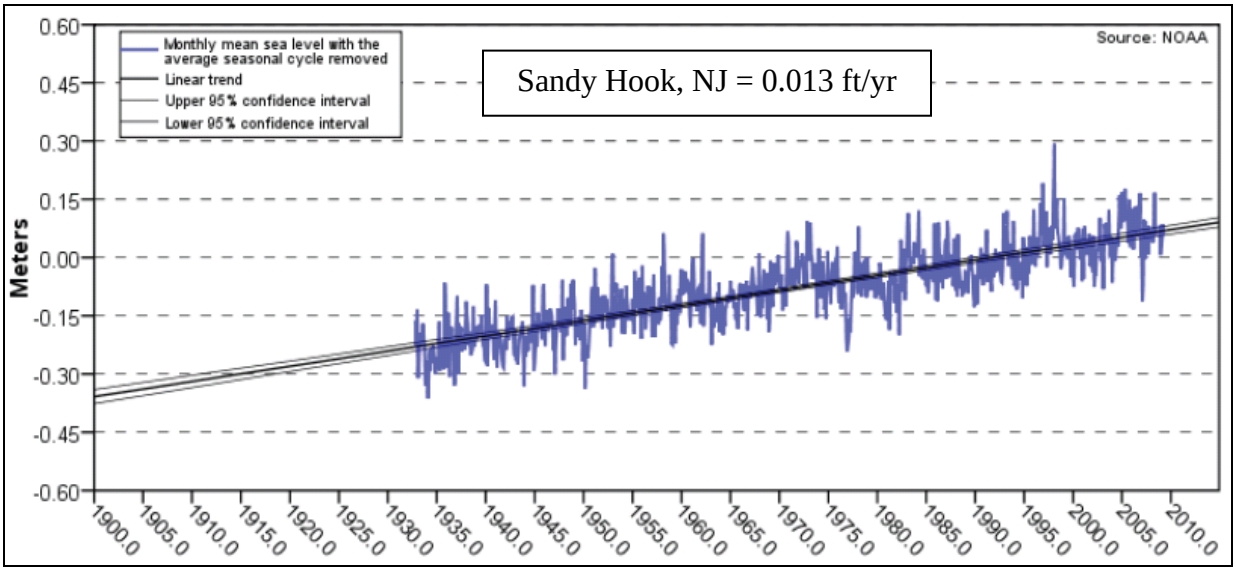


Figure 17. Mean Sea Level Trend for Sandy Hook, New Jersey (NOAA, 2008, http://tidesandcurrents.noaa.gov)

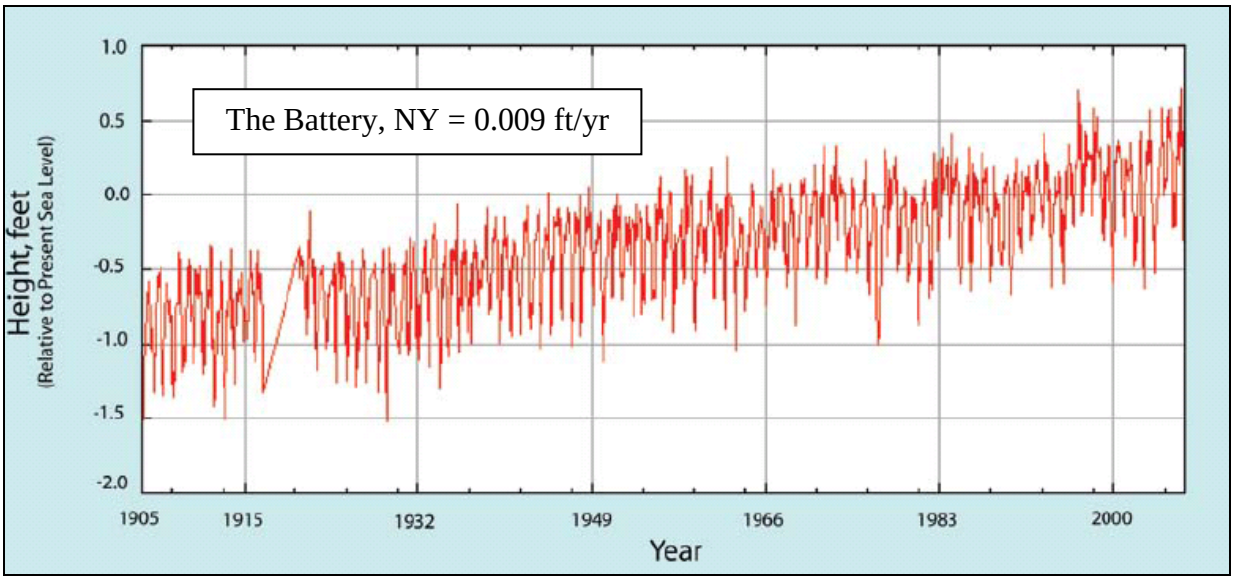


Figure 18. Mean Sea Level Trend in New York City (Data from NOAA: NOS Battery Tide gage, http://tidesandcurrents.noaa.gov)

Rising sea level has major implications on planning for long term flood protection. For the purpose of this study, the sea level rise value for Long Beach follows Tanski's (2007) estimate of 0.01 ft/yr, which is the approximate average of the predictions of nearby tide gauges. This historic rise in sea level is accounted for in the following development of potential storm surge

levels in the bay. However, a recent study on the review of sea level rise estimates by the end of the 21st century (Fletcher, 2009) has pointed out that recent IPCC projections do not include the potential effect of ice calving (melting glacial ice-sheets), which is also true for historic rates. Pointing to a previous study by Pfeffer *et. al.* (2008), Fletcher (2009) suggests that global sea level may rise between 0.8 m (2.6 ft) and 2.0 m (6.6 ft), favoring the lower end of this range by 2100. Although it is also noted that there are site specific factors that govern the local rate of rise, flood protection planning should consider the potential for acceleration of sea level rise due to global factors such as melting glacial ice sheets.

Storm Surge Levels

Estimated flood damages due to storm surge from hurricanes impacting the City of Long Beach could be severe and widespread, particularly if the storm were to make landfall at high tide. For determination of the storm surge potential in the City of Long Beach, FEMA bay stage curves were used (FEMA, 1976). Since these values were developed about 30 years ago, 0.3 ft (0.01 ft/yr) of increased water elevation due to sea level rise was accounted for when determining bay stage levels shown in Table 1.

Table 1. Bay Stage Levels for Nassau County, NY

Return Period	Water Level
(yrs)	(ft. NGVD)
10	6.2
20	6.7
50	7.7
100	8.6
200	9.6
500	11.4

Table 1 shows that the minimum elevation to provide protection from flooding during a 100-year return period storm is +8.6 ft-NGVD on the island's bayside. Considering that the City has had positive results from elevating bulkheads to +9.0 ft-NGVD, these estimates appear to be in the correct range. It is likely that raising all the existing bulkheads to +9.0 ft-NGVD will address flooding at the 100-year level for about the next 40 years assuming a constant rise in sea level of 0.01 ft/yr. If the rate of sea level rise increases, or a storm greater that the 100-year surge level hits the area, then the risk of flooding also increases.

FEMA Flood Maps

The 100-year and 500-year storm events are used by FEMA to determine base flood elevations and the level of protection at island locations. The approved FEMA Flood Insurance Rate Maps (FIRMs) for Nassau County that were available at the time of this study are dated April 2, 1997 (Appendix A). Since then, FEMA has updated the FIRMs, which were only recently made available online in September 2009. However, the City of Long Beach has obtained hardcopies

of the 2009 FIRMs for future reference. While the 2009 maps were too recent to be included in this study in detail, their implications are discussed below.

The flood maps were reviewed to determine the risk areas within the City of Long Beach. FEMA's risk assessment in developing the maps was based on several factors, including velocity of water, terrain, size of watershed, volume of water, ground cover, topography, and tides. In the 1997 assessment, virtually all of the City of Long Beach is included in a Special Flood Hazard Area (SFHA). Out of 1,569 acres total, 184 acres are designated "VE Zone": high risk from coastal (wave related) flooding; and 932 acres are designated "AE Zone": high risk from precipitation and storm surge flooding. The remaining 453 acres are designated moderate risk "X Zone" (based on updated data from Jimmy Chin, ISO Inc., 2008).

The base flood elevations computed by FEMA and are shown on Figure 19 (reproduced from Saccardi & Schiff, Inc., 2007). The figure shows that the majority of the City of Long Beach was already at risk for storm surge flooding during a 100-year storm event in 1997, categorized as Zone AE. Areas designated as Zone X were deemed to be at risk during a 500-year storm. The difference between the 100-year and 500-year risk areas is generally the 10 ft-NGVD contour, although other factors are also accounted for as noted above.

In 1997, the northern half of the island was deemed susceptible from storm surge flooding from a 100-year storm, while the entire island was at risk from the 500-year storm. The 2009 FIRM updates now depict nearly the entire City within the 100-year "AE" flood zone, with the exception of a limited number of small areas listed as "X" zone. The expanded flood zone area from 1997 to 2009 is an indication of FEMA's recognition that the entire City of Long Beach is now at high risk from flooding of a 100-year storm event.

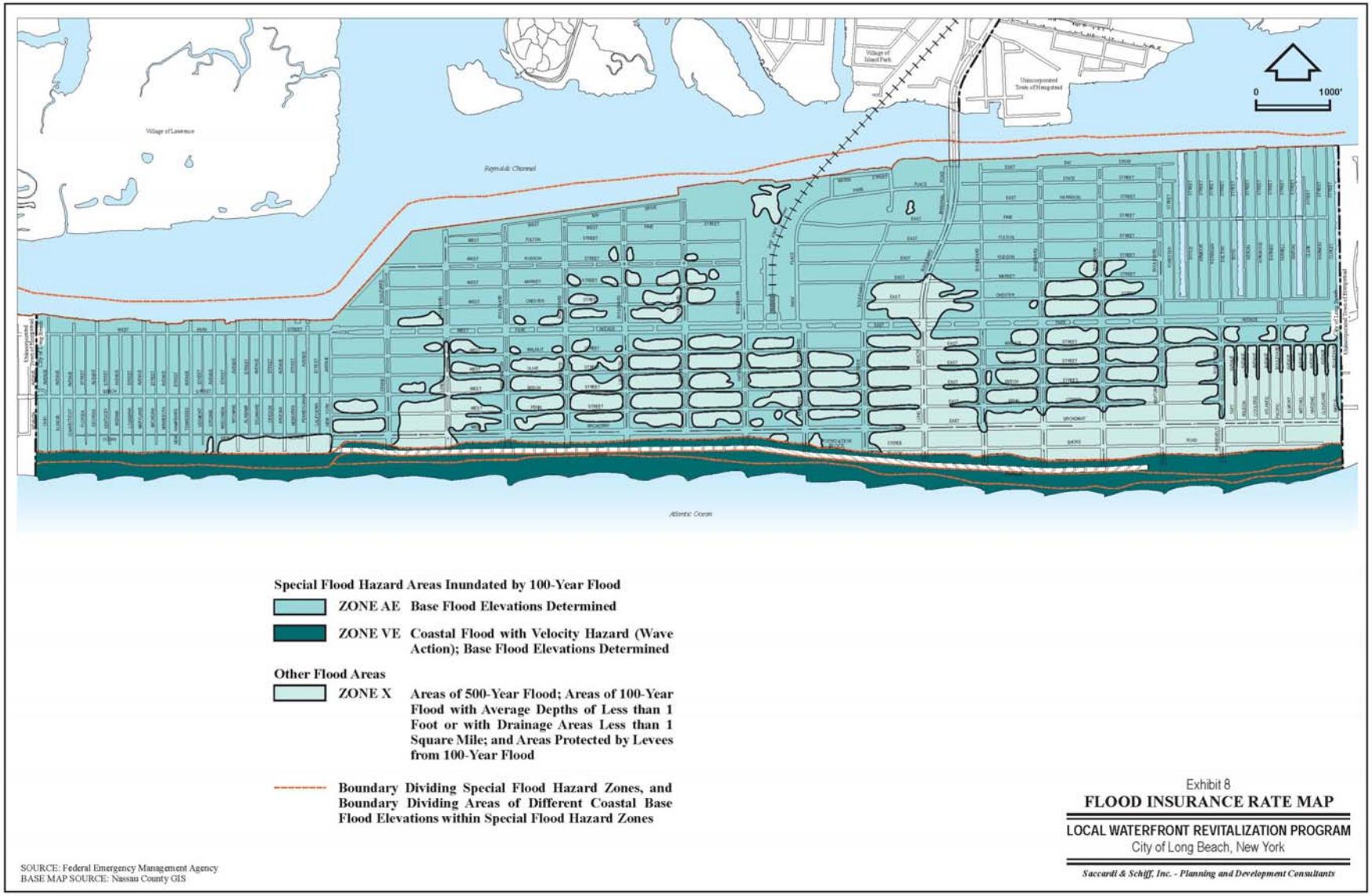


Figure 19. FEMA Base Flood Elevations (Saccardi & Schiff, Inc., 2007)

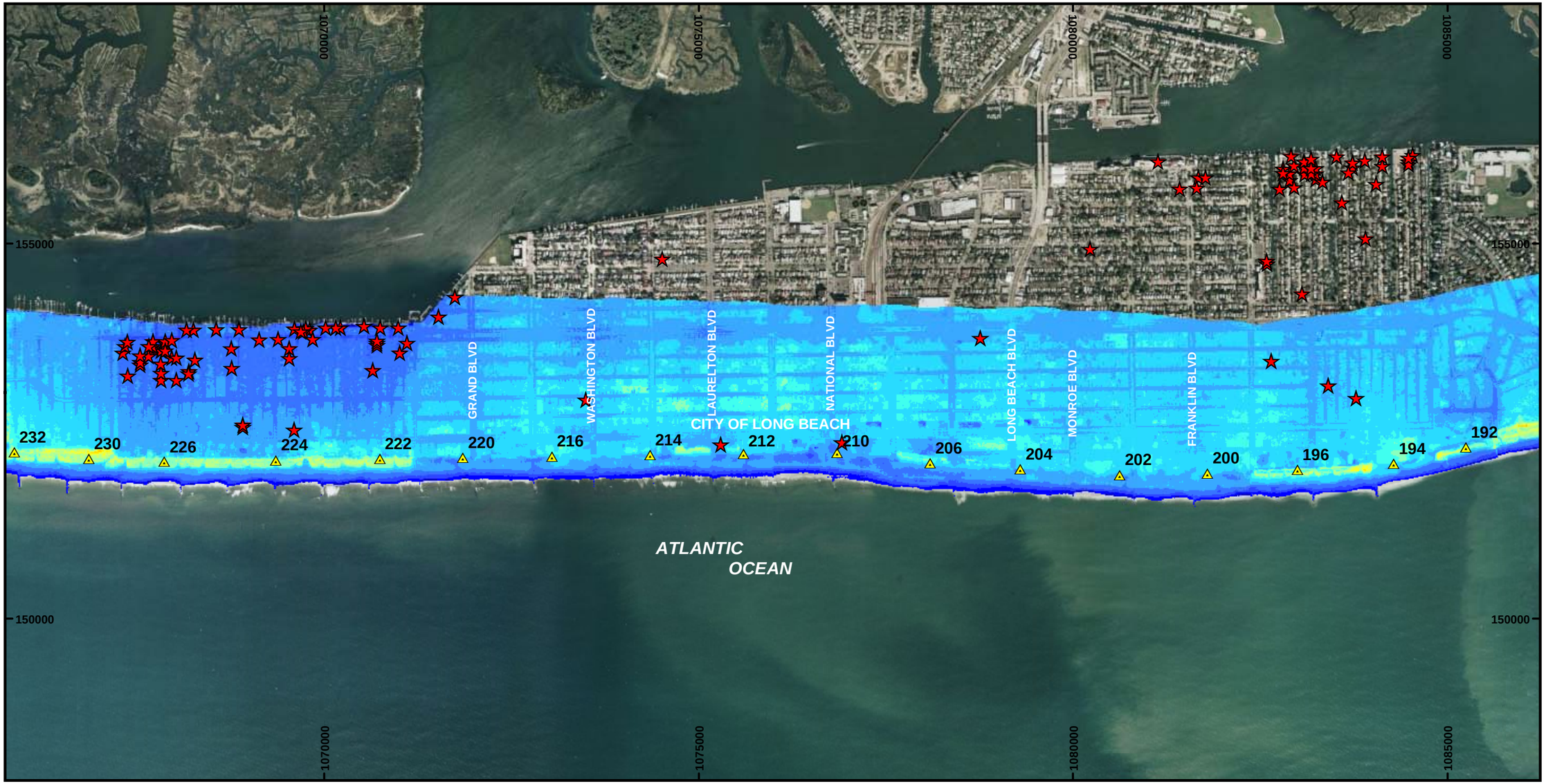
LIDAR Analysis

LIDAR (Light Detection and Ranging) is an optical remote surveying technology that measures properties of scattered light to determine distance to an object or surface though laser pulses. Since LIDAR is conducted by airplane, the survey results in a wide swath of high density topographic data. These types of surveys are commonly performed in coastal areas by the U.S. Army Corps of Engineers (Corps). The most recent Corps LIDAR survey for the Long Beach area was flown from October 1, 2005 to November 26, 2005. The data from that survey is shown in Figure 20, but only covers the southern half of the island due to limitations of the flight path. However, the data provides valuable information when compared to common flooding areas deemed to be "repetitive loss" properties.

Figure 20 shows the LIDAR survey elevations in the City of Long Beach with the repetitive loss (RL) properties overlaid as red stars on the map. The RL properties are defined as properties that repeatedly have claims resulting from flooding damage. These properties are tracked for insurance reasons and submission to FEMA, and are logged in the City's GIS database. The common problem areas are easily identified by the clustering of RL symbols in Figure 20.

In comparing the LIDAR data and the RL property locations, the major flood zones appear to be concentrated in two low lying areas that border the bay. One of these areas is the residential eastern canals neighborhood. The other area is also residential, and is located in the western portion of the City. Based on the LIDAR data, the western area has low land elevations of approximately +5 to +6 ft-NGVD, but can range from +4.5 to +7.5 ft-NGVD. The LIDAR data does not extend into the canal neighborhood, but this area also has a high density of RL properties indicating that the land elevations are likely similar to the western area. Both these areas were observed during the June 22, 2009 site visit and were determined to have many bulkheads with elevations less than +9.0 ft-NGVD, as well as potential drainage issues.

Based on these observations, the residential neighborhoods on the east and west ends of the City have the most critical potential for bayside flooding. The bayfront properties in these two areas will need to raise their bulkheads to at least the +9.0 ft-NGVD level to meet the elevation of the City's bulkhead improvements and create a continuous level of protection. The canal neighborhood has a complex array of bulkheads with limited space and will likely require a site-specific solution since improving every bulkhead in the neighborhood may not be feasible.



NOTES:

1. COORDINATES ARE IN FEET BASED ON THE NEW YORK STATE PLANE COORDINATE SYSTEM, LONG ISLAND ZONE NORTH AMERICAN DATUM OF 1983 (NAD 83).
2. AERIAL PHOTOGRAPHY PROVIDED BY MICROSOFT VIRTUAL EARTH.
2. REPETITIVE LOSS PROPERTIES PROVIDED BY THE CITY OF LONG BEACH.
3. SHADED RELIEF MAP OF LONG BEACH, NY AND SURROUNDING AREA DERIVED FROM 2005 AIRBORNE LIDAR DATA, FLOWN BY USACE USING THE CHARTS SYSTEM BETWEEN OCTOBER 1 AND NOVEMBER 26, 2005.
4. ELEVATIONS SHOWN IN FEET ARE IN REFERENCE TO NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88).
5. CONVERSION FROM NAVD88 TO NGVD29 IS 1.1 FT (I.E. +9 FT NGVD = +7.9 FT NAVD).

LEGEND:

REPETITIVE LOSS PROPERTIES

216 ACOE MONUMENTS

2005 BARE EARTH LIDAR (NAVD FT)

29 - 30
27 - 28
25 - 26
23 - 24
21 - 22
19 - 20
17 - 18
15 - 16
13 - 14
11 - 12
9 - 10
7 - 8
5 - 6
3 - 4
0 - 2

N

0 700 1,400 Feet

1 inch = 1,400 feet

TITLE:

REPETITIVE LOSS PROPERTIES
CITY OF LONG BEACH
LONG ISLAND, NEW YORK

COASTAL PLANNING & ENGINEERING, INC
2481 NW BOCA RATON BLVD.
BOCA RATON, FL 33431
PH. (561) 391-8102
FAX.(561) 391-9116

DATE: 07/09/09	BY: HMV	COMM NO: 7350.00	Figure 20

G:\NewYork\7350000_LONG_BEACH_COASTAL_PROTECTION_STUDY_MXD\FEMA_DATA_072809.mxd

Flood Gates

The canal neighborhood is a critical area for improvements due to low and non-uniform bulkheads that allow repeated flood conditions along the canal front properties. An alternative to repairing/upgrading all the existing bulkheads throughout each canal is installing flood gates at the canal openings to the bay. The gates could be closed before storms, which would keep the rising storm water level out of the canals. After the storm has passed and the water levels return to normal, the gates could be opened again, thus eliminating the need to raise all the bulkheads within the canals to specified elevation.

There are many different types of flood gates in use around the world (Appendix B). Flap gates, tainter gates, and sector gates are commonly used for controlling water levels in rivers and canals. A flap gate rests on the seafloor where it is hinged to a sill at one side, and then raised to an angle that prevents water flow. Tainter gates rest above the water and are supported by adjacent overhead structures, which are mechanically lowered into place for protection. Sector gates are large pie-shaped gates that rotate horizontally to close off the waterway. However, many of these gate configurations are expensive and/or have other drawbacks. Some require large overhead or adjacent structures that are in place at all times and require constant maintenance in the marine environment. Therefore, their application may be of limited use in the canal openings fronting the bay. However, there are other options that may better suit the site-specific conditions in Long Beach such as inflatable rubber dams.

Inflatable rubber dams have been available for 30 years and provide a less expensive alternative to large structural flood gates. With more than 2,200 in use around the world, rubber dams have been shown to have lower initial and maintenance costs than traditional concrete and metal gate dams. They also have the flexibility of inflating during storms and lowering out of site during normal tidal fluctuations. There are currently two manufacturers that produce these dams: Japan's Bridgestone and Sumigate (http://www.tempe.gov/lake/Lakehistory/dams.htm). The first Bridgestone inflatable dams were available in 1978 with an estimated design life of 30 years (Tuthill, 2001).

The inflatable dams are secured to the bottom of a canal or river by a concrete sill where they remain out of sight until inflated with air, water, or both to close the canal opening. When inflated, they maintain a relatively low pressure (typically 4 to 10 psi) and are strong enough to prevent water flow. The present trend suggests an increased use of air-filled membranes (verses water-filled) because they can be deflated or inflated quicker, and they are less affected by freezing conditions. For example, the Rampsol storm surge barrier (Netherlands) is approximately 200 feet wide and 27 feet high, and takes about an hour to inflate (ARCADIS, 2006). The dams do not leak through the side or bottom seals when fully inflated, which often occurs with conventional steel gates. However, the dams may risk damages by vandalism when inflated, or by boats, anchors, or debris when deflated on the canal floor. A diagram of a typical inflatable dam system is provided in Figure 21.

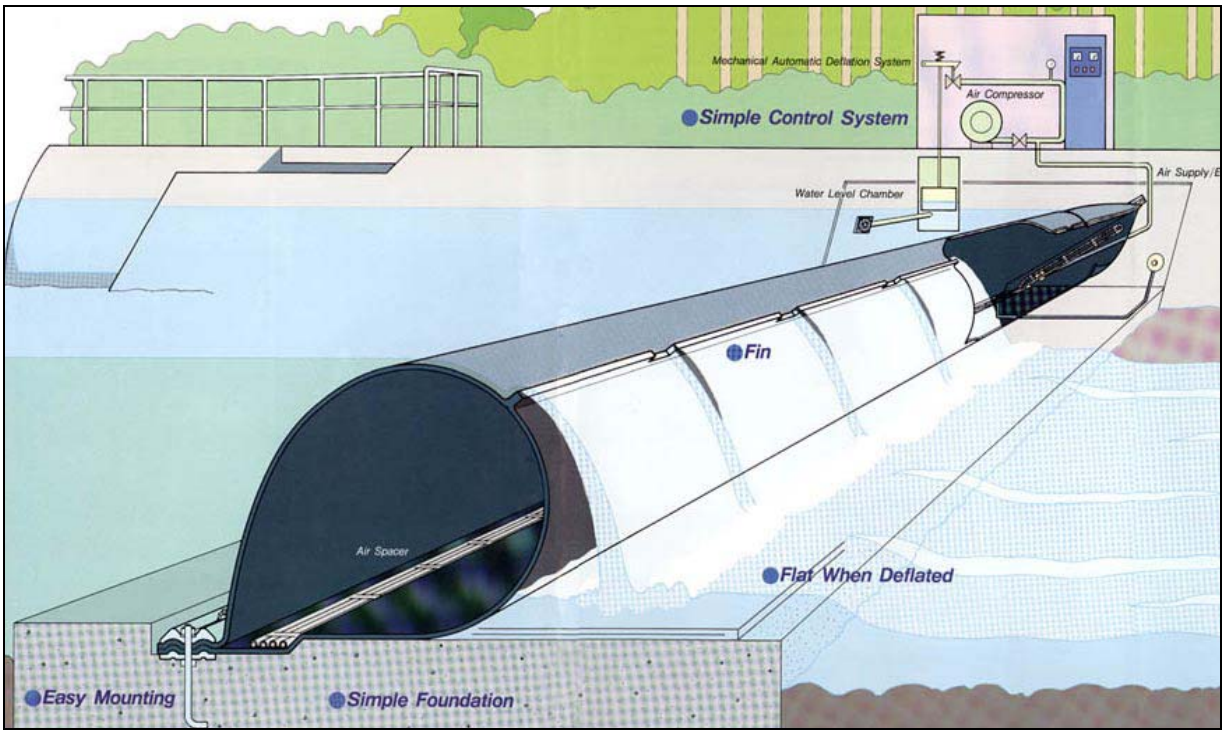


Figure 21. Inflatable rubber dam diagram (Source: www.bridgestoneindustrial.com)

Inflatable rubber dams are most commonly used in lake and river applications to divert water for irrigation, flood control, water retention for aquifer recharge, reducing or preventing salt water intrusion into fresh water areas, protect low-lying coastal areas from tidal flooding, enabling fish passage past diversion works and for sewage retention/separation during flood events (http://www.tempe.gov/lake/Lakehistory/dams.htm). They typically range in height from 1.3 to 15 feet, and are capable of spanning from 20 to 290 feet. As far as environmental conditions, they operate successfully in freezing conditions, and weed growth is minimized on the ethylene propylene diene monomer (EPDM) rubber compound. An example of a rubber dam installed in a location in Norway is provided in Figure 22.

Inflatable dams are also installed in many locations in the United States. The world's longest rubber dam was constructed in 1970 on the Susquehanna River at Sunbury, PA. This dam has a total length of 2,100 feet and consists of six rubber tubes each 300 feet in length and one tube 175 feet in length. The dam creates a seasonal recreational pool for boating and other water sports (Daus, 2001). Another example of an inflatable dam project is the Rio Salado project located on the Salt River in Tempe, Arizona (Figure 23). In this case, two inflatable dams were constructed within an existing flood-control project to create a two-mile-long recreation lake in the heart of downtown Tempe (http://www.tempe.gov/lake/Lakehistory/dams.htm). As an example of cost comparison, the Army Corps constructed a steel-gated concrete weir on Oil Creek, Pennsylvania at a cost of $2.2 million. A similar sized inflatable rubber dam costs $1.5 million (Tuthill, 2001).

Figure 22. Sumito electric rubber dam in Norway (courtesy of http://www.dyrhoff.co.uk/Dryhoff_Web_Brochure.pdf)

Figure 23. Dams on the Salt River in Tempe, Arizona (http://www.tempe.gov/lake/Lakehistory/dams.htm)

VI. NASSAU COUNTY HAZARD MITIGATION PLAN (NCHMP)

In 2006, URS Consultants completed a draft study for Nassau County entitled "*Nassau County, New York – Multi-Jurisdictional Natural Hazard Mitigation Plan*" to guide county and local officials in preparing, mitigating, planning for, and managing natural disasters. In September, 2008, the City of Long Beach adopted the Nassau County plan. The full document is available online at: http://www.nassaucountyny.gov/agencies/OEM/hazmit/FINALPLAN.html and is summarized below.

In accordance with Part 201.6 of the Disaster Mitigation Act of 2000 (DMA 2000), Nassau County, New York, has developed and adopted a Multi-Jurisdictional Hazard Mitigation Plan (NCHMP) to identify hazards that threaten the County and ways to reduce future damages associated with these hazards. In January of 2003, local officials from Nassau County joined members of the New York State Emergency Management Office (NYSEMO) to conduct an analysis of the County's hazards. The County also competed nationally for, and was later a recipient of, Fiscal Year 2003 Pre-Disaster Mitigation (PDM) planning grant funds from the Federal Emergency Management Agency (FEMA) for the purpose of developing this hazard mitigation plan.

The Draft Plan was first released in June 2006. Based on comments received, a Revised Draft was released in July 2006. Nassau County passed a resolution to formally adopt this as the Final Plan on March 5, 2007. By formal resolution of the City Council, the City of Long Beach adopted this plan as their local Hazard Mitigation Plan on September 2, 2008. This adoption was acknowledged and approved by FEMA September 3, 2008, and satisfied the City's obligations under the Disaster Mitigation Act of 2000 (DMA). The plan is considered a "living document", and will be monitored, evaluated, and updated on a 5-year cycle. The initial cycle is set at 3.5 years (p. 303, NCHMP) and the first update appraisal is due around March 2012.

Implementation Strategy

As part of the implementation strategy, several measures were recommended to all communities in Nassau County. The objective was to build and support local capacity to enable the public to prepare for, respond to, and recover from disasters. The recommendations included:

- Public education, community outreach to promote awareness of disaster preparation and disaster plans
- Acquisition of emergency weather radios by key facilities and organizations
- Development of detailed evacuation planning documents
- Flood-proofing of police stations identified as being at risk from flooding:
    - Designation and publication of Red Cross shelter locations
    - Update of master list of critical facilities
    - Promotion of disaster resistant development

Specific measures that were recommended to reduce the possibility of damage and losses caused by coastal floods and hurricane storm surges included:

- Participation in the National Flood Insurance Program (NFIP). As a participant, flood zones within the participating community will be identified and mapped. In return, the participating community will become eligible for flood insurance as long as the local governing body adopts and enforces a floodplain ordinance.

- Restricting uses of floodways to those tolerant of occasional flooding, including but not limited to agriculture, outdoor recreation, and natural resource areas.

- Identification and documentation of repetitively flooded properties. Exploration of mitigation opportunities for repetitively flooded properties, and if necessary, acquisition, relocation, elevation, and/or flood-proofing measures to protect these properties.

Action Items

Each of the participating communities was asked to prioritize the recommendations and identify action items. The action item evaluation and prioritization was undertaken during a meeting of the Planning Group on June 6, 2006. After reviewing the many types of action items suggested in the previous section, and adding any new items that might be unique for their community, each participant was asked to select a manageable number of action items which they felt their jurisdiction could reasonably commit to achieving in the next five years until the next plan update (maintenance cycle).

The action item identified for the City of Long Beach was to seek funding for the purchase and installation of back up electric and telecommunications in local government owned critical facilities. The participating representatives identified this as a high benefit, high cost, medium priority action item. Additional action items related to storm water and drainage that also apply to the City of Long Beach, but were not initially included are:

- Installation of storm drains

- Installation of backflow check valves for all drainage outfalls

- Repair and improve bulkheads (public and private) along bayfront areas

- Identify and implement localized flood reduction projects

It is recommended that the City of Long Beach contact the Hazard Mitigation Coordinator at the Nassau County Office of Emergency Management to address these minor deficiencies in the "Implementation Strategy" section of the NCHMP. Specifically, Table 51 (p. 282) of the NCHMP "City of Long Beach" section should be amended to include these additional action items. A formal update of the plan may need to occur during the scheduled plan maintenance cycle.

VII. FEMA GRANT PROGRAMS

The Department of Homeland Security (DHS) Federal Emergency Management Agency (FEMA) Hazard Mitigation Assistance (HMA) grant programs present a critical opportunity to protect individuals and property from natural hazards while simultaneously reducing reliance on Federal disaster funds. The HMA programs provide pre-disaster mitigation grants annually to States, Territories, Tribes, and local communities. The statutory origins of the programs differ, but all share the common goal of reducing the loss of life and property due to natural hazards. The Pre-Disaster Mitigation (PDM) program is authorized by the Robert T. Stafford Disaster Assistance and Emergency Relief Act (Stafford Act) and focuses on mitigation projects and planning activities that address multiple natural hazards, although these activities may also address hazards caused by manmade events.

The Flood Mitigation Assistance (FMA) program, Repetitive Flood Claims (RFC) program, and Severe Repetitive Loss (SRL) program are authorized by the National Flood Insurance Act (NFIA), and focus on reducing claims against the National Flood Insurance Program (NFIP). In the application process for the City of Long Beach, the City is considered the Sub-applicant, whereby their sub-application is submitted to the State, who acts as the Applicant to FEMA. A description of these programs and their potential utility to the City of Long Beach is summarized below. A sample application is provided for reference in Appendix C. The detailed regulations regarding administration of FEMA Grant Programs may be found in the Code of Federal Regulations (CFR), Title 44, Chapter 1, Part 13, "*Emergency Management and Assistance, Federal Emergency Management Agency, Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments*".

National Flood Insurance Program (NFIP)

The National Flood Insurance Program (NFIP) provides Federal Government backed flood insurance to individual property owners in FEMA designated Structural Flooding Hazard Areas (SFHA). One of the NFIP's primary objectives is to guide development away from high flood risk areas. As a condition of community participation in the NFIP, those structures built within SFHAs must adhere to strict floodplain management regulations enforced by the community.

The NFIP defines covered flooding as a general and temporary condition during which the surface of normally dry land is partially or completely inundated. Two properties in the area or two or more acres must be affected to qualify. Coverage is provided for flooding caused by:

- Overflow of inland or tidal waters;
- Unusual and rapid accumulation or runoff of surface waters from any source, such as heavy rainfall;
- Mudflow, i.e., a river of liquid and flowing mud on the surfaces of normally dry land areas;

- Collapse or subsidence of land along the shore of a lake or other body of water, resulting from erosion or the effect of waves, or water currents exceeding normal, cyclical levels.

The City of Long Beach falls in the categories of the first and second types of flooding, and is a participant in the National Flood Insurance Program. The City has an active outreach program designed to encourage participation by eligible property owners. As of February 28, 2006, there were 6,246 NFIP policies in force in the City of Long Beach, with 1,530 claims awarded from January 1, 1978 to February 28, 2006 totaling $8,316,199. In addition, the City has adopted all required building codes regarding construction in the SFHAs and recently participated in FEMA's Community Rating System (CRS) Program.

Through the CRS program, FEMA uses a point system to score communities based on their efforts to mitigate NFIP claims. The CRS then rewards communities that undertake floodplain activities beyond the requirements of the NFIP. The rewards take the form of reduced NFIP premiums for communities that meet the three goals of the CRS: reducing flood losses, facilitating accurate insurance ratings, and promoting awareness of the NFIP program. The City is actively pursuing these goals.

Flood Mitigation Assistance (FMA) Program

The Flood Mitigation Assistance (FMA) Program was created as part of the National Flood Insurance Reform Act (NFIRA) of 1994 (42 U.S.C. 4101) with the goal of reducing or eliminating claims under the National Flood Insurance Program. FEMA provides FMA funds to assist States and communities in implementing measures that reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other structures insurable under the National Flood Insurance Program.

FMA grants are provided to eligible Applicant States that, in turn, provide sub-grants to local governments. Since the State is the Applicant for these grants, the local communities are considered Sub-applicants and file their applications through a designated State point of contact for FEMA grants. The Applicant State selects and prioritizes applications developed and submitted to them by local jurisdictions (Sub-applicants) to submit to FEMA for grant funds (see Appendix C for an example application). Three types of FMA grants are available to States and communities as described below: Planning Grants, Project Grants, and Technical Assistance Grants.

<u>FMA Planning Grant - New Mitigation Plan</u>

This type of grant may be used by communities or States without a Mitigation Plan to prepare new Flood Mitigation Plans. Since the last Hazard Mitigation Plan (Nassau County) was approved and adopted by the City of Long Beach in 2008, the City is not eligible for this particular type of FMA grant until the current plan expires sometime in 2012. Even then, the recommended course of action would be to update the existing Flood Mitigation Plan, not create a new one.

FMA Planning Grant - Update of Existing Flood Mitigation Plan

Planning activities that develop local flood mitigation plans that meet the planning requirements in 44 CFR Part 201 are eligible for FMA Planning funds. The Planning grant is limited to those activities necessary to develop or update the flood portion of any mitigation plan. Plans may be either single or multi-jurisdictional. The mitigation planning regulation 44 CFR201.6(d)(3) states "*A local jurisdiction must review and revise its plan to reflect changes in development, progress in local mitigation efforts, and changes in priorities, and resubmit it for approval within five years in order to continue to be eligible for mitigation project grant funding*". A comprehensive update of an existing mitigation plan is appropriate to meet the cyclical update requirements (5 years for Single Jurisdiction Plans or 3 years for Multi-Jurisdiction Plans) under 44 CFR Part 201 and all update guidance documentation. As the lead agency in preparation of the existing mitigation plan, the Nassau County Office of Emergency Management is also responsible for this periodic comprehensive update, with input provided by local jurisdictions.

Eligible planning update activities may include:

- Local jurisdictions that participated in a multi-jurisdictional mitigation plan preparing a single-jurisdictional mitigation plan.
- Addressing data deficiencies identified in a previously approved mitigation plan.
- Addressing process limitations such as participation, public input, and plan maintenance already identified in a previously approved mitigation plan.
- Modifying actions and strategy in a previously approved mitigation plan.

The updated mitigation plan may include a revised risk assessment, but must include a modified mitigation strategy and specific, related action items. The update must clearly build on the existing approved mitigation plan and comply with the Multi-Hazard Mitigation Planning Guidance available on the FEMA Web site:
http://www.fema.gov/plan/mitplanning/guidance.shtm

The updated Mitigation Plan must:

- Include an attached State Standard/Enhanced or Local Plan Review Worksheet from the previous FEMA-approved mitigation plan. These worksheets are available from the Regional Office.
- Comprehensively describe any data deficiencies to be addressed.
- Provide a minimum of one example of how the jurisdiction implemented the strategy from the existing plan for mitigation actions for natural hazards (i.e., grants applied for, projects implemented, approval of mitigation related to legislation, zoning, or codes).

If a planning sub-grant is awarded, the existing plan and approval date remain valid until the 3-year expiration date for State plans or the 5-year expiration date for local plans. However, the Hazard Mitigation Coordinator at the Nassau County Office of Emergency Management recommended that since the City of Long Beach is covered under the Nassau County Plan it should remain that way (personal communication 5/5/09, Terry Winters). Funding is limited and it is unlikely that an application of this nature would be competitive enough to receive a planning grant.

Furthermore, a jurisdiction cannot receive a planning grant if they do not intend to create either a new plan or a comprehensive update of an already approved plan. If the City took one of these courses of action, they would then become solely responsible for plan maintenance. However, periodic plan monitoring, evaluation, and minor updating are allowable maintenance requirements for any jurisdiction with an approved Hazard Mitigation Plan. The City can at any point reevaluate their portion of the plan and add or address any data they feel necessary, without a planning grant or a comprehensive update.

FMA – Project Grants

This type of FMA grant is used to implement measures to reduce flood losses, such as elevation, acquisition, or relocation of NFIP-insured structures. States are encouraged to prioritize FMA funds for applications that include repetitive loss properties, defined as structures with 2 or more losses each with a claim of at least $1,000 within any ten-year period since 1978. Only NFIP-participating communities with approved Flood Mitigation Plans can apply for FMA Project grant. The City of Long Beach has an approved FMP (as part of the NCHMP) and thus is eligible to apply for this type of grant.

FMA eligible project activities include:

- Acquisition and demolition or relocation of structures, with conversion of the underlying property to deed-restricted open space and relocation of properties to areas outside the SFHA.

- Elevation of existing structures to at least the Base Flood Elevation (BFE) or an ABFE or higher.

- Dry flood-proofing of non-residential structures.

- Minor localized flood reduction projects.

These projects may include the installation or modification of culverts and floodgates, the creation of small retention and detention basins, and the upgrade of culverts to bridges. Minor localized flood reduction projects may not duplicate the flood prevention activities of other Federal agencies. At least 50% of the structures directly benefiting from the mitigation activity must be NFIP insured properties. Documentation must be provided in the sub-application that identifies all properties that will benefit from this activity and specifically identifies the NFIP insured properties.

FMA - Technical Assistance Grants

This type of FMA grant is intended for the State to help administer the FMA program and activities. Local communities such as the City of Long Beach are not eligible for Technical Assistance Grants.

FMA – Funding and Cost Sharing

An Applicant's FMA project and planning target allocation is based on the national percentage of NFIP policies within the jurisdiction. An Applicant may, however, apply for funding exceeding its target allocation and FEMA may contribute up to 75% Federal funding for the amount approved under the grant award. A Federal cost share of 90% is available for FMA grants under Section 322 of the Stafford Act for the mitigation of severe repetitive loss (SRL) properties.

Any State applicant that has taken actions to reduce the number of repetitive loss properties, and has a FEMA approved State Mitigation Plan with a "Repetitive Loss Strategy" that specifies the details of the actions taken may be eligible for increased cost sharing. The City has documented over 40 Repetitive Loss properties for which action has been taken to reduce flooding. These properties were proposed for removal from the Repetitive Loss properties list. Based on these actions, it appears the City, through the State as Applicant, may qualify for an increased Federal cost share.

Pre-Disaster Mitigation (PDM) Program

The Pre-Disaster Mitigation (PDM) program provides funds to States, territories, Indian tribal governments, communities, and universities for hazard mitigation planning (Planning Grants) and the implementation of mitigation projects prior to a disaster event (Project Grants).

Funding these plans and projects reduce overall risks to the population and structures, while also reducing reliance on funding from actual disaster declarations. PDM grants are to be awarded on a competitive basis and without reference to State allocations, quotas, or other formula-based allocation of funds. For example, Nassau County was granted PDM funds for planning activity in FY 2003 which were used to create the NCHMP.

PDM – Planning Activities Grants

Planning activities eligible for funding under the PDM program include:

- Local jurisdictions that participated in a multi-jurisdictional mitigation plan preparing a single-jurisdictional mitigation plan.
- Addressing data deficiencies identified in a previously approved mitigation plan.
- Addressing process limitations such as participation, public input, and plan maintenance already identified in a previously approved mitigation plan.

- Modifying actions and strategy in a previously approved mitigation plan.

The updated mitigation plan may include a revised risk assessment, but must include a modified mitigation strategy and specific, related action items. The update must clearly build on the existing approved mitigation plan and comply with the Multi-Hazard Mitigation Planning Guidance available on the FEMA Web site:
http://www.fema.gov/plan/mitplanning/guidance.shtm

However, as discussed above, recent guidance received from the Hazard Mitigation Coordinator at Nassau County recommended that the City should remain under the existing Nassau County Plan. Currently, the multi-jurisdictional plan is the responsibility of Nassau County and periodic plan monitoring, evaluation, and updating are all maintenance requirements of any jurisdiction with an approved Hazard Mitigation Plan. Therefore, the City can reevaluate their portion of the plan at any time and add or address any data they feel necessary, without a planning grant or a comprehensive update.

PDM – Eligible Project Activities

Project activities eligible for funding under the PDM program include:

- Acquisition and demolition or relocation of structures, with conversion of the underlying property to deed-restricted open space.

- Relocation of public or private structures.

- Elevation of existing public or private structures to avoid coastal or riverine flooding.

- Retrofitting (e.g., storm shutters, hurricane clips, bracing systems) of existing public or private structures to meet or exceed applicable building codes relative to hazard mitigation.

- Construction of safe rooms (tornado and severe wind) for public and private structures that meet the project criteria identified in FEMA Mitigation Interim Policy MRR-2-07-1.

- Hydrologic and hydraulic studies/analyses, engineering studies, and drainage studies for the purpose of project design and feasibility determination included as part of a project sub-application.

- Vegetation management for natural dune restoration, wildfire, or snow avalanche.

- Protective measures for utilities (e.g., electric and gas), water and sanitary sewer systems and/or other infrastructure (e.g., roads and bridges).

- Stormwater management projects (e.g., culverts and retention basins) to reduce or eliminate long-term risk from flood hazards.

- Localized flood reduction projects, such as certain ring levees and floodwall systems that are designed specifically to protect critical facilities (defined as Hazardous Materials Facilities, Emergency Operation Centers, Power Facilities, Water Facilities, Sewer and Wastewater Treatment Facilities, Communications Facilities, Emergency Medical Care Facilities, Fire Protection, and Emergency Facilities) and that do not constitute a section of a larger flood control system.

PDM – Eligible Management Activities

Management activities eligible for funding under the PDM program as a sub-category of a Project Grant include:

- The solicitation, review, and processing of PDM planning and project sub-applications and sub-grant awards.

- Providing technical assistance to Sub-applicants regarding BCA and Environmental/Historic Preservation documentation.

- Geocoding mitigation projects selected for further review.

- Delivery of technical assistance (e.g., plan reviews, and planning workshops) intended to support the implementation of planning and project activities.

- Managing grants (e.g., quarterly reporting and closeout).

- Technical monitoring (e.g., site visits and technical meetings).

- Hiring staff to perform the above activities.

PDM – Funding and Cost Sharing

The Federal cost share for the PDM grant program is 75% Federal and 25% Non-Federal. For Sub-applicant planning activity grants, new plan development may not exceed $800,000 Federal share. Comprehensive update of a plan may not exceed $400,000 Federal share, and information dissemination activities may not exceed 10% of the total Federal share requested as part of the planning sub-application.

It is not recommended at this time that the City of Long Beach pursue a Planning Grant under either the FMA or PDM programs. Because the City has adopted the Multi-Jurisdictional Hazard Mitigation Plan for Nassau County, it is much simpler and quicker to add or revise individual action items in the existing plan. It is recommended that the City contact the Hazard Mitigation Coordinator at the Nassau County Office of Emergency Management (Terry Winters) to reevaluate their portion of the plan and add or address any data that may be lacking.

Repetitive Flood Claims (RFC) Program

This program provides funding to States and communities to reduce or eliminate the long-term risk of flood damage to structures insured under the NFIP that have had one or more claims for flood damages. To be eligible for this grant program, the City of Long Beach must demonstrate that it is unable to provide the 25% local share of activity costs or is unable to manage the activities; otherwise the FMA program is used. It is unlikely that the City of Long Beach would qualify for this type of grant.

Severe Repetitive Loss (SRL) Program

This program provides funding to reduce or eliminate the long-term risk of flood damage to severe repetitive loss (SRL) structures insured under the National Flood Insurance Program (NFIP). The Severe Repetitive Loss (SRL) grant program was authorized by the Bunning-Bereuter-Blumenauer Flood Insurance Reform Act of 2004, which amended the National Flood Insurance Act of 1968. The amendment was instituted to provide funding to reduce or eliminate the long-term risk of flood damage to severe repetitive loss (SRL) structures insured under the National Flood Insurance Program (NFIP).

The definition of severe repetitive loss as applied to this program was established in Section 1361A of the National Flood Insurance Act, as amended (NFIA), 42 U.S.C. 4102a. An SRL property is defined as a residential property that is covered under a NFIP flood insurance policy and:

> (a) Has at least four NFIP claim payments (including building and contents) over $5,000 each, and the cumulative amount of such claims payments exceeds $20,000; or
>
> (b) For which at least two separate claims payments (building payments only) have been made with the cumulative amount of the building portion of such claims exceeding the market value of the building.

For both (a) and (b) above, at least two of the referenced claims must have occurred within any ten-year period, and must be greater than 10 days apart. It is unknown at this time the number of qualified structures under these criteria in the City of Long Beach. In order for the number of qualifying SRL properties to be quantified, the City's flood insurance claims records will need to be reviewed in detail and compared to the criteria above, which is beyond the scope of this report. However, the eligible project activities are described below for reference.

<u>SRL – Eligible Project Activities</u>

Eligible flood mitigation project activities under SRL grant program include:

- Acquisition and demolition or relocation of at risk structures and conversion of the property to open space.

- Elevating existing structures to at least the Base Flood Elevation (BFE) or an Advisory Base Flood Elevation (ABFE) or higher.

- Minor physical localized flood reduction projects.

- Dry flood-proofing of historic properties.

SRL – Funding and Cost Sharing

FEMA may contribute up to 75% Federal funding for the amount approved under the grant award to implement approved SRL activities. An increased Federal cost share of up to 90% is available for any Applicant that has taken actions to reduce the number of repetitive loss properties, including severe repetitive loss properties. A FEMA-approved State or Tribal Mitigation Plan that specifies how the number of such repetitive loss properties were reduced (and/or are intended to be reduced), is also required for the increased Federal share.

Summary of Grant Supported Activities

A summary of the types of activities supported under each grant program is given in Table 2, below (from FEMA's "Hazard Mitigation Assistance Program Guidance – June 2008").

Table 2. FEMA Grant Program Supported Activities

Type of Activity	FEMA Program			
	PDM	FMA	RFC	SRL
1. Property Acquisition and Demolition or Relocation Project:				
Property Acquisition and Demolition or Relocation	X	X	X	X
2. Construction Type Projects:				
Property Elevation	X	X	X	X
Mitigation Re-Construction[1]				X
Localized Minor Flood Reduction Projects	X	X	X	X
Dry Flood-proofing of Residential Property[2]		X		X
Dry Flood-proofing of Non-Residential Structures		X	X	
Stormwater Management	X	X		
Infrastructure Protection Measures	X			
Vegetative Management/Soil Stabilization	X			
Retrofitting Existing Buildings and Facilities (Wind/Earthquake)	X			
Safe room construction	X			
3. Non-Construction Type Projects:				
All Hazard/Flood Mitigation Planning	X	X		
Note 1. The SRL Program allows Mitigation Reconstruction projects located **OUTSIDE** the regulatory floodway or Zone V as identified on the effective Flood Insurance Rate Map (FIRM), or the mapped limit of the 1.5-foot breaking wave zone. Mitigation Reconstruction is only permitted if traditional elevation cannot be implemented.				
Note 2. The residential structure must meet the definition of "Historic Structure" in 44 CFR § 59.1.				

VIII. FEMA HAZARD MITIGATION ASSISTANCE GRANT APPLICATIONS

For the purposes of this study, the types of activities for which Hazard Mitigation Assistance (HMA) grant funds are applicable may be split between those activities designed to mitigate damages to individual, privately owned structures, and those designed to mitigate damages to public or City owned facilities or larger areas containing multiple parcels. Activities such as relocating or elevating structures, flood-proofing structures (wet or dry), and floodwalls designed to protect individual parcels would fall under the first category. Activities such as improvements to City-owned bulkheads and drainage system improvements would fall under the second category.

The City of Long Beach may wish to pursue grants for the first category of activities (private properties), and there is enough information contained herein to begin this process. However, the main focus of this study is on activities in the second category, which is related to infrastructure improvements for public or City owned properties. These activities are designed to mitigate flooding by conveying runoff to the bay efficiently and preventing bay waters from inundating normally dry land during storm surges and extremely high tides. Activities such as bayside bulkhead construction or upgrades, improvements to stormwater drainage systems, and minor (less than $1 million) localized flood reduction projects fall under the second category, and are the focus of the following sections.

Programmatic Requirements

Proposed mitigation projects must meet all programmatic requirements including that they:

- Be cost-effective and able to substantially reduce the risk of future damage, hardship, loss, or suffering resulting from a major disaster.

- Have a Benefit Cost Analysis (BCA) using a FEMA-approved methodology that results in a Benefit Cost Ratio (BCR) of 1.0 or greater.

- Conform with 44 CFR Part 9, Floodplain Management and Protection of Wetlands, and 44 CFR Part 10, and any applicable environmental laws and regulations.

- Not duplicate benefits available from another source for the same purpose or assistance that another Federal agency or program has the primary authority to provide.

- Be technically feasible and have the ability to be implemented. The project cost estimate must reflect the engineering design, if applicable, and include all anticipated costs.

- Not be suspended or withdrawn from the NFIP program.

- Solve a problem independently or constitute a functional portion of a solution where there is assurance that the project as a whole will be completed.

- Meet the requirements of applicable Federal, State, Indian Tribal, and local laws, implementing regulations, and Executive Orders (E.O.).

Management Costs

Sub-applicants (i.e., the City of Long Beach) may include a maximum of 5% of the total funds requested in their sub-application for management costs to support the activity. Sub-applicant management cost activities must be consistent with U.S. Office of Management and Budget (OMB) Circular A-87, "*Cost Principles for State, Local, and Indian Tribal Governments*". Sub-applicants requesting management costs should provide supporting documentation and include these costs as separate line items in the cost estimate portion of the sub-application. Sub-applicant management costs must be included in the BCA for a project. Indirect costs, if requested, must also be included as part of the Sub-applicant management costs, not to exceed 5% of the total cost of the sub-application. Indirect costs should be supported with a current Indirect Cost Rate that is approved by a Federal Cognizant Agency.

Application Procedure

In the application process for the City of Long Beach, the City is considered the Sub-applicant, whereby their sub-application is submitted to the State, who acts as the Applicant to FEMA. A description of the application process and requirements is summarized below. A sample application is provided for reference in Appendix C.

Unified Hazard Mitigation Assistance (UHMA) Application

FEMA's Mitigation Directorate is currently unifying the multi-hazard PDM program with the FMA, RFC, and SRL programs into a unified HMA program application cycle. The intent of this alignment is to enhance the quality and efficiency of grant awards on an allocation and competitive basis. The Unified Hazard Mitigation Assistance (UHMA) application period is from June 1, 2009 through December 4, 2009. Applicants must submit an FY 2010 grant application to FEMA through the *e*Grants system by December 4, 2009, at 3:00:00 p.m. Eastern Standard Time.

*e*Grants System

FEMA utilizes a web-based system for all HMA grant applications. Applicants and Sub-applicants must use FEMA's Electronic Grants Management System (*e*Grants) to submit grant applications to FEMA. If a local Sub-applicant does not use the *e*Grants system to submit their planning and/or project sub-application(s) to the Applicant, then the Applicant must enter the Sub-applicant's paper sub-application(s) into the *e*Grants system on their behalf.

- Applicants must provide an *original and two copies* of any paper supporting documentation that cannot be electronically attached to the *e*Grants application (*e.g.*, engineering drawings, photos, maps) to the appropriate Regional Office by the

application deadline. The City of Long Beach falls in Region II, which can accessed through the following link: http://www.fema.gov/about/contact/regionii.shtm

- Applicants must submit separate applications for each Project Grant. Additional information regarding the eGrants system is available on the Mitigation eGrants System website: http://www.fema.gov/government/grant/egrants.shtm

FEMA will provide assistance to Applicants and Sub-applicants during the application period. Additional information for FEMA mitigation grant activities, including project development and pre-award requirements, is available on the Grant Applicant Resources webpage. The information entered in the *e*Grants system must include:

- Whether the proposed activity is consistent with the Applicant's mitigation goals and objectives as stated in the Applicants' Mitigation Plan as well as the goals and objectives of the Sub-applicant's local or Tribal mitigation plan.

- Whether the proposed activity is feasible and will provide a long-term, independent solution to mitigate natural hazards.

- A statement that the Sub-applicant is able to manage the grant funds and complete the activity in the time specified.

Cross Program Applications

FEMA may determine that sub-applications submitted under a specific grant program but not funded under the requested grant program may be considered by another mitigation grant program(s) when the following requirement is met: Applicants must include a statement in their grant application under the "Comments for FEMA" field in *e*Grants indicating their interest to have their sub-applications considered for another mitigation grant program and specify the additional mitigation grant program(s) and corresponding Catalog of Federal Domestic Assistance (CFDA) number(s). The CFDA numbers for the four mitigation grant programs under HMA are:

- PDM: 97.047;
- FMA: 97.029;
- RFC: 97.092; and
- SRL: 97.110.

Project Sub-application Checklist

Sub-applications (from the City of Long Beach) must include a detailed scope of work and other necessary information for each proposed project. This information will be used by FEMA to evaluate the project for eligibility and completeness in order to select projects for award. Sub-applicants must submit a separate project sub-application for each project for which funding is requested. The project sub-application provides all of the necessary information for FEMA to determine the eligibility of proposed projects under the HMA program. The project sub-

application must include the following information (from FEMA's "Hazard Mitigation Assistance Program Guidance Document" of June 19, 2008):

- **Sub-Applicant Information**: Provide name, type of Sub-applicant (e.g., State agency, local government, or federally recognized Indian Tribal government), address, State and Federal Tax numbers, and Employer Identification Number.

- **Contact Information**: Provide name, agency, and address for the point(s) of contact for the sub-application.

- **Sub-Application Name**: Applicants must verify that the sub-application name includes the location of the proposed activity and the activity type.

- **Community Information**: Provide the name of the community and a brief description of the community to include population, location, any geographic areas of interest, a synopsis and history of hazards affecting the community, and other applicable information that will clarify the need for the mitigation project.

- **Mitigation Plan Information**: Indicate whether the State, Indian Tribal government, or Territory is covered by a FEMA-approved State Mitigation Plan (Standard or Enhanced) or Tribal Mitigation Plan. Indicate whether the local entity is covered by a FEMA-approved Tribal or local mitigation plan and describe how the proposed project is consistent with the goals, objectives, and priorities identified in any existing mitigation plans.

- **Scope of Work**: Describe the purpose, objectives, methodology, feasibility, outcomes, resources, deliverables, and benefits of the proposed project, including the hazard(s) to be mitigated, location of project (e.g., appropriate sections of the FIRM), and the engineering design, feasibility, and effectiveness for relocation projects (see Appendix A of this document, "Sample Scope of Work", for further details).

- **Activity Information**: Identify, at the project level, the alternative project types considered and the type of activity selected, including a written justification for the selected project type.

- **Hazard Information (PDM Only):** Identify the hazard to be mitigated by the project and the location and dimensions (i.e., area, volume, depth) of the project, including the project site location on at least a 1:24,000 scale USGS topographic map, photographs showing the project site, sketches, and/or drawings showing the project site (e.g., appropriate sections of a FIRM).

- **Decision-making Process (SRL and PDM Only):** Identify alternatives considered to address the hazard prior to selecting the proposed project, describe the process used to determine that the proposed project is the best alternative to solve the identified problems, and provide the reasons the alternatives were not selected. For SRL only, provide an explanation detailing why the Sub-applicant included some SRL properties in

the consultation process, but did not include other SRL properties within the Sub-applicant's jurisdiction.

- **Properties**: Provide a list of properties to be mitigated. For each property, provide the address, latitude, and longitude, NFIP repetitive loss number, and NFIP Insurance Policy Number. In addition, provide a Notice of Voluntary Interest (or similar acknowledgement that property owner is aware of the voluntary nature of their participation) signed by owners of properties identified in the sub-application. For acquisition, relocation, or elevation projects, a photograph of each property to be mitigated is required.

- **For SRL only:** Provide a signed Pre-Award Consultation Agreement for each property identified in the sub-application.

- **Schedule**: Provide timeframes to complete each project task (e.g., survey, appraisal, permitting, inspection requirements, and site preparation), and significant milestones throughout the entire period of performance.

- **For SRL only:** During the consultation and mitigation offer process, individual property owners must be apprised of the anticipated project schedule for relocation, elevation, acquisition, minor physical localized flood reduction projects, or flood-proofing (historic properties only) in the Pre-Award Consultation Agreements.

- **Cost Estimate**: Provide all anticipated and potential costs for each proposed project activity. Costs should be provided as line items, not lump sums. Provide an Approved Indirect Cost Agreement, if applicable. Include information on payments received under the URA as amended, if applicable.

- **For SRL only:** The Pre-Award Consultation Agreements must inform individual property owners of the anticipated offer amount for relocation, elevation, acquisition, minor physical localized flood reduction projects, or flood-proofing (historic properties only).

- **Match Sources**: Provide the non-Federal cost share for the proposed activity, including documentation to support the non-Federal cost share.

- **Cost-effectiveness Information**: Provide a complete project-level BCA for the project sub-application.

- **Environmental/Historic Preservation Review**: Provide a description of Environmental and Historic Preservation impacts and the alternatives considered prior to deciding upon the project. Provide documentation that property owners offered assistance under the HMA programs have been notified, if applicable, of the potential historic significance of their property.

- **Maintenance Schedule and Costs:** Provide a maintenance schedule, including cost information, and identify the entity that will perform long-term maintenance.

- **Evaluation Information:** Provide responses to the questions for each sub-application for competitive National Ranking and Evaluation, including documentation for the BCA, if applicable.

- **Property Acquisition Statement of Assurances:** Information required for property acquisition and relocation sub-applications is detailed in Section 2.3.13, Property Acquisition and Relocation for Open Space.

- **Assurances and Certifications**: Complete the Summary Sheet for Assurances and Certification, FEMA Form 20-16; Assurances-Non-construction Programs, FEMA Form 20-16A; Assurances-Construction Programs, FEMA Form 20-16B; Certification Regarding Lobbying; Debarment, Suspension, and Other Responsible Matters; and Drug-Free Workplace Requirements, FEMA Form 20-16C; and Disclosure of Lobbying Activities, Standard Form LLL.

A summary sheet for Assurances and Certifications is available at:
ftp://ftp.txdps.state.tx.us/dem/empg/ff_20-16_packet.pdf.

Points of Contact

The following are the official Points of Contact (POC) for the Hazard Mitigation Grant Program at the State and County levels. They can answer any questions about the programs and assist in the preparation and filing of grant applications. The normal protocol is to use the Nassau County POC, who will then communicate directly with the State and FEMA and provide guidance to the City.

- POC at Nassau County is Terry Winters - Hazard Mitigation Coordinator, Nassau County Office of Emergency Management 100 Carman Ave East Meadow, NY 11554; 516-573-0636; Twinters@nassaucountyny.gov

- POC at NY State is Tom Abbati - State Emergency Mitigation Manager for Nassau County. 518-292-2371; Thomas.Abbati@semo.state.ny.us

- Section 2.7.14, Regional Contact Information:

  Mr. Richard Lord New York State Emergency Management Office
  1220 Washington Avenue, Suite 101
  Building # 22
  Albany, NY 12226
  Phone: 518-292-2370
  Fax: 518-457-7528
  E-Mail: richard.lord@semo.state.ny.us
  Web Page: www.semo.state.ny.us/

- Mitigation eGrants Help Desk (FMA and PDM technical assistance):
  MTeGrants@dhs.gov Phone 1-866-476-0544

IX. U.S. ARMY CORPS OF ENGINEERS

Thus far, the ongoing studies for the U.S. Army Corps of Engineers Storm Damage Reduction Project for Long Beach Island have been restricted to ocean-side flood potential. Since it is well documented that the City of Long Beach floods from both sides of the island, there should be sufficient justification for Corps support on the bayside as well. In fact, the U.S. House of Representatives, Committee on Transportation and Infrastructure, passed a Resolution on April 5, 2006 that requests the Secretary of the Army to initiate a review of the pertinent reports to determine the need for a bay shore storm protection project in Long Beach (Appendix D).

Since there is an existing directive to review the problem, the U.S. Army Corps of Engineers could commence a reconnaissance level study to determine if a bayside project for Long Beach is in the federal interest. If the result of the reconnaissance study was positive, then the Corps could then seek further authorization for a feasibility level study that would identify potential solutions.

Although there is a standing directive from the federal government for the Corps to determine the need for a project dealing with bayside storm protection in Long Beach, tagging a new bayside study onto the ongoing ocean-side plan could result in a delay of the overall process. However, if Corps support is warranted, the process can be run in a separate but parallel track. It is recommended that the Corps representative be contacted to discuss the feasibility of such a plan and determine the best course of action to commence the reconnaissance study.

X. CONCLUSIONS AND RECOMMENDATIONS

The City of Long Beach is subject to flooding from both sides of the barrier island during storms and unusual high tides. The bayfront shoreline consists of a mix of residential and commercial property with bulkheads that are discontinuous and variable in elevation. In addition, the stormwater outfalls that normally drain into the bay tend to backflow with seawater during times of high water, which results in flooding of streets and other low lying areas. Although the City has made improvements to some of the outfalls by installing check valves and has raised a number of City-owned bulkheads, there are points in the system that allow flooding to occur. Sea level rise and recent updates to the FEMA flood maps further underscore the need for a bayside flood protection project in the City of Long Beach.

The City may be eligible for Project Grants under the Flood Mitigation Assistance (FMA) and Pre Disaster Mitigation (PDM) Programs, which are under the FEMA Hazard Mitigation Assistance Program. Eligible project types include floodwall construction and upgrades, drainage and outfall improvements, and small flood control projects costing less than $1 million each. Multiple applications may be submitted and specific projects should be identified for consideration.

There is a standing directive from the U.S. House of Representatives for the Army to determine the need for a bayside storm protection project in Long Beach. Based on this directive, the Corps could commence a reconnaissance level study to evaluate the level of federal interest in such a project. However, pursuing a Corps' project on the bayside should proceed in a parallel

but separate track from the ocean side study to avoid delaying either project. The Corps should be contacted to determine what is needed to commence the reconnaissance study for the bayside.

To address storm surge and tidal flooding from the bayside of the island, it is recommended that the City take the following actions and implement vital improvements:

1. Perform a detailed inspection of all stormwater outfalls and existing bulkheads to identify specific issues that need to be addressed.

2. Repair existing bulkheads to their top elevation by filling in all holes in the steel sheet piles and replace any damaged areas that may be subject to storm surge.

3. Install Tide Flex, or similar, valves on all storm drain outfalls to eliminate backflow issues through the existing drainage system.

4. Implement a basic maintenance plan to periodically inspect storm drains/outfalls and bulkheads to ensure they remain fully functional at all times.

5. Raise all bayfront bulkheads (public and private) to a minimum design elevation of +9.0 ft-NGVD or higher. Likewise, install new bulkheads to the same elevation in areas where they are currently lacking or have been destroyed.

6. Consider a site-specific solution for the canal entrances to the bay, such as flood gates or inflatable rubber dams that can be moved into place prior to the onset of a storm tide.

7. Contact the Nassau County Hazard Mitigation Coordinator in order to initiate updates/maintenance of the Multi-Jurisdiction Hazard Mitigation Plan.

8. FEMA Grants under the FMA, PDM, SRL programs should be sought to the greatest extent practicable with the City of Long Beach acting as a sub-applicant to NY State. Contact specified staff members of the Hazard Mitigation Grant Program at the State and County levels for further consultation.

9. Determine which of the repetitive loss properties identified in existing records would qualify as Severe Repetitive Loss properties to increase potential Federal cost sharing under the SRL and FMA Grant Programs, and to increase the priority level of any application.

10. Determine if U.S. Army Corps support is in the federal interest for a bayside storm protection project. The City should coordinate with the Corps to commence a reconnaissance level study under the existing directive from the House of Representatives.

XI. REFERENCES

ARCADIS. 2006. Inner Harbor Navigation Canal Conceptual Study. http://usace-no.arcadis-us.com/Lists/Announcements/Attachments/10/IHNC-Floodgates_Report-with_costs.pdf

City of Long Beach, October, 2008. Community Rating System Application for FEMA National Flood Insurance Program.

Code of Federal Regulations (CFR), Title 44, Chapter 1, Part 13, "*Emergency Management and Assistance, Federal Emergency Management Agency, Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments*". www.access.gpo.gov/nara/cfr/waisidx_00/44cfrv1_00.html

Daus, G. Flood Protection, Feasibility Study Proposes Inflatable Dam. WATER Engineering & Management. November 2001. www.waterinfocenter.com.

Dirke, P. October 2006. ARCADIS Inner Harbor Navigation Canal Alternatives Study.

Federal Emergency Management Agency, 1996. Flood Insurance Rate Maps, Q3 Flood Mapping.

Federal Emergency Management Agency - Multi-Hazard Mitigation Planning Guidance available on the FEMA Web site: http://www.fema.gov/plan/mitplanning/guidance.shtm

Federal Emergency Management Agency (FEMA) Flood Insurance Study, Town of Hempstead, Nassau County, NY, Oct. 1976.

Fletcher, C.H. (2009), "Sea Level by the End of the 21st Century: A Review." *Shore & Beach* - Journal of the American Shore & Beach Preservation Association, Vol. 77, No. 4, Fall 2009.

Frederick S. Peters Jr., January 2, 2009. Letter to City of Long Beach re: Farrell Street flooding records.

Insurance Services Office Inc. Jimmy Chin, 2008. Miscellaneous open space calculations, floodplain parcel inventories for City of Long Beach.

Mean Sea Level Trends for Sandy Hook, NJ and The Battery, NY. 2008. NOAA Tides and Currents. http://tidesandcurrents.noaa.gov/

Morang, A. (2007) *Hurricane Barriers in New England and New Jersey – History and Status After Four Decades.* Coastal and Hydraulics Laboratory, U.S. Army Research & Development Center, Vicksburg, MS. ERDC/CHL TR-07-11

OMB Circular A-87, "*Cost Principles for State, Local, and Indian Tribal Governments*"

Pfeffer, W.T., J.T. Harper, and S. O'Neel (2008), "Kinematic Constraints on Glacier Contributions to 21st Century Sea-Level Rise." *Science*, 321, p. 1340-1343.

Saccardi & Schiff, Inc., Eschbacher Engineering, P.C., May 2005. City of Long Beach Comprehensive Plan Technical Memorandum –Existing Conditions, Issues and Opportunities".

Saccardi & Schiff, Inc. April 2007. "City of Long Beach Comprehensive Plan."

Saccardi & Schiff, Inc. Nov 2007. City of Long Beach Local Waterfront Revitalization Program Long Beach, New York, Draft.

Steel-Fab, Inc. 2009. http://www.steel-fab-inc.com/gates/tainter.html

Spillway Gates and Inflatable Rubber Dams. Dryhoff company brochure.
http://www.dyrhoff.co.uk/Dryhoff_Web_Brochure.pdf

Tempe Town Lake on the Rio Salado – Inflatable Dams. 2001.
http://www.tempe.gov/lake/Lakehistory/dams.htm

Tuthill, Andrew M. Research Hydraulic Engineer, Ice Engineering Group, RS/GIS/Water Resources Branch, U.S. Army Cold Regions Research and Engineering Laboratory (CRREL), Engineer Research and Development Center (ERDC), Hanover, New Hampshire, October 2001. *Performance Survey of Inflatable Dams in Ice-Affected Waters.* Ice Engineering. Number 30.

URS Consultants, February, 2007. "Nassau County, New York – Multi-Jurisdictional Natural Hazard Mitigation Plan" (Final) Prepared for Nassau County Office of Emergency Management.