11.0 INTRODUCTION

This chapter examines the potential impacts to sewer and water infrastructure from the implementation of one or more proposed initiatives (Proposed Actions) intended to enhance coastal and social resiliency along the Tottenville shoreline of the South Shore of Staten Island, NY. These initiatives include the Living Breakwaters Project (Breakwaters Project) and Tottenville Shoreline Protection Project (Shoreline Project).

In accordance with the 2014 *City Environmental Quality Review (CEQR) Technical Manual* and the National Environmental Policy Act (NEPA), the chapter describes:

- Existing wastewater and stormwater conveyance, and wastewater treatment;
- Wastewater and stormwater conveyance, and wastewater treatment conditions in the future without the Proposed Actions (the No Action Alternative); and
- Potential impacts of the Proposed Actions on wastewater and stormwater systems under three proposed alternatives (Alternative 2: the Layered Strategy, or the Preferred Alternative; Alternative 3: the Breakwaters Project without the Shoreline Project; and Alternative 4: the Shoreline Project without the Breakwaters Project).

11.1 PRINCIPAL CONCLUSIONS

The Proposed Actions would result in the implementation of one of three alternatives analyzed in this environmental impact statement (EIS); Alternative 2 includes both the Breakwaters Project and the Shoreline Project; Alternative 3 includes only the Breakwater Project component; and Alternative 4 includes only the Shoreline Project component.

The proposed breakwaters system would be installed within Raritan Bay off the south shore of Staten Island. The Shoreline Project elements, and the proposed shoreline restoration and on-shore Water Hub elements of the Breakwaters Project would be implemented along the shoreline and in upland areas almost entirely within Conference House Park. The study area is within the portion of Staten Island that is partially sewered, with some areas serviced by separate sanitary and storm sewers, and the remaining area served by septic systems for the treatment of sanitary waste.

During the placement of sand for shoreline restoration (an element of the Breakwaters Project), measures would be implemented to protect the existing stormwater outfall in Raritan Bay at the end of Loretto Street. During construction of the Shoreline Project, measures developed in consultation with New York City Department of Environmental Protection (NYCDEP) would be implemented to protect the stormwater outfalls at the end of Loretto Street, Sprague Avenue, Joline Avenue and Bedell Avenue from the physical impact of the additional sand and associated additional loads that would be placed on these outfalls. Additionally, construction of shoreline elements (Shoreline Project and proposed on-shore Water Hub elements) would be undertaken

in accordance with erosion and sediment control plans and best management practices (e.g., silt fencing and hay bales) incorporated into the SWPPP prepared for the Proposed Actions under the SPDES General Permit GP-0-15-002 for Stormwater Discharges from Construction Activity and would not result in adverse impacts to storm sewers. Therefore, construction of the Proposed Actions would not result in significant adverse impacts to stormwater infrastructure.

Should a sanitary sewer be constructed in Page Avenue, as indicated in the City's approved Drainage Plan by the 2020 build year, the discharge of 1,350 gallons per day (gpd) of sanitary waste from the Proposed Water Hub (if sited at Potential Location 1) as estimated in accordance with the *CEQR Technical Manual*[1] would not be expected to adversely affect the operation of this sanitary sewer. Should a sanitary sewer not be available to receive sanitary waste from the proposed Water Hub at Potential Location 1, similar to other areas within the study area, sanitary waste would be discharged to a septic system designed in accordance with NYCDEP, New York City Department of Buildings (NYCDOB), New York City Department of Health and Mental Hygiene (DOHMH), New York State Department of Environmental Conservation (NYSDEC), and New York State Department of Health (NYSDOH) requirements and standards. If programming of the Water Hub is sited at Potential Location 2 within an existing New York City Department of Parks and Recreation (NYC Parks) building, sanitary waste would be discharged to the existing septic system. As part of the repurposing either NYC Parks structure, the septic system will be evaluated and upgrades made as necessary to accommodate the new use. Water Hub Potential Location 3 would not result in discharge of sanitary waste to any wastewater system within the study area.

The Breakwaters Project has been designed to reduce wave energy at the shoreline, and prevent or reverse shoreline erosion, without adversely affecting tidal flushing within the study area. The Breakwaters Project is not anticipated to interfere in the current functionality of the existing outfalls (maintained by NYCDEP in accordance with current maintenance practices and future practices under the NYC Stormwater Management Program Plan [Draft for public review, April 2018], to be implemented pursuant to NYC's Municipal Separate Storm Sewer Systems [MS4] permit). Therefore, the Proposed Actions are not expected to result in significant adverse impacts to the operation of the stormwater outfalls on Loretto Street, Sprague Avenue, Joline Avenue, and Bedell Avenue due to increased sedimentation of the outfalls.

The Shoreline Project has been designed to reduce risk for the shoreline area of Tottenville from wave action. Comprised of a series of porous structures (earthen berm, eco-revetments, hybrid dune/revetment, and raised edge), the Shoreline Project would allow water to seep through, either from the upland side to the Raritan Bay side, or from the Raritan Bay side to the upland side; the project is not intended to prevent Raritan Bay storm surge from entering the land, nor would it retain water inland.

Risk of exposure to storm surge would occur with or without the implementation of the Shoreline Project. However, with the Shoreline Project, as long as storm surge conditions do not exceed +8.0 feet NAVD88, the structures would serve to delay water inundation to the land side, based on the seepage rate calculated for the structures. Seepage through/under the structures to the land side would continue until reaching the approximate elevation of the water on the Raritan Bay side. Once the water on the bay side would begin to recede back towards mean high water (MHW), the water on the land side would seep back through to the bay side. For storm surge

[1] *CEQR Technical Manual*, March 2014, p. 13-12.

conditions where Raritan Bay water elevation exceeds +8 feet NAVD88 (i.e. the raised edge structure would be overtopped), the volume of water behind the shoreline structures would remain in place until the water level on the bay side recedes, at which point that water would seep through the structures towards the Bay. The seepage analysis performed for the project conservatively determined that in conditions when storm surge overtops the shoreline system, the maximum amount of freestanding water retained behind the proposed shoreline structures would be approximately 28,500 cubic feet (1,056 cubic yards), and would flow back to the bay side of the project components over a period of approximately 1.5 hours or less. Any stormwater from the land side not currently managed though the City's drainage/stormwater system would seep to the bay side of the Shoreline Project elements over the same incremental drainage time of 1.5 hours or less. Any storm surge water captured by the City's drainage/stormwater system would result in a smaller volume of water on the landside of the shoreline structures that would need to flow through the structure, and the time to drain the retained water would subsequently be reduced.

A preliminary analysis of the site conditions based on best available information indicates that that the majority of the area currently less than +8 NAVD88 would experience similar storm surge retention time under conditions with the Proposed Actions as it does under existing conditions for events that overtop the shoreline protection system. For cases that would not overtop the proposed shoreline protection system but would inundate existing topography, it is anticipated that proposed conditions will lead to overall less retention time. Additional modeling will be conducted during the detailed design phase in consultation with NYCDEP to ensure the Shoreline Project does not worsen drainage issues associated with storm surge as compared to the existing condition in the area. During extreme surge events, stormwater outfalls along the coastline may experience backflow inundation leading to flooding of inland catch basins. This backflow flooding condition along the shoreline would be experienced with or without the Shoreline Project. Its existence is a feature of the current stormwater infrastructure, which falls outside the scope of this Shoreline Project.

Where stormwater outfalls intercept the Shoreline Project footprint, NYCDEP consultation would be provided to avoid potential impacts to the stormwater infrastructure.

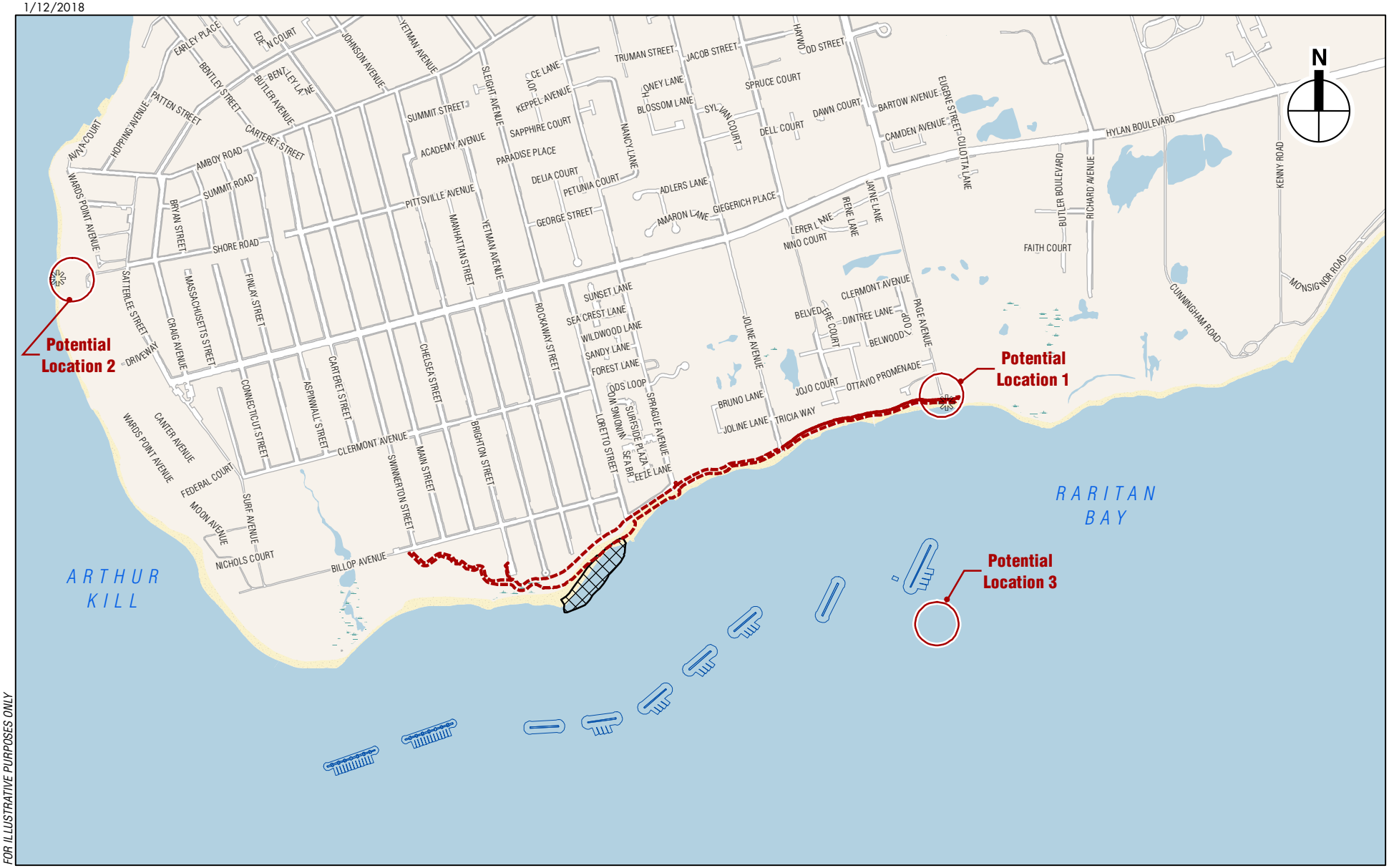
The Shoreline Project has integrated green infrastructure measures such as bioswales into the design for the eco-revetment and the raised edge where possible to minimize potential impacts to storm sewers. Other green infrastructure measures will be considered, as necessary, as design progresses. With these measures in place, runoff resulting from the Proposed Actions would not have the potential to result in significant adverse impacts the storm sewer collection system.

11.2 METHODOLOGY

11.2.1 STUDY AREA

The Proposed Actions would be undertaken in the Tottenville area of Staten Island, along the neighborhood's southern shoreline and just offshore within the waters of Raritan Bay. Tottenville is located at the southwestern tip of Staten Island, and is the southernmost neighborhood in New York City (see **Figure 11-1**). It is bounded by water on three sides, with the Arthur Kill to the west and north and Raritan Bay to the south.

1/12/2018



Proposed Breakwater Features

Proposed Shoreline Restoration Area

Proposed Shoreline Project Elements

Potential Location of Proposed Water Hub (exact location to be determined)

Proposed Floating Dock (associated with Water Hub Potential Locations 1 and 2 only)

Potential Water Access

0 2,000 FEET

Project Location

Figure 11-1

Coastal and Social Resiliency Initiatives for Tottenville Shoreline

For the purposes of this assessment, the study area for sewer and water infrastructure comprises the infrastructure systems bounded by Hylan Boulevard to the north, Raritan Bay to the south, Finlay Street and portions of Conference House Park to the west, and Page Avenue to the east.

11.2.2 WATER SUPPLY

According to the *CEQR Technical Manual,* a preliminary water supply analysis is needed if a project would result in an exceptionally large demand of water (over 1,000,000 gpd), or if it is located in an area that experiences low water pressure (i.e., an area at the end of the water supply distribution system such as the Rockaway Peninsula or Coney Island). The Proposed Actions are located in Tottenville, Staten Island, an area not indicated as experiencing low water pressure.

The proposed Water Hub (a component of the Breakwaters Project) is the only element of the Proposed Actions which could require connection to the New York City water supply system (depending on the location selected). If sited at Potential Location 1, the Water Hub would be an enclosed approximately 5,000-square-foot newly constructed building elevated above the 100-year flood elevation by 3 feet, with approximately 35,500 square feet of site improvements that would include landscaping, parking and utility spaces and designated space for the use of NYC Parks vehicles and equipment. An approximately 210-foot-long by 8-foot wide accessory seasonal boat launch would extend from the shoreline into the water for use by shallow draft research vessels. The new building would require connection to the City's public water supply. Siting the Water Hub programming at Potential Location 2 includes the adaptive reuse of one of two existing NYC Parks buildings (either the Henry-Hogg Biddle House or the Rutan-Beckett House). Both of these existing buildings are connected to the public water supply. Water Hub Potential Location 3 would involve a "floating" Water Hub, or vessel that would be docked at existing facilities in the City and would visit the project area approximately once per week from April through November and host community events approximately twice per month. This Water Hub option would not require connection to the public water supply.

Should Water Hub programming be located at Potential Location 2 or 3, a small facility to provide seating, wayfinding, interpretive elements and potential storage for kayaks would be constructed near the terminus of Page Avenue. This facility may be connected to the City's water supply.

Future water demand and sanitary sewage generation from the proposed Water Hub are calculated based on use generation rates set by the *CEQR Technical Manual.*[2] On the basis of the proposed Water Hub building size at Potential Location 1, the estimate water usage rate using the Commercial/Office rate with air conditioning would be approximately 1,350 gpd, far below the 1,000,000 gpd that would require analysis of potential impacts to water supply under *the CEQR Technical Manual*. Because the Biddle House (4,960 total square feet) and Rutan-Beckett House (2,760 total square feet) at Potential Location 2, or the new small facility (approximately 400 square feet) that would be located near the terminus of Page Avenue (if either Potential Locations 2 or 3 are selected) would be even smaller, the water usage associated with those facilities would be even less. Therefore, a preliminary infrastructure analysis of potential effects to water supply is not required for the Proposed Actions.

[2] *CEQR Technical Manual*, March 2014, p. 13-12.

11.2.3 WASTEWATER AND STORMWATER CONVEYANCE AND TREATMENT

The *CEQR Technical Manual* indicates that a sewer analysis is warranted if a project site is located in an area that is partially sewered or currently unsewered[3]. The study area is within the portion of Staten Island that has areas that are partially sewered, as described below. Therefore, analysis of the Proposed Action's effects on wastewater and stormwater infrastructure is presented.

11.3 EXISTING CONDITIONS

Existing wastewater and stormwater conveyance systems have been characterized on the basis of the Drainage Plans and "design" and "as-built" sewer drawings provided by NYCDEP.

11.3.1 WASTEWATER

The study area is located within the portion of Staten Island that contains separate systems for sanitary sewage and stormwater. Additionally, the portion of the study area approximately east of Loretto Street appears to use septic systems to dispose of sanitary sewage. The sanitary collection system west of Loretto Street consists of 10 inch, 12 inch, 15 inch and 18 inch sanitary sewers that discharge into interceptor sewers. Sanitary Interceptors are located in Main Street between Billop Avenue and Hylan Boulevard (24-inch diameter) and in Hylan Boulevard (48 inch diameter). Potential Location 2 for the Water Hub uses septic systems. Currently based on information from NYCDEP, there is no sanitary sewage infrastructure in Page Avenue south of Hylan Boulevard, although such conveyance is planned as per NYCDEP Drainage Plans. The sanitary interceptor in Hylan Boulevard runs in an easterly direction and increases in size to a 48-inch sewer east of Richard Avenue, and eventually conveying sanitary waste to the Oakwood Beach Water Pollution Control Plant (WPCP), which is located outside of the project area, in the eastern portion of Staten Island.

Oakwood Beach WPCP has a drainage area of 10,779 Acres.[4] The drainage area extends to South Avenue to the northwest, to Amsterdam Avenue to the north (south of the Staten Island Expressway), and to Roanoke Street east of La Tourette Park to the eastern shore of Staten Island. It serves approximately 244,918 residents. The average daily sanitary sewage flow rate is roughly 29 million gallons per day (MGD). The Oakwood Beach WPCP has a design dry-weather flow (DDWF) capacity of 39.9 MGD.

11.3.2 STORMWATER

The study area is within portions of three Tributary Areas of the NYCDEP Drainage Plans for Tottenville which are bounded by Amboy Road, the Arthur Kill, Raritan Bay and the western portion of Mount Loretto Unique Area. The Tributary Areas are described as follows:

- Western Tributary Area—The western Tributary Area extends from the Arthur Kill to Swinnerton Street.

[3] http://www.nyc.gov/html/oec/downloads/pdf/2014_ceqr_tm/2014_ceqr_tm_ch13_water_sewer_infrastructure_sewered_and_unsewered.pdf

[4] http://www.nyc.gov/html/dep/html/wastewater/wwsystem-plants.shtml

- Middle Tributary Area—The middle Tributary Area extends from Main Street to Bedell Avenue.
- Eastern Tributary Area—The eastern Tributary Area extends from east of Bedell Avenue to the western portion of Mount Loretto Unique Area.

Amended Drainage Plans have been approved for the western and eastern Tributary Areas.

The stormwater collection system for the western Tributary Area consists of storm sewers varying in size from 12 inch diameter to a 7 foot 3 inch wide by 3 foot by 6 inch high double barrel sewer in Finlay Street. The storm sewer collection system from this area discharges into the Conference House Park Bluebelt stormwater management system,[5] an open channel within an the approximately 2.4-acre marsh within Conference House Park just south of Clermont Avenue (see additional details in Chapter 9, "Natural Resources"). Stormwater flows into a best management practice (BMP) detention pond located just north of a future extension of Billop Avenue west of Swinnerton Street. The detention pond discharges into a 12 ft by 4 ft culvert under the Billop Avenue extension to an open channel just south of Billop Avenue, which flows through Conference House Park and tidal wetlands prior to discharging into Raritan Bay.

Within the middle Tributary Area, from Main Street to Loretto Street, runoff is collected from the street system via catch basins. The runoff is then discharged to pipe-and-box storm sewers and conveyed to a large-box sewer in Loretto Street, which discharges to Raritan Bay through a 13 ft 6 inch by 5 ft stormwater outfall located in the extension of Loretto Street south of Surf Avenue.

The NYCDEP Drainage Plan for the area between Loretto Street and Bedell Avenue shows existing storm sewers in portions of Sprague Avenue, Hylan Boulevard, Joline Avenue and Bedell Avenue. There is an existing 5 ft by 3 ft stormwater outfall leading into Raritan Bay south of the Surf Avenue right-of-way in the extension of Joline Avenue, and an existing 36 inch stormwater outfall leading into Raritan Bay in the extension of Bedell Avenue south of the Surf Avenue right-of-way. Additionally, there is an existing 36 inch diameter stormwater outfall at the end of Sprague Avenue that discharges to Raritan Bay.

While there is no existing stormwater infrastructure east of Bedell Avenue within the eastern Tributary Area south of Hylan Boulevard, NYCDEP Drainage Plans indicate a future 83 inch by 53 inch stormwater outfall in the extension of Page Avenue south of the Surf Avenue right-of-way serving an upland area of approximately 65 acres. To the east of the study area is the Butler Manor Bluebelt stormwater management system that is serving an upland area of approximately 160 acres and discharges into Raritan Bay.

11.4 EFFECTS ASSESSMENT

11.4.1 ALTERNATIVE 1—NO ACTION ALTERNATIVE

The No Action alternative assumes that no new structural risk reduction projects or marine habitat restoration projects will be implemented in the study area. The existing wastewater and stormwater collection systems and outfalls would be as described under the existing condition, with the implementation of any infrastructure improvements approved by NYCDEP as per the

[5] http://www.nyc.gov/html/dep/pdf/brochures/si_bluebelt_brochure.pdf

existing and/or future amendments to the Drainage Plans and constructed by the 2020 build year. This alternative also assumes that current trends with respect to coastal conditions at Tottenville—i.e., relating to erosion and wave action—will continue. Under the No Action Alternative, the existing man-made temporary dune system would remain in the 2020 build year. These dunes and the Tottenville shoreline would remain vulnerable to intense wave energy and thus continue to be at risk from storm wave damage. Under the No Action condition, the Tottenville shoreline is expected to continue to erode in certain locations. Numeric simulation of shoreline changes revealed that in the southwestern portions of the site (southwest of Sprague Avenue) both the overall pattern and rates of shoreline erosion and accretion are likely to continue into the future, including erosion rates of 1.0 to 2.0 feet per year between Loretto Street and Manhattan Street, and between 2.0 and 3.5 feet per year in Conference House Park between Main Street and Wards Point. Northeast of Sprague Avenue, the general pattern of erosion and accretion appear to remain the same, though rates of change simulated are slightly lower in the future than those historically observed.

11.4.2 ALTERNATIVE 2 (PREFERRED ALTERNATIVE)—THE LAYERED TOTTENVILLE SHORELINE RESILIENCY STRATEGY: LIVING BREAKWATERS AND TOTTENVILLE SHORELINE PROTECTION PROJECT (LAYERED STRATEGY)

As described in Chapter 1, "Purpose and Need and Alternatives," Alternative 2 consists of the implementation of two individual projects: Breakwaters Project and the Shoreline Project, as a layered strategy that would increase the overall resiliency of the Tottenville shoreline. The preferred layout of the breakwaters would attenuate wave energy and reduce shoreline erosion at the water's edge, effectively holding, or in some locations increasing, beach width. The primary goal of the Shoreline Project is to reduce the risk of wave energy along the shoreline and to address future shoreline erosion. Nevertheless, it would temporarily delay flooding of inland areas during certain storm events (in cases where over-topping from storm surge does not occur), providing some level of risk reduction from coastal flooding.

CONSTRUCTION

The proposed shoreline restoration associated with the Breakwaters Project would extend along the length of shoreline between Manhattan Street and Loretto Street. During the placement of sand for shoreline restoration, measures would be implemented to protect the existing stormwater outfall in Raritan Bay at the end of Loretto Street. During construction of the Shoreline Project, measures would be implemented to protect the stormwater outfalls at the ends of Loretto Street, Sprague Avenue, Joline Avenue, and Bedell Avenue. This includes consideration of potential physical effects of the additional sand and associated additional loads that would be placed on these outfalls. These measures to avoid potential adverse effects to the stormwater outfalls would be coordinated with NYCDEP.

Construction of shoreline elements (Shoreline Project and proposed on-shore Water Hub elements of the Breakwaters Project) would be undertaken in accordance with erosion and sediment control plans and best management practices (e.g., silt fencing and hay bales) incorporated into the SWPPP prepared for the Proposed Actions under the SPDES General Permit GP-0-15-002 for Stormwater Discharges from Construction Activity and would not result in adverse impacts to storm sewers from stormwater discharge during construction. This would include all staging areas, and any areas used for the temporary storage of excavated material. With these measures in place, construction of Alternative 2 would not have the potential to result

in significant adverse impacts to storm sewers or to the Conference House Park Bluebelt project. Construction of Alternative 2 would not have the potential to adversely affect the sanitary sewer system.

OPERATION

Wastewater

Should the sanitary sewer be constructed in Page Avenue as indicated in the approved Drainage Plan by the 2020 build year, the discharge of approximately 1,350 gpd of sanitary waste from the proposed Water Hub if sited at Potential Location 1 as estimated in accordance with the *CEQR Technical Manual*[6] would not be expected to adversely affect the operation of this sanitary sewer. Should a sanitary sewer not be available to receive sanitary waste from the proposed Water Hub at Potential Location 1, similar to other areas within the study area, sanitary waste would be discharged to a septic system designed in accordance with NYCDEP, NYCDOB, DOHMH, NYSDEC, and NYSDOH requirements and standards. The proposed Water Hub at Potential Location 2, if selected, would discharge to the existing septic system of the repurposed NYC Parks building and would not, therefore, have the potential to affect the NYCDEP sanitary sewer system. As part of the repurposing either NYC Parks structure, the septic system will be evaluated and upgrades made as necessary to accommodate the new use. Water Hub Potential Location 3 would not result in discharge of sanitary waste to any wastewater system within the study area.

Stormwater

The Breakwaters Project has been designed to reduce wave energy at the shoreline, and prevent or reverse shoreline erosion, without adversely affecting tidal flushing within the study area. Therefore, the Breakwaters Project component of Alternative 2 is not expected to result in significant adverse impacts to the operation of the stormwater outfalls on Loretto Street, Sprague Avenue, Joline Avenue, and Bedell Avenue due to increased sedimentation at the outfalls. The Breakwaters Project is not anticipated to interfere in the current functionality[7] of the existing outfalls maintained by NYCDEP (maintained by NYCDEP in accordance with current maintenance practices and future practices under the NYC Stormwater Management Program Plan [Draft for public review, April 2018], to be implemented pursuant to NYC's Municipal Separate Storm Sewer Systems [MS4] permit).

The Shoreline Project has been designed to reduce risk for the shoreline area of Tottenville from wave action. Comprised of a series of porous structures (earthen berm, eco-revetments, hybrid dune/revetment, and raised edge), the Shoreline Project would allow water to seep through, either from the upland side to the Raritan Bay side, or from the Raritan Bay side to the upland side; the project is not intended to prevent Raritan Bay storm surge from entering the land, nor would it retain water inland.

As described in Chapter 1, "Purpose and Need and Alternatives," the shoreline risk reduction measures were designed to respond to the changing character of the shoreline between

[6] *CEQR Technical Manual*, March 2014, p. 13-12.

[7] Additional analyses will be conducted during the design process in consultation with NYCDEP to evaluate the current functionality of the existing outfalls.

approximately Carteret Street and Page Avenue, resulting in four types of elements (earthen berm, eco-revetments, hybrid dune/revetment and raised edge), with varying crest elevations along the system. The lowest crest elevation would be along the raised edge at approximately +8.0 feet North American Vertical Datum of 1988 (NAVD88) at the eastern portion of the Shoreline Project. Higher crest elevations would occur along the earthen berm and both eco-revetment sections (approximately +12.5 feet NAVD88), and along the hybrid dune/revetment (approximately +14 feet NAVD88).

Risk of exposure to storm surge would occur with or without the implementation of the Shoreline Project. However, with the Shoreline Project, as long as storm surge conditions do not exceed +8.0 feet NAVD88, the structures would serve to delay water inundation to the land side, based on the seepage rate calculated for the structures. Seepage through/under the structures to the land side would continue until reaching the approximate elevation of the water on the Raritan Bay side. Once the water on the bay side would begin to recede back towards mean high water (MHW), the water on the land side would seep back through to the bay side. For storm surge conditions where Raritan Bay water elevation exceeds +8 feet NAVD88 (i.e., the raised edge structure would be overtopped), the volume of water behind the shoreline structures would remain in place until the water level on the Bay side recedes, at which point that water would seep through the structures towards the Bay. A seepage analysis was performed for the project at 30% schematic design to determine the rate at which water from the landside or Bay side would seep through the proposed structures.

The seepage analysis was conducted assuming a maximum structural crest elevation for overtopping at elevation +8.0 feet NAVD88, which is the elevation of the raised edge in the eastern portion of the project area (i.e., the lowest proposed Shoreline Project element). Since there would be a hydraulic connection along the entire length of the Shoreline Project on the land side, any water temporarily seeping through or overtopping the higher project elements to the west of the raised edge (at an elevation above +8 feet NAVD88) would naturally flow toward areas of lower elevation along the shoreline. Therefore, any water temporarily retained behind any of the Shoreline Project elements, would never exceed elevation +8 feet NAVD88. The area within this elevation contour includes portions of Conference House Park and private residences south of Billop Avenue, between Brighton and Rockaway Streets. Currently, this area is upland of the temporary dune system constructed by NYC Parks as interim protective measures post-Sandy, and therefore any water temporarily retained within this area would occur with or without the Shoreline Project. However, unlike the temporary dune system, the Shoreline Project has been designed to be porous and therefore, as described above seepage back to the bay side is expected to begin once the storm surge on the bay side recedes below the elevation of the water on the land side. As a conservative assumption, the seepage analysis assumed that no seepage would occur from the land side to the bay side until the storm surge has completely receded to the mean high water level (elevation +2 feet NAVD88).[8]

Based on the assumptions described above, in conditions when storm surge overtops the shoreline system, the seepage analysis identified that the maximum amount of freestanding

[8] The range of the tidal cycle plays a significant role in recession time of storm surge from peak levels to MHW. Based on a review of data from a range of past storm events (from 1944 through 2017 [and including Superstorm Sandy]), recession time would be anticipated to be less than 6 hours in most cases. This would occur with or without the proposed project.

water retained behind the proposed shoreline structures at elevation +8 feet NAVD88 would be approximately 28,500 cubic feet (1,056 cubic yards). This volume of water would flow back to the bay side of the project components over a period of approximately 1.5 hours or less.[9] At elevations below +8.0 feet, seepage back to the bay side would take less time. A preliminary analysis of the site conditions based on best available information indicates that that the majority of the area currently less than +8 NAVD88 would experience similar storm surge retention time under conditions with the Proposed Actions as it does under existing conditions for events that overtop the shoreline protection system. For cases that would not overtop the proposed shoreline protection system but would inundate existing topography, it is anticipated that proposed conditions will lead to overall less retention time. Additional modeling will be conducted during the detailed design phase in consultation with NYCDEP to ensure the Shoreline Project does not worsen drainage issues associated with storm surge as compared to the existing condition in the area.

For the purposes of the seepage analysis, the effects of the Shoreline Project were isolated from the existing stormwater system, such that all water entering the land from the bay side was assumed to flow back to the bay side through the proposed structures. Any stormwater from the land side not currently managed though the City's drainage/stormwater system would seep to the bay side of the Shoreline Project elements over the same incremental drainage time of 1.5 hours or less. There is a possibility that at elevation +8.0 feet NAVD88, water could still flow into the City's drainage/stormwater system. If this is the case, the volume of water on the landside of the shoreline structures that would need to flow through the structure would be reduced and the time to drain the retained water would be reduced. During extreme surge events, stormwater outfalls along the coastline may experience backflow inundation leading to flooding of inland catch basins. This backflow flooding condition along the shoreline would be experienced with or without the Shoreline Project. Its existence is a feature of the current stormwater infrastructure, which falls outside the scope of this Shoreline Project.

Where stormwater outfalls intercept the Shoreline Project footprint, NYCDEP consultation would be provided to avoid potential impacts to the stormwater infrastructure.

The Shoreline Project has integrated green infrastructure measures such as bioswales into the design for the eco-revetment and the raised edge where possible to minimize potential impacts to storm sewers from Alternative 2. Other green infrastructure measures will be considered, as necessary, as design progresses. With these measures in place, runoff resulting from Alternative 2 would not have the potential to significantly adverse impacts the storm sewer collection system. The Water Hub at Location 2, if selected, would adaptively reuse one of two existing NYC Parks buildings and would not result in land disturbance that would require post-construction stormwater management.

[9] This drainage time was calculated by assessing the seepage rates at critical sections across each proposed element of the project at one foot intervals between elevation +8.0 feet NAVD88 and +3.0 feet NAVD88, and multiplying these by the corresponding element's wetted length (the length where freestanding water is against the structure). To be conservative, the seepage rates and wetted lengths selected correspond to the lower elevation of the one foot interval, where the total drainage rate is lower than it would be if the seepage rates and wetted lengths at the upper or midpoint elevation were selected.

11.4.3 ALTERNATIVE 3—BREAKWATERS WITHOUT SHORELINE PROTECTION SYSTEM

Alternative 3 would develop the Breakwaters Project components as described in Alternative 2, including the in-water breakwaters, shoreline restoration and the proposed Water Hub elements. None of the Shoreline Protection Project components would be developed under Alternative 3.

Under Alternative 3, sanitary waste from the proposed Water Hub at Locations 1 or 2 would not have the potential to adversely affect the sanitary sewer for the reasons discussed under Alternative 2.

Under Alternative 3, without the Shoreline Project, the barrier bags that comprise the temporary man-made dune would remain the only shoreline risk reduction feature. The barrier bags would not provide the same level of shoreline resilience as Alternative 2 and the remaining portions of the shoreline within the study area would remain in their current condition of being subject to wave energy and erosion. Additionally, Alternative 3 would not provide the benefit to the existing storm water collection system during periods of high wave action as described under Alternative 2. Therefore, under Alternative 3, the storm sewer collection system would remain as vulnerable during periods of high wave action as Alternative 1.

11.4.4 ALTERNATIVE 4—SHORELINE PROTECTION SYSTEM WITHOUT BREAKWATERS

Alternative 4 would develop the Shoreline Project components as described in Alternative 2, including the earthen berm, hybrid dune/revetment, eco-revetments, and raised edge and wetland enhancement. None of the Breakwaters Project components would be developed under Alternative 4.

WASTEWATER

Under Alternative 4, the proposed Water Hub would not be developed and there would be no discharge of sanitary waste resulting from the Proposed Actions.

STORMWATER

Under Alternative 4, the same measures discussed under Alternative 2 for the Shoreline Project would be such that construction and operation of Alternative 4 would not result in significant adverse impacts to the storm sewer system.

11.5 MINIMIZATION AND MITIGATION OF IMPACTS

The Proposed Actions would not result in significant adverse impacts to wastewater and stormwater infrastructure within the study area; therefore, no mitigation is needed for the Proposed Actions. Measures incorporated into the Proposed Actions to minimize adverse impacts to stormwater infrastructure include:

- Implementing erosion and sediment control measures and stormwater management measures in accordance with the SWPPP prepared as required under the SPDES General Permit GP-0-15-002 for Stormwater Discharges from Construction Activity.
- Incorporating bioswales and other green infrastructure stormwater management measures to allow infiltration of runoff.

- Continuing to coordinate with NYCDEP to ensure the Breakwaters Project would not interfere with the current functionality of the existing outfalls maintained by NYCDEP.
- Incorporating measures to protect the stormwater outfall in Raritan Bay at the end of Loretto Street during the placement of sand for shoreline restoration.

Incorporating any measures necessary, developed in consultation with NYCDEP, to protect the stormwater outfalls at the ends of Loretto Street, Sprague Avenue, Joline Avenue, and Bedell Avenue, from the physical impact of the additional fill and associated additional loads that would be placed on these outfalls. ✷