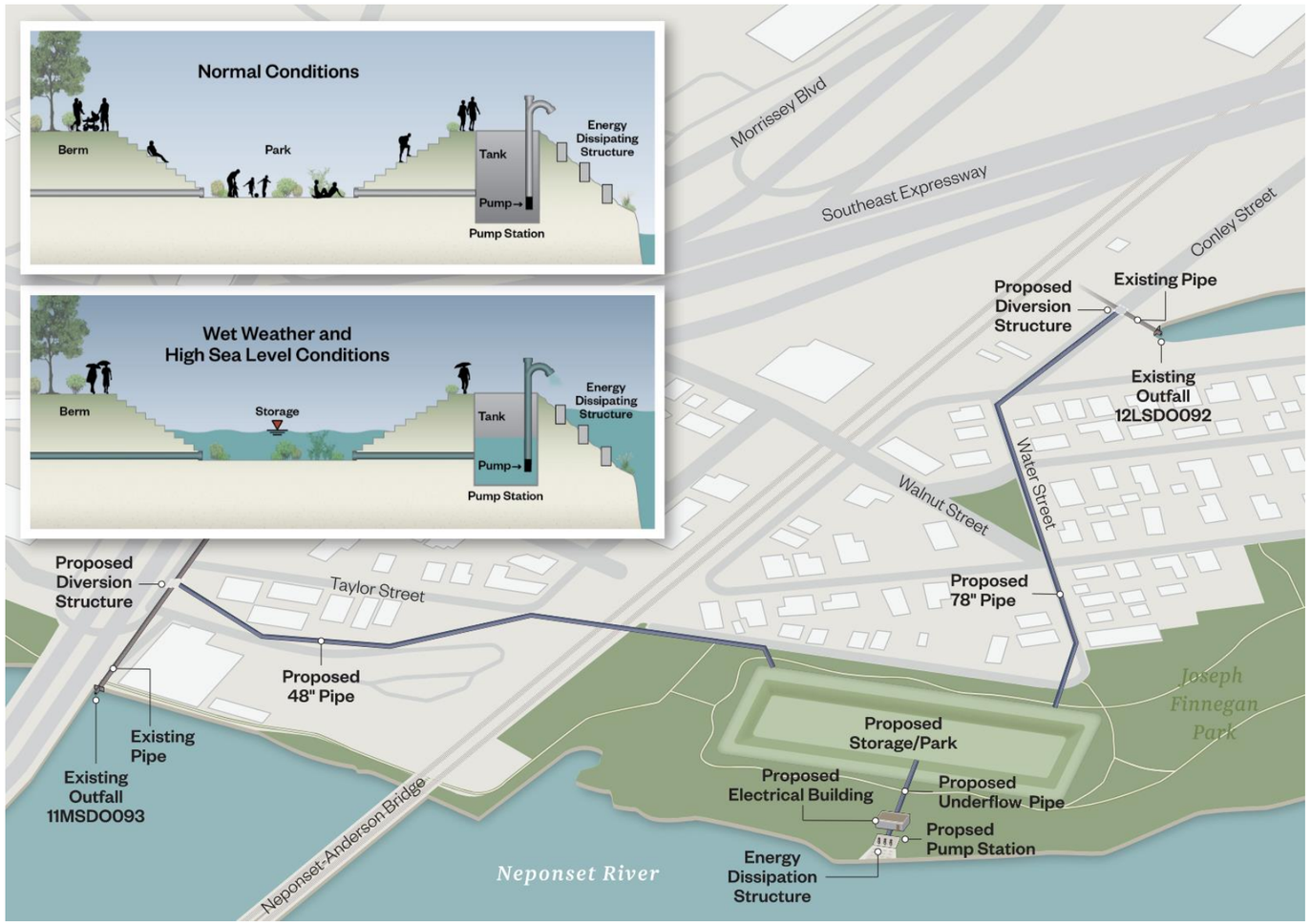
Joseph Finnegan Park *Concept Overview*



Conceptual Solution

The Joseph Finnegan Park storage basin is a hybrid “natural” (above ground) storage system with a pump station that can be used during larger storm events. The basin and pump station are located inside Joseph Finnegan Park and next to the Neponset River. The basin has a rectangular perimeter and walls that slope inward at a 1:4 slope. During dry weather or low tide rain events, the basin functions as walkable recreation space. During rain events, if a high tide level begins to reduce the ability of existing outfalls 12LSDO092 and 11MSDO093 to discharge by gravity, then a diversion structure with a static weir directs excess flow to the park storage basin. The storage basin is connected to the pump station, which sits near the shoreline and can pump water into the Neponset River. The pump station includes one duty and one standby pump.

Type: Storage and Pumping
Total Drainage Area: 170 acres
Coastal Flood Vulnerable Drainage Area Protected: 170 acres

Concept Elements:

- Above ground “nature based” storage basin
- Improved public amenity/park
- Diversion Structures
- Subsurface Pump Station

Outfalls Included in Concept:

- 12LSDO092
- 11MSDO093

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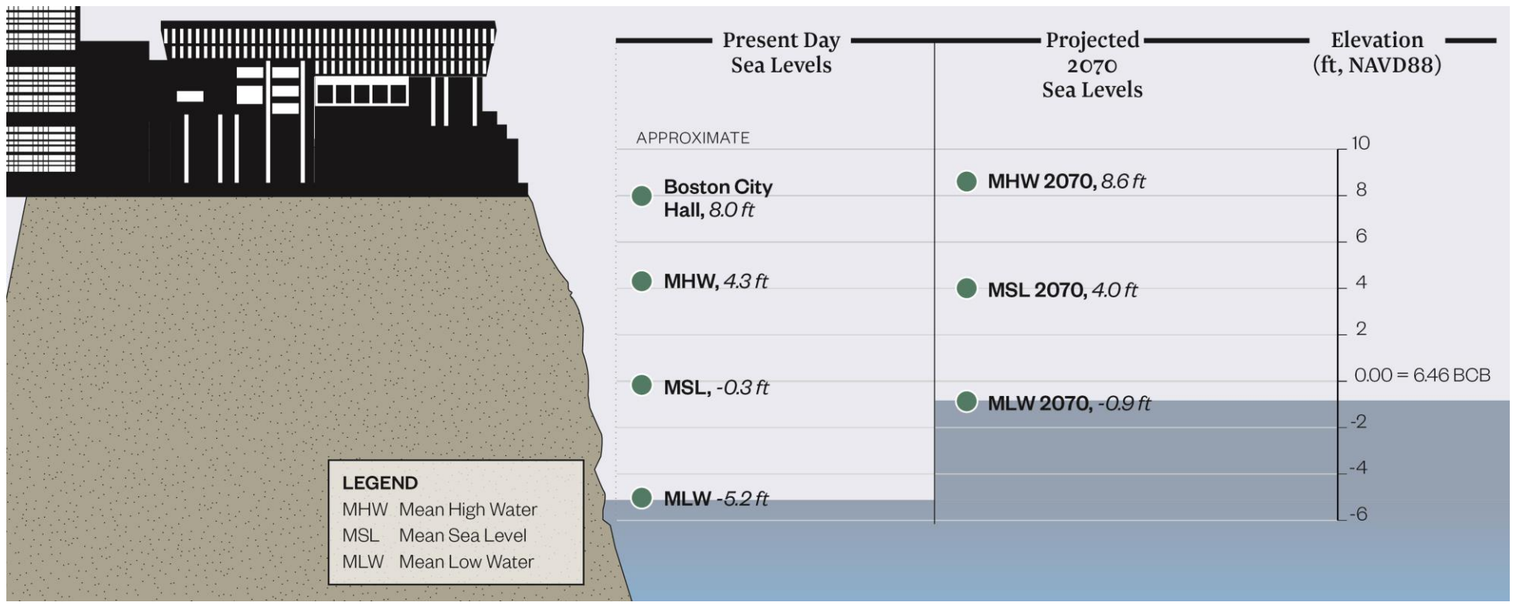
Assumptions

Sea Level Rise and Datum

The Finnegan Park Pump Station concept was designed for consistency with Climate Ready Boston (CRB) proposed adaptations and analyzed based on sea level rise (SLR) projections in the Massachusetts Coastal Flood Risk Model (MC-FRM). The SLR values applied in MC-FRM are consistent with the standards for the State of Massachusetts developed by Coastal Zone Management. The MC-FRM utilizes a "High" SLR scenario. This scenario is based on the relative SLR projections under Relative Concentration Pathway (RCP) 8.5 (a "worst case scenario" of increasing atmospheric carbon concentrations) and represents elevations that have a 99.5% probability of not being exceeded within the respective timeframes. In 2030, that amounts to an increase of 1.3 feet in Boston from a baseline condition (2008 centered tidal epoch), and in 2070 that amounts to an increase of 4.3 feet.

The concept developed in this project was analyzed using coastal conditions that include 2070 projected SLR and storm surge resulting from a 100-year tropical storm. The peak water surface elevation (WSE) predicted by the MC-FRM during these conditions is approximately 13.8 feet NAVD88 (varies by location). In mid 2022, the Greater Boston Research Advisory Group (BRAG) issued an updated report with new SLR projections. The report acknowledges that long term SLR projections are associated with significant uncertainty, and that updated projections include less SLR by 2100 (according to earlier projections in the 2015 BRAG Report). According to the report, the likely range of SLR by 2070 under an RCP 8.5 scenario is 1.4 – 2.8 feet. Based on this information, projections from the MC-FRM that were utilized in this project are conservative and appropriate for long term planning purposes.

Unless otherwise noted, all elevations are based on the NAVD88 vertical datum. Elevations given in NAVD88 can be converted to Boston City Base (BCB) elevation by adding 6.46 feet.



Climate Ready Boston and Shoreline Protection

The Finnegan Park Pump Station concept was developed to maintain consistency with possible Climate Ready Boston (CRB) adaptations based on the latest available information at the time they were developed. As the CRB program continues to evolve, it is anticipated that proposed concepts will need to be adapted.

The concept was developed to be consistent with stated neighborhood design flood elevations. In the Neponset River Waterfront Zone (location of Finnegan Park), where the stated design flood elevation is 14.4 feet, pumps would be designed to discharge to a minimum elevation of 14.4 feet.

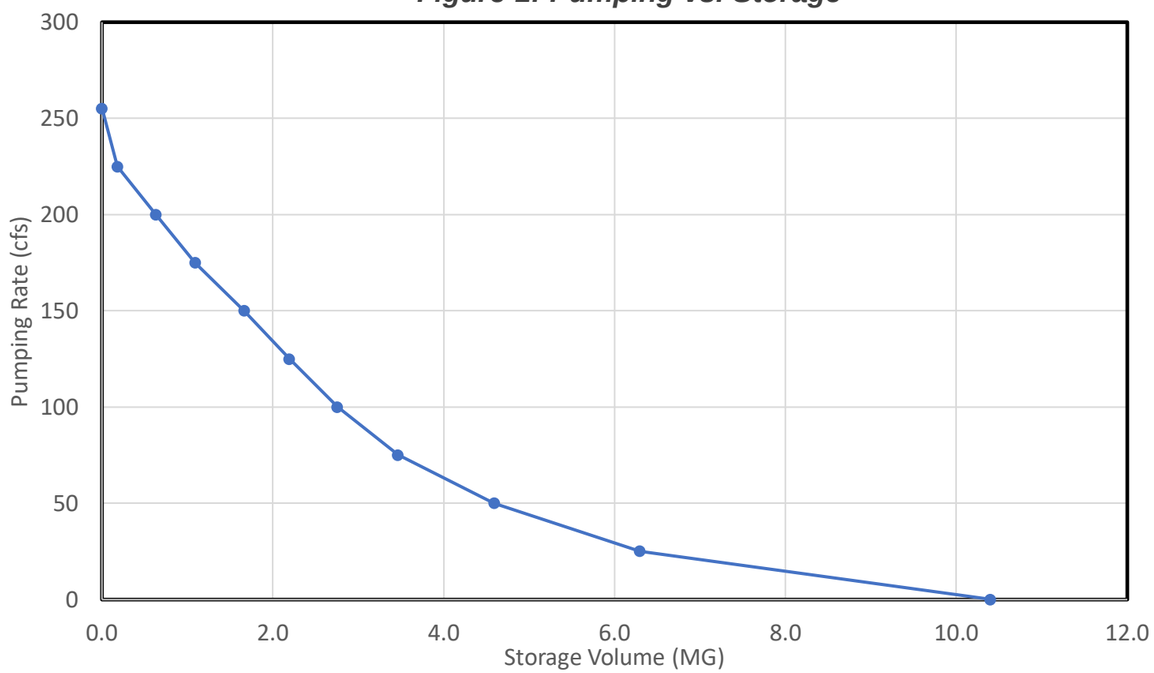
At the time of this project, many CRB concepts were in early planning stages and not fully defined. **In consideration of this, it was assumed the shoreline protection around the City of Boston is 100% effective for all modeling evaluations.** This assumption eliminates overland coastal flooding from model predictions, allowing for isolation of flooding that results only from rainfall and stormwater that cannot be discharged due to high sea levels. It is important to recognize that additional flooding, beyond what is depicted herein, would be expected if 100% effective shoreline protection is not implemented.

Basis of Design

Storage and Pumping

Model simulations were conducted to determine the maximum Hydraulic Grade Line (HGL) that occurs at Outfalls 12LSDO092 and 11MSDO093 with the current tide cycle. Analyses were then conducted to determine the acceptable combinations of storage volume and pumping rate required to maintain the existing HGL with 2070 projected sea level rise and 100-year storm surge, as shown in Figure 1. The City of Boston's Parcel database was used to identify publicly owned parcels near the existing outfall. An analysis of the pump station was performed to identify a pump rate and physical dimensions that are hydraulically viable. It was found that a 10 MG storage basin and a 50 cfs pump station ~20.5 feet deep could fit within the property. The storage tank and pump station occupy an area of 133,020 ft^2. The storage basin has a rectangular perimeter and walls that slope inward at a 1:4 slope. During dry weather or low tide rain events, the basin functions as walkable recreation space. During rain events, if a high tide level begins to reduce the ability of existing outfalls 12LSDO092 and 11MSDO093 to discharge by gravity, then a diversion structure with a static weir directs excess flow to the park storage basin. The storage basin is connected to the pump station, which sits near the shoreline and can pump water into the Neponset river. The Finnegan park pump station utilizes one duty pump, one standby pump, and two dewatering pumps. The pump station is configured with vertical, axial electric submersible pumps in parallel bays.

Figure 1: Pumping vs. Storage



Rainfall and Coastal Conditions

The Commission currently utilizes a 10-year, 24-hour design storm to establish its target level of service. For the purpose of sizing new piping and evaluating storage capacity, a projected 2070 10-year, 24-hour design storm was developed. For consistency with Climate Ready Boston, performance of the DBB storage concept was also evaluated with projected rainfall from a 100-year tropical event (developed during the Commission's Inundation Model Project). The DBB was evaluated using a 100-year return period coastal boundary condition. Data for this condition were obtained from the MC-FRM. For the purpose of evaluating the effectiveness of the concept, it was further assumed that complete shoreline protection was implemented, preventing flow of water between land and the harbor/Neponset River. Table 2 contains a summary of the coastal conditions that were analyzed.

Table 1: Rainfall Conditions

Scenario	Purpose	Rainfall Depth (in)	Peak Intensity (in/hr)
Present Day 10-year, 24-hr design storm	Baseline Conditions	5.15	3.32
Projected 2070 10-year, 24-hr design storm	Design Conditions	6.18	4.08
100-year Tropical Storm	Damage Analysis	9.58	0.84

Table 2: Coastal Conditions

Scenario	Purpose	Peak Water Surface Elevation (ft, NAVD88)	Source
Present Day	Baseline Conditions	3.7	BWSC Existing Model (April 2016 Tide Cycle)
2070,100-year Tropical Storm	Damage Analysis	13.8	MC-FRM

Joseph Finnegan Park

Outfalls 12LSDO092 and 11MSDO093 Diversion to Storage Area and Neponset River

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Flood Modeling and Damage Analysis

Figure 2: Estimated Replacement Cost

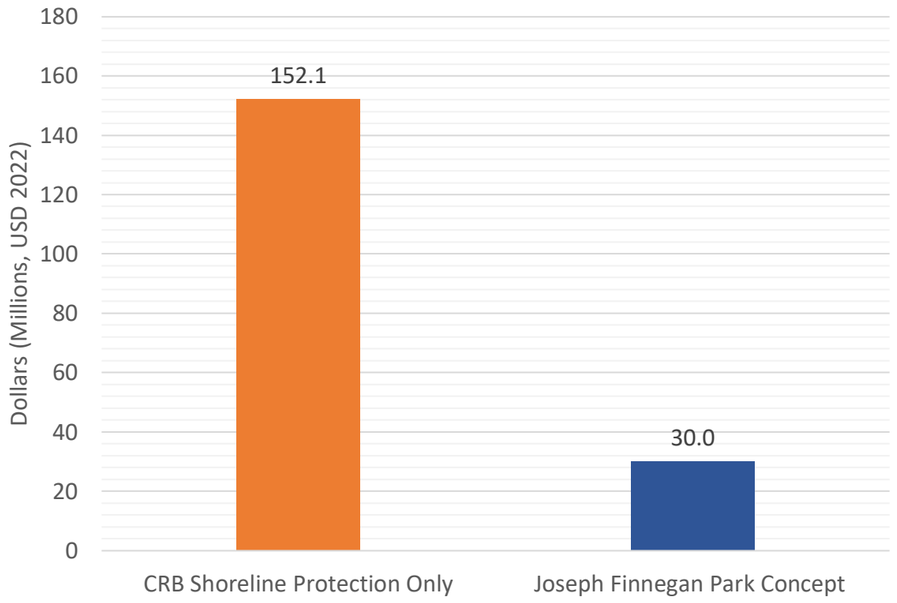


Figure 3: Loss of GDP

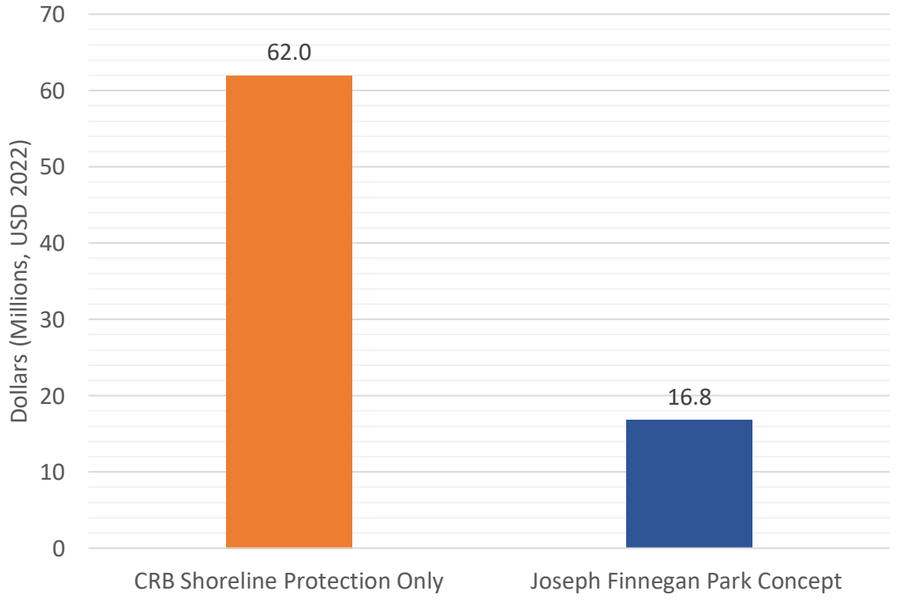
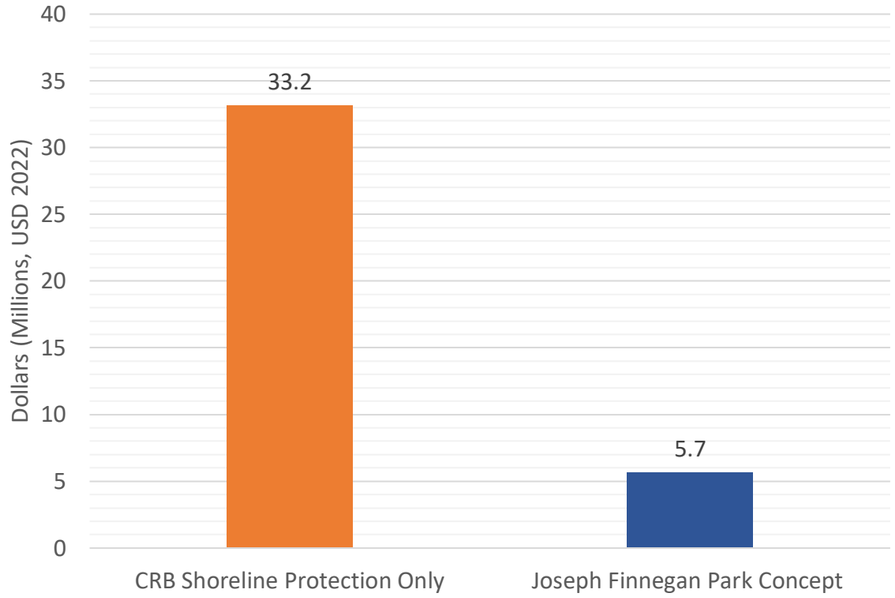


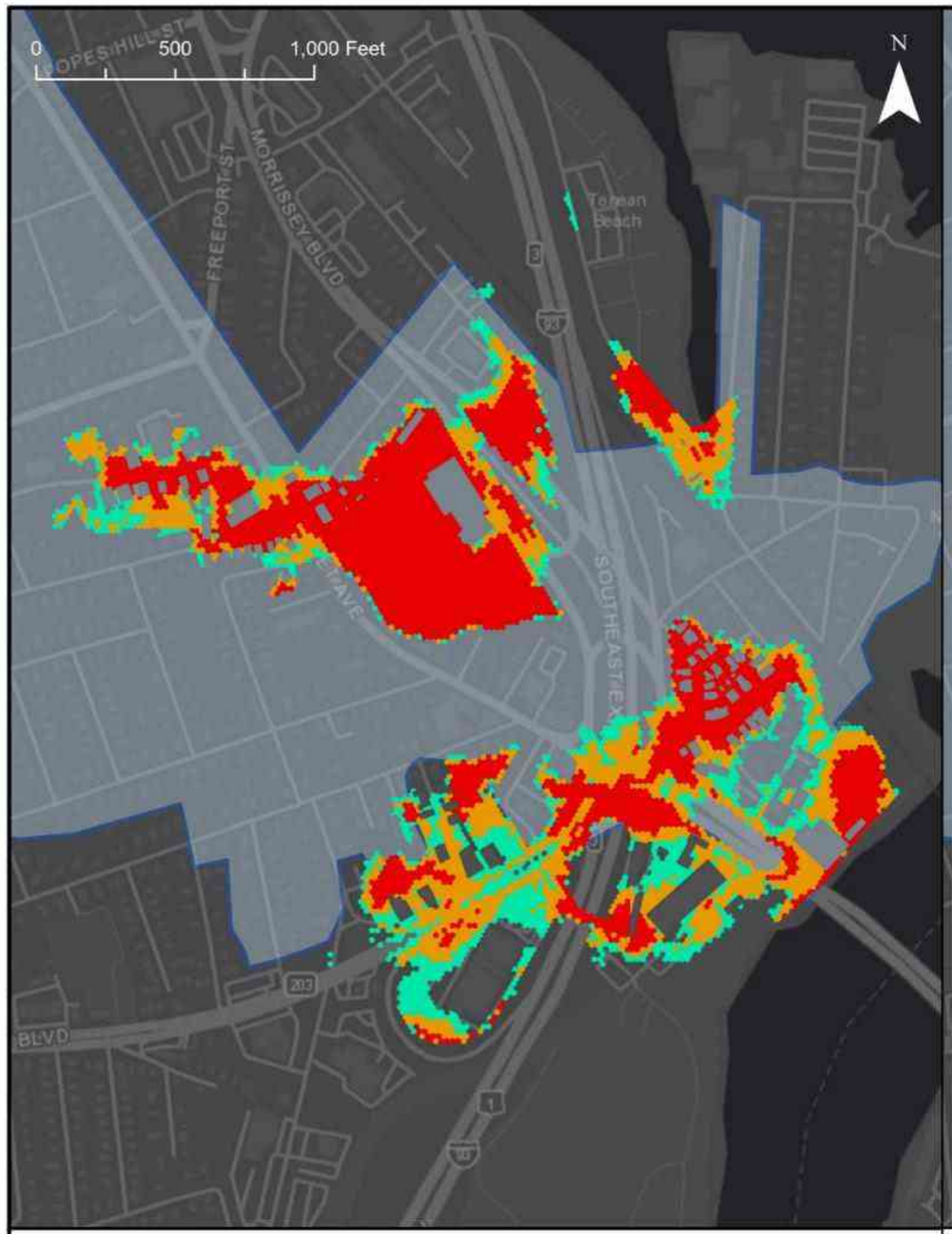
Figure 4: Physical Damage



The flood reduction benefits of the Joseph Finnegan Park concept were evaluated using the Commission's 2D Inundation Model by simulating a 100-year tropical storm event with 2070 SLR and storm surge. The figures on the following page depict the peak flooding that was predicted in the Joseph Finnegan Park drainage area with shoreline protection only and with the pump station and tide gates on all vulnerable BWSC owned outfalls. An analysis of economic losses/physical impacts from flooding under both scenarios was performed by risQ Inc.

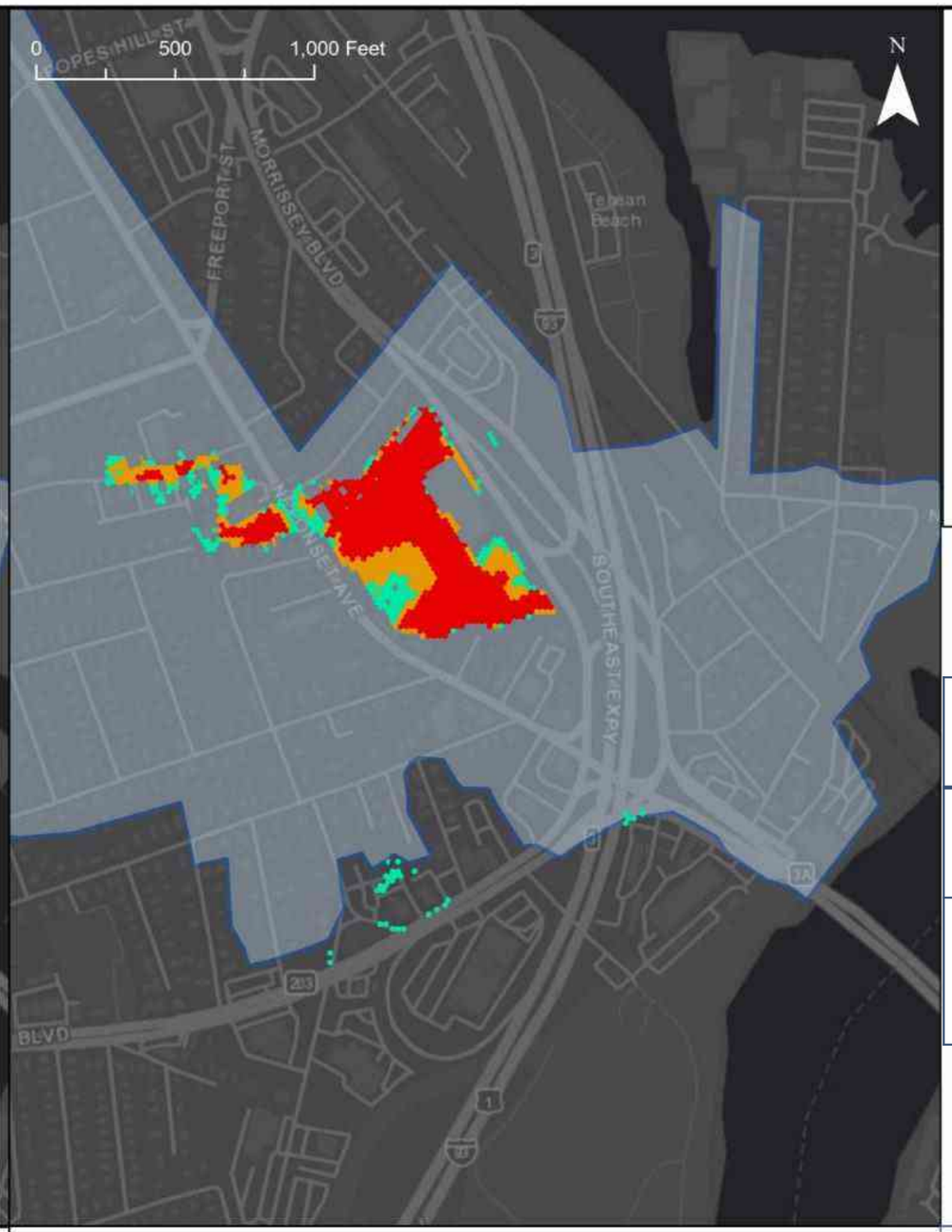
Model predictions indicate that the Joseph Finnegan Park concept reduces physical damage by **$27.5 million**, avoids **$122.1 million** in rebuilding costs, and mitigates a GPD loss of **$45.2 million** during a 100-year tropical storm event in 2070.

Note: replacement values include the total value of impacted buildings in flooded areas (e.g., impacted buildings are fully replaced), whereas physical damage includes estimated costs to repair flood damage based on predicted flood depths and building characteristics. The values shown are the average of minimum and maximum calculated losses. Refer to the Project's Final Report for more information.



2070 SLR + 100yr Tropical Storm + Storm Surge

Shoreline Protection Only



2070 SLR + 100yr Tropical Storm + Storm Surge

Joseph Finnegan Park Pump Station

Legend

- Flood Depth > 4 in and < 1 ft
- Flood Depth > 1 ft and < 2 ft
- Flood Depth > 2 ft
- Drainage Area Analyzed

Simulation Parameters

Storm Type	100yr Tropical Storm
Rainfall Depth	9.6 inches
Peak WSE 2070 SLR + 100yr Surge	13.8 feet NAVD88

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Cost Estimate and FEMA BRIC Considerations

Capital Cost Estimate

A construction cost estimate for the Joseph Finnegan Park concept was developed for planning purposes. Assumptions for the cost estimate include 15-year escalation to the mid-point of construction and the inclusion of a 50% design contingency. Utility hookup costs were not included.

Table 3: Joseph Finnegan Park Cost Estimate Subtotals

Remaining Design Development & Construction Administration (assumed 20% of total less design contingency)	$4,708,000
Direct Construction Costs	$9,246,000
Indirect Construction Costs	$1,849,000
Mark-Up *(Including 50% design contingency)*	$23,787,000
Total	**$39,590,000**

Social Vulnerability and FEMA BRIC Funding

FEMA BRIC funding prioritizes disadvantaged communities. Table 4 contains a summary of several indicators for the Joseph Finnegan Park tributary area that could be used help characterize the community for future FEMA funding applications and prioritization of projects that benefit disadvantaged communities.

Table 4: Joseph Finnegan Park Tributary Area Social Vulnerability Indicators

Low Income & Persistent Poverty	
Per Capita Income	$50,749
Below Poverty Line	6%
High Housing Cost Burden	
Stressed Renters (>40% rent-to-income)	25%
Households With Food Insecurity	14%
Racial and Ethnic Segregation	
Asian Population	9%
Black Population	10%
Hispanic Population	4%
White Population	75%
Education and Employment	
Adults Age 25+ Without High School (or equivalent) Degree	8%
Unemployment Rate (Age 16+)	4%

Data provided by risQ inc. from the US census and American Community Survey

Planting Palette

A planting palette was developed for the stormwater storage areas at Joseph Finnegan Park. Parts of the concept are designed to temporarily flood during intense storm events. The selected plant species are tolerant of occasional temporary flooding. After construction, planting of native plant species could provide a public amenity with new green space and environmental benefits associated with native plant species.

Trees

Amelanchier canadensis
Canadian serviceberry

Juniperus virginiana
eastern red cedar

Betula populifolia
gray birch

Celtis occidentalis
hackberry

Shrubs

Spirea tomentosa
steeplebush

Aronia arbutifolia
red chokeberry

Clethra alnifolia
sweet pepperbush

Lindera benzoin
spicebush

Herbaceous and Grasses

Eupatorium album
white throughwart

Schizacharium scoparium
little bluestem

Symphyotrichum novi-belgi
New York aster

Euthamia graminofolia
grass-leaved goldenrod

Coastal Stormwater Discharge Analysis
Joseph Finnegan Park

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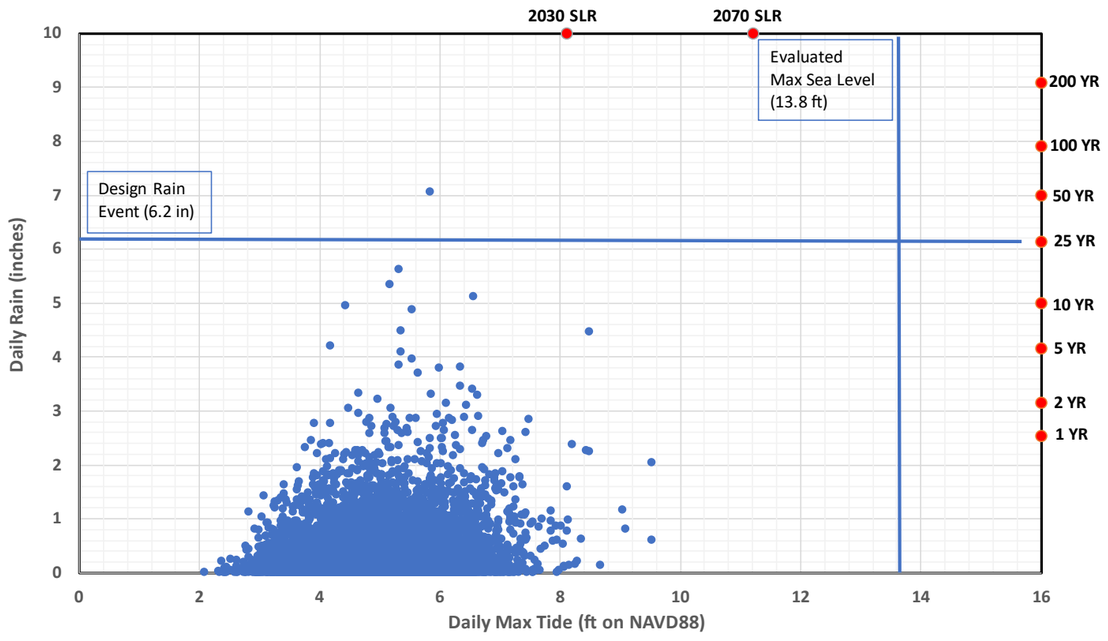
Adaptability and Implementation

Adaptability

Figure 4 below depicts historical daily rainfall totals and tide levels. As shown in this figure, the conditions that were used to design and analyze and design the Finnegan Park storage concept are conservative and represent more extreme conditions than have occurred historically. As such, it is likely that the Finnegan Park storage concept will function even without the need for significant pumping in the future under many conditions. Regardless, the following measures could be implemented to adapt the concept to more severe conditions (additional SLR, more intense rainfall, etc.) in the future:

- Expand the pump station to maintain lower water levels during a storm event
- Deepen the storage basin and redesign the pump station to obtain additional usable storage
- Other interior drainage improvements could be made to convey additional flow to the Finnegan Park storage concept

Figure 4: Design and Analysis Conditions vs. Historical Tide and Rainfall



Implementation Considerations

- Coordination with CRB (and other relevant stakeholders) to construct adequate shoreline protection around Finnegan Park is essential for successful implementation of this concept. To function as designed, Finnegan park must be fully isolated from high sea levels; as such, careful coordination with CRB is essential at this location.
- Coordination with park planners and users of the park should be conducted to ensure that risks associated with having significant topographic variation are mitigated, such as determining locations where activities such as throwing frisbees and balls is discouraged. The design should be modified as necessary to ensure the park area is compliant with the Americans with Disabilities Act and fully accessible.
- On-site signage and community outreach will be required to adequately inform the public that the park will be a drowning hazard for children and people with physical disabilities during wet weather events.
- A portion of the Neponset River is federally designated as a superfund site. A survey of hazardous materials, and detailed list of required permits, should be developed before beginning the final design process.
- Active flow control gates at proposed diversion structures could be used to divert flow into Finnegan Park during low-intensity rain events; this could help prevent sediment deposition in the pipelines.
- Planting of native plant species and other green features will provide an improved public amenity and preserve the “look and feel” of the park.
- A comprehensive permitting evaluation should be conducted to evaluate possible impacts from construction and operation of the pump station to the receiving water.
- Community engagement with stakeholders may help build project support by illustrating the flood control benefits of the storage basin and pump station.

Replicability and Implementation Timeline

Summary of Similar Concepts

Number of Sites: 21

Vulnerable Area: 462 acres

The Finnegan Park solution unique and not directly replicable in other locations. The design of the pump station could be replicated at other locations in the City. Additional detail about outfalls that could be protected with a similar pump station can be found in the Commission's Coastal Stormwater Discharge Analysis Implementation Timeline.

ATTACHMENT A
JOSEPH FINNEGAN PARK CONCEPTUAL DESIGN DRAWINGS

A-1: Overview Plan and Storage Section Views
A-2: Pump Station Plan and Section View

Coastal Stormwater Discharge Analysis
Joseph Finnegan Park

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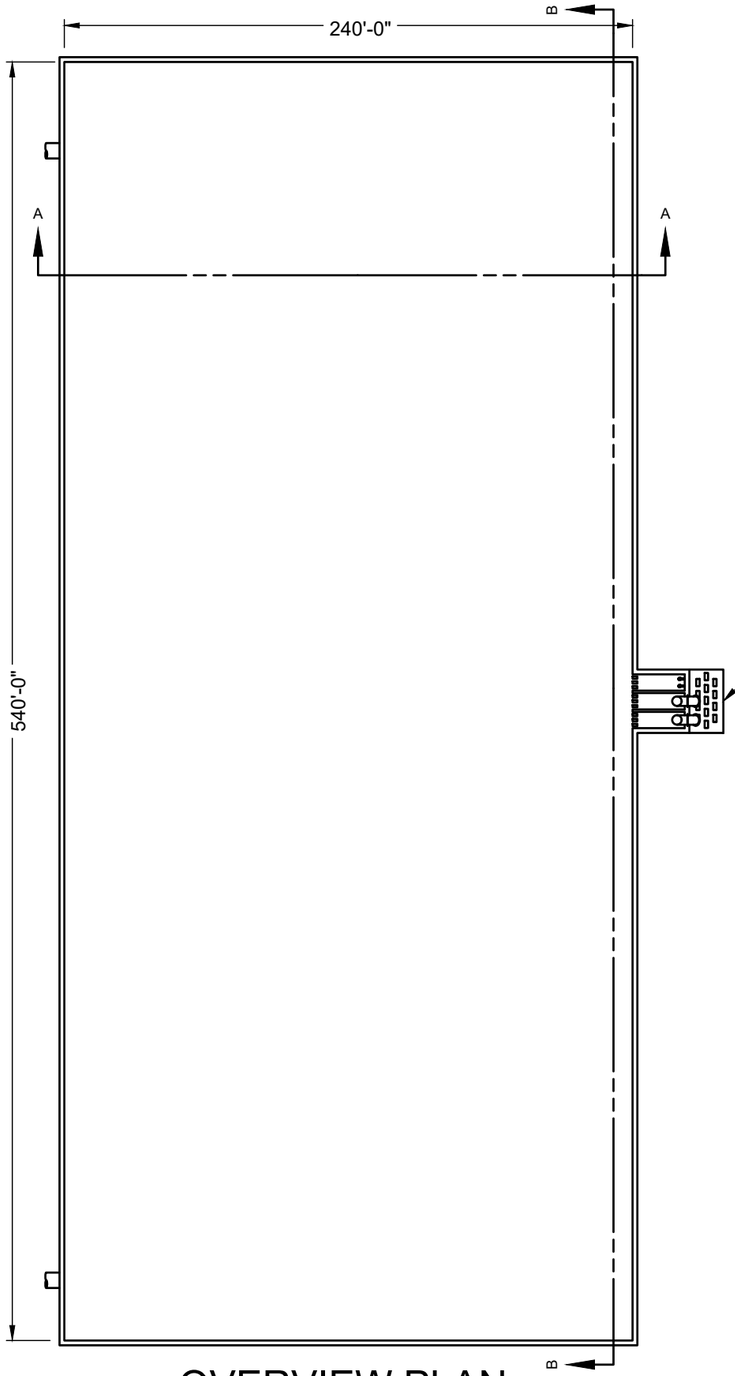
Finnegan Park Stormwater Management Concept

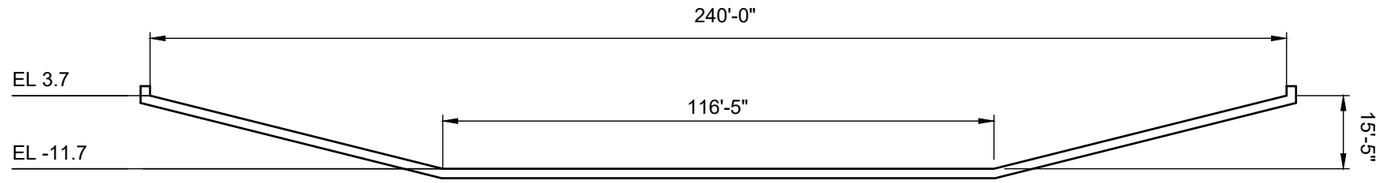


OVERVIEW PLAN

SCALE: NTS

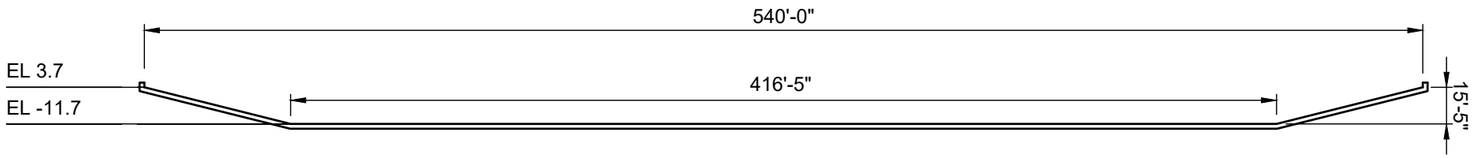
NOTES

1. FOR WATER SURFACE ELEVATIONS REFER TO OPERATIONAL TABLE.
2. ALL ELEVATIONS USE THE NAVD88 VERTICAL DATUM UNLESS OTHERWISE STATED.
3. CONCEPTUAL DRAWING, NOT FOR CONSTRUCTION.



SECTION A

SCALE: NTS



SECTION B

SCALE: NTS

COASTAL STORMWATER DISCHARGE ANALYSIS

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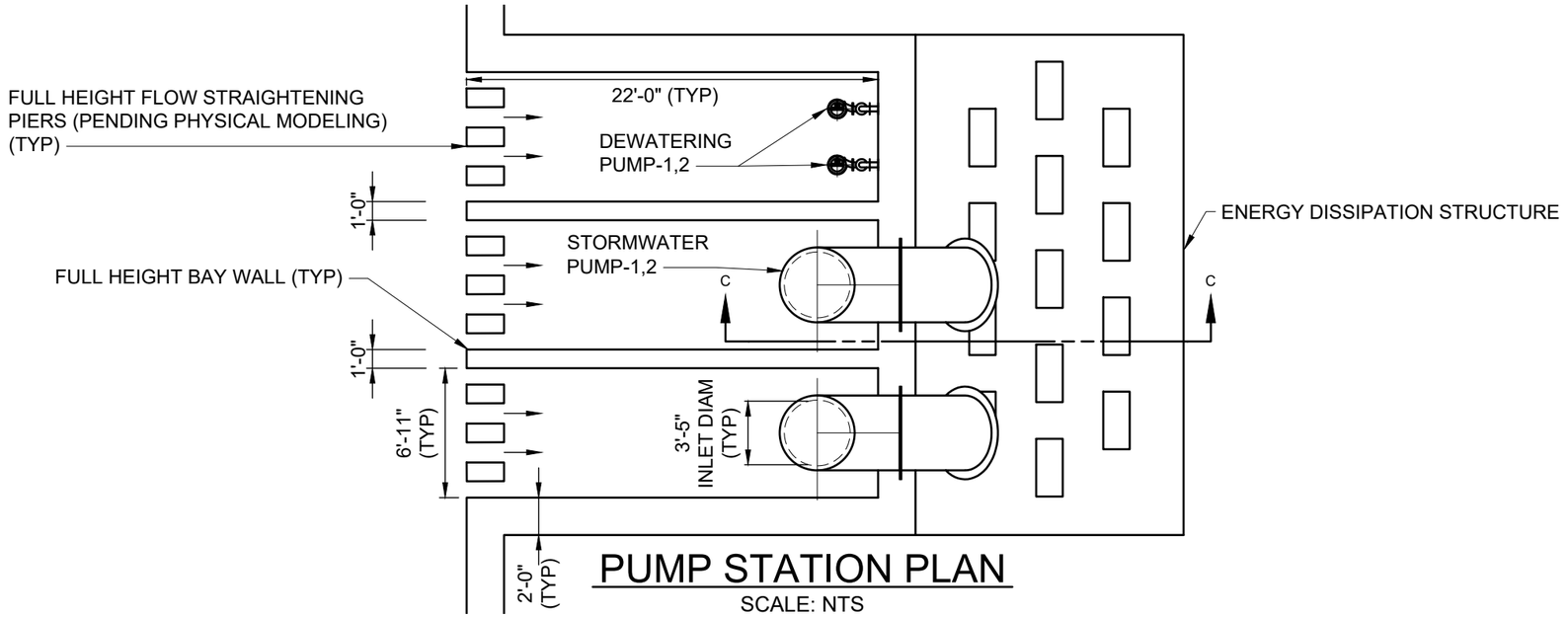
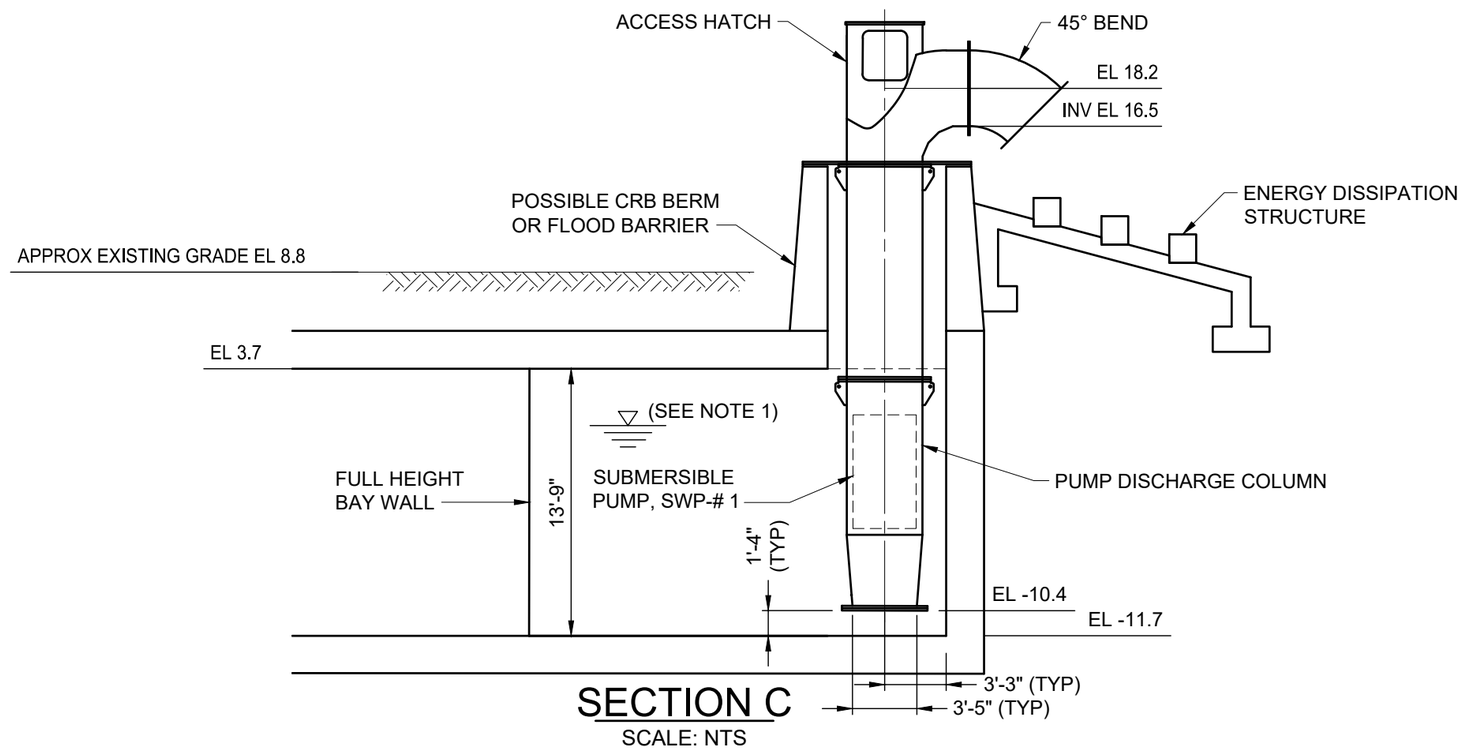
Finnegan Park Stormwater Management Concept



PUMP STATION PLAN

SCALE: NTS



SECTION C

SCALE: NTS

NOTES

1. FOR WATER SURFACE ELEVATIONS REFER TO OPERATIONAL TABLE.
2. ALL ELEVATIONS USE THE NAVD88 VERTICAL DATUM UNLESS OTHERWISE STATED.
3. CONCEPTUAL DRAWING, NOT FOR CONSTRUCTION.

STORMWATER PUMP-1,2 OPERATIONAL PARAMETERS	
FLOW RATE, CFS	50
STATIC HEAD RANGE, FT	14.5 - 22.1
DESIGN FLOOD ELEVATION, FT	15.5

STORMWATER PUMP-1,2 OPERATIONAL WSE TABLE		
NOTE	OPERATION	ELEVATION, FT
A	HIGH LEVEL ALARM	2.7
B	LAG PUMP ON	1.9
C	LEAD PUMP ON	-0.9
D	LEAD PUMP OFF	-1.9
E	LOW LOW ALARM	-2.9
G	MIN PUMP SUBMERGENCE	-3.9

COASTAL STORMWATER DISCHARGE ANALYSIS

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