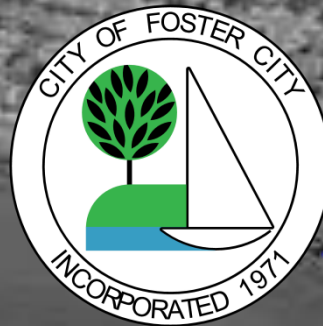




# LEVEE PROTECTION PLANNING AND IMPROVEMENTS PROJECT

Improving Today and Preparing for Tomorrow

Progress Update  
February 6, 2018

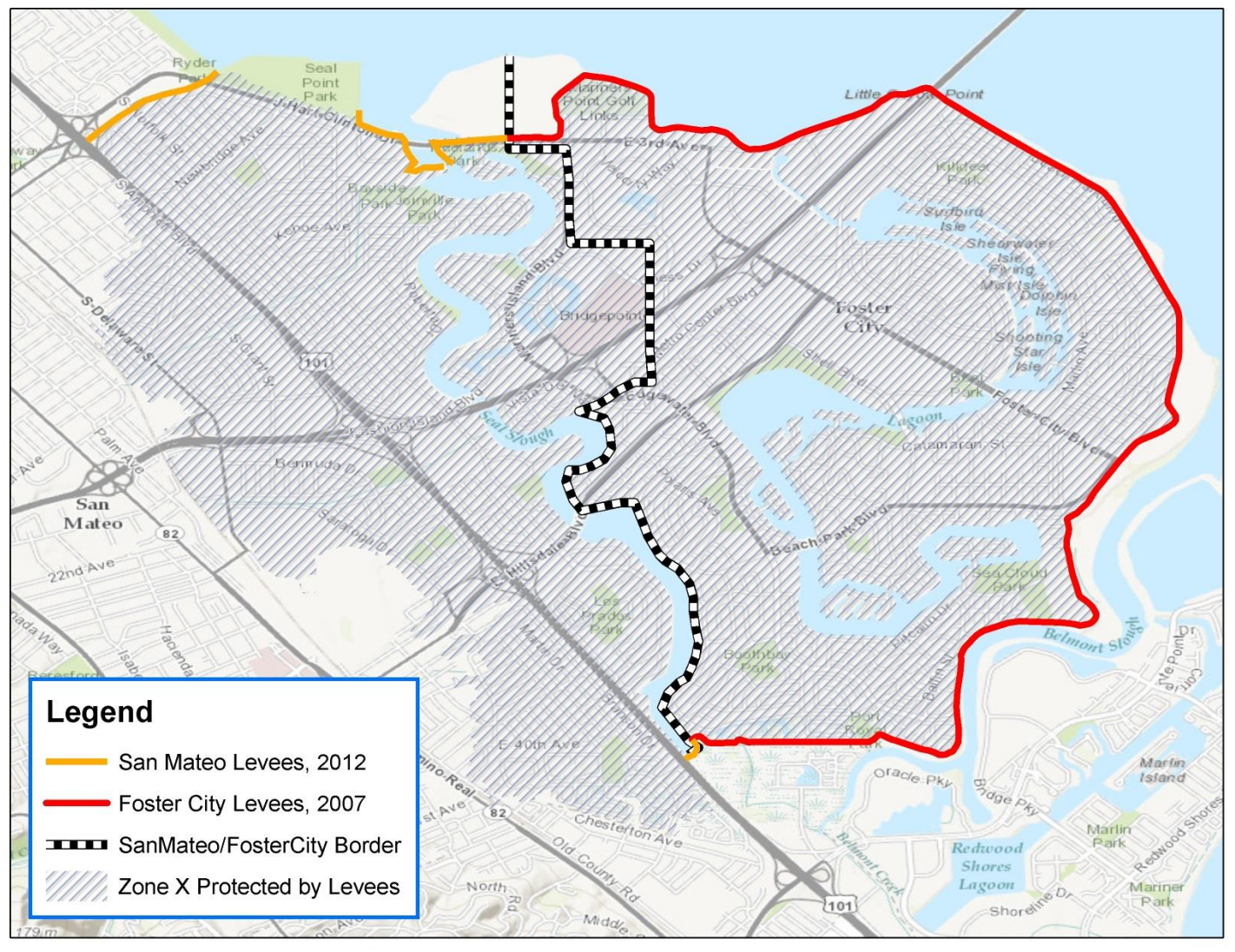


**Schaaf & Wheeler**  
CONSULTING CIVIL ENGINEERS

# Presentation

- Need for Levee Improvements
- City Council Direction
- Proposed Levee Improvements
- Accomplishments to Date
- Remaining Schedule

# Levee System Overview

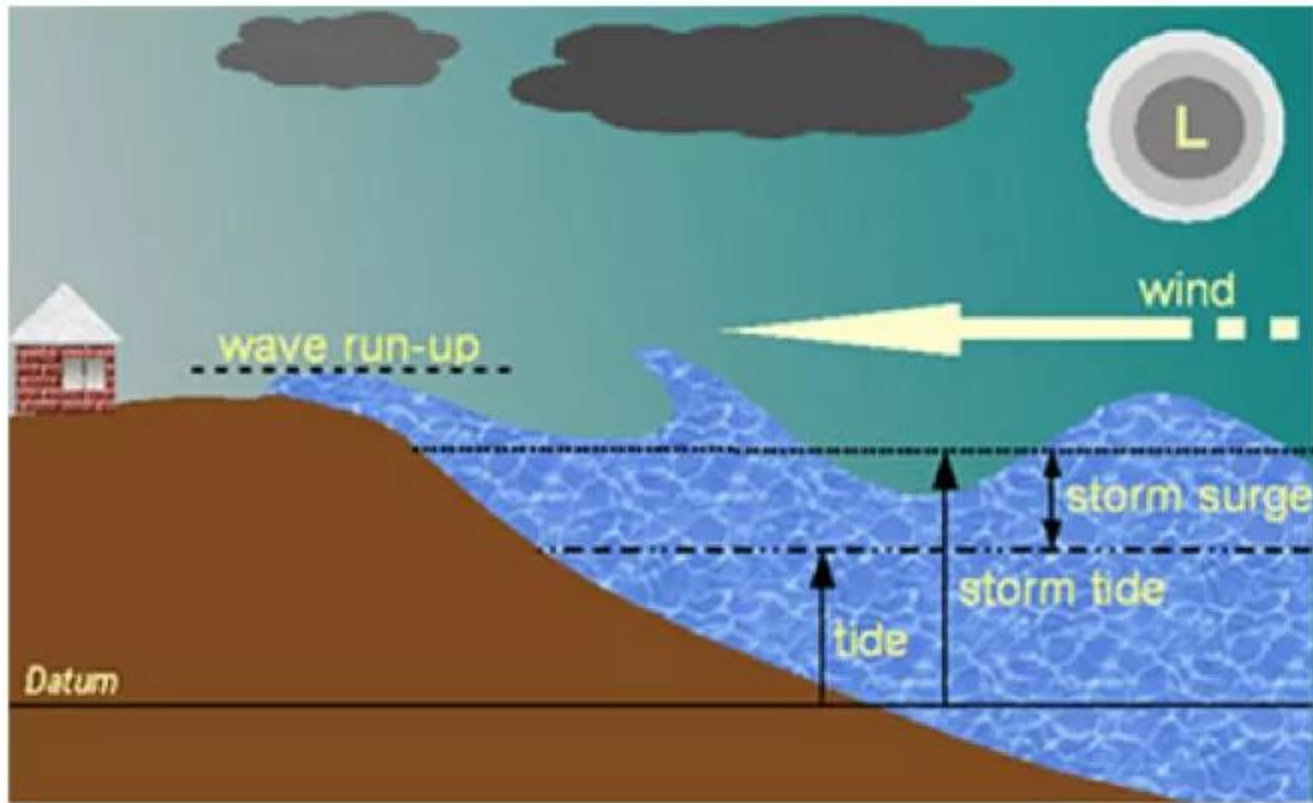


# Typical Levee in Foster City

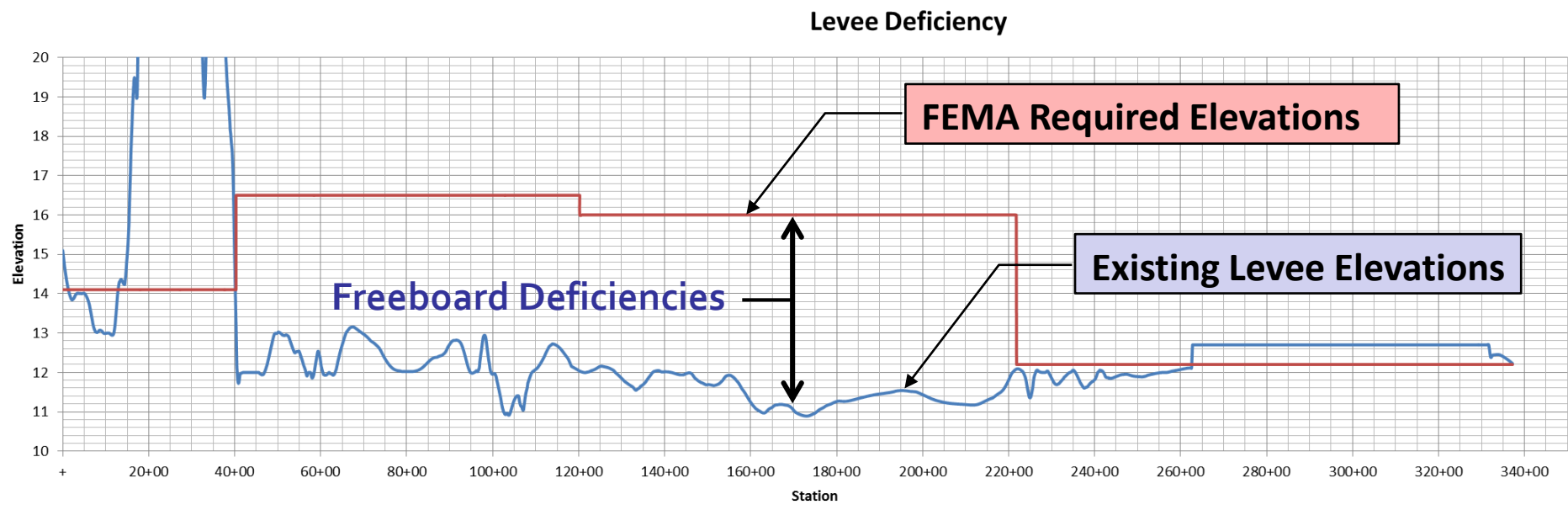


# FEMA Coastal Flood Hazard Study (2014)

**Maximum vertical elevation reached by the sea:**  
Combination of the wave set-up that is induced landward of the  
wave breaking zone and wave run-up



# Levees do not meet requirements for FEMA accreditation.



- No Deficiency
- Freeboard Deficient



# Regulatory Environment

- ❑ Levee improvement project requires numerous permits.
- ❑ The State recognizes that Sea Level Rise (SLR) is a significant threat.
- ❑ BCDC requires resilience through design to the high range of 2050 SLR.
- ❑ Both RWQCB and BCDC require risk assessments and adaptation strategies to address 2100 SLR.



## Policies for a Rising Bay Project Final Report

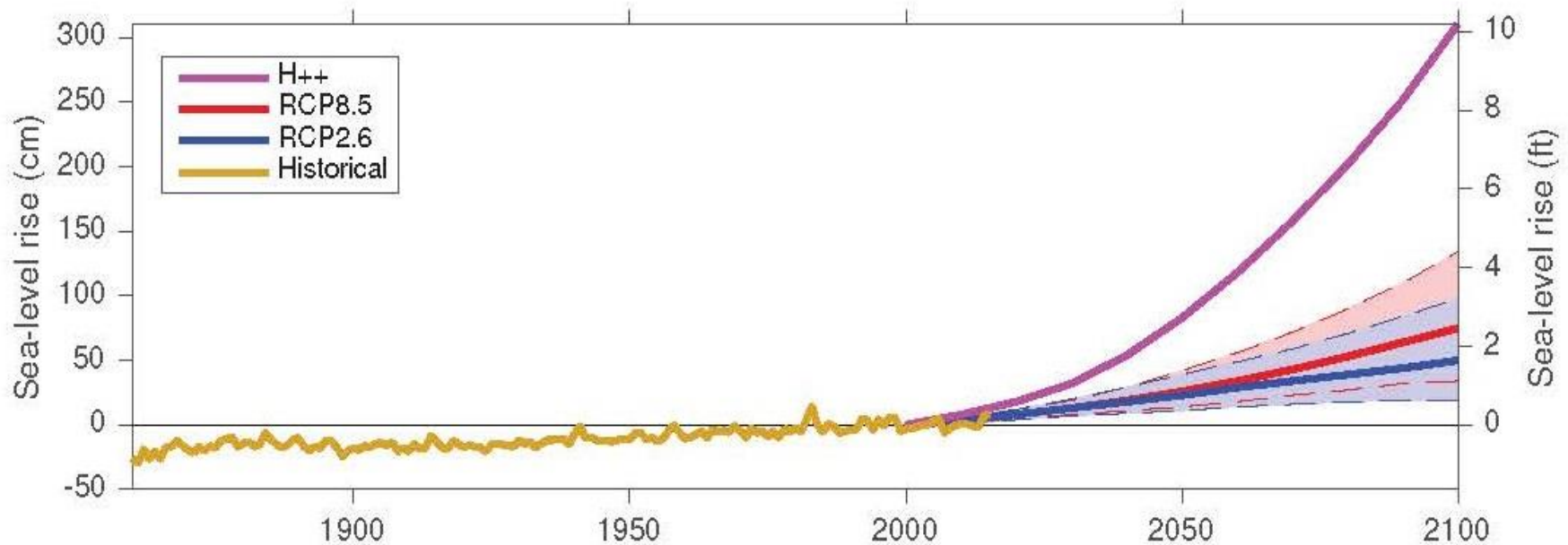
SAN FRANCISCO BAY CONSERVATION AND DEVELOPMENT COMMISSION

NOVEMBER 1, 2016



# Current Sea Level Rise Predictions

(b) Relative sea level in San Francisco, California



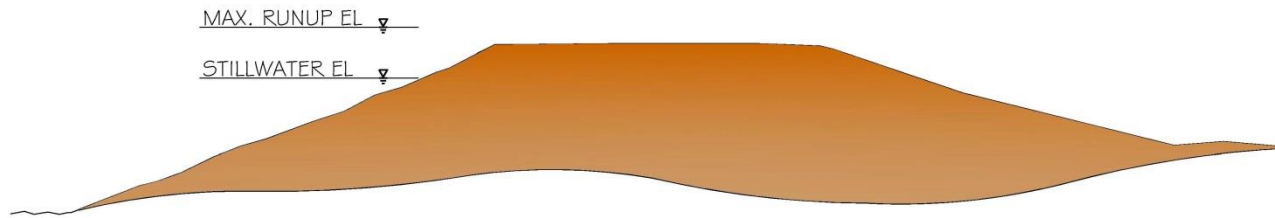
California Ocean Protection Council, Rising Seas in California: An Update on Sea-Level Rise Science, April 2017.



# Proposed Levee Improvements

## Raise the Existing Earthen Levee

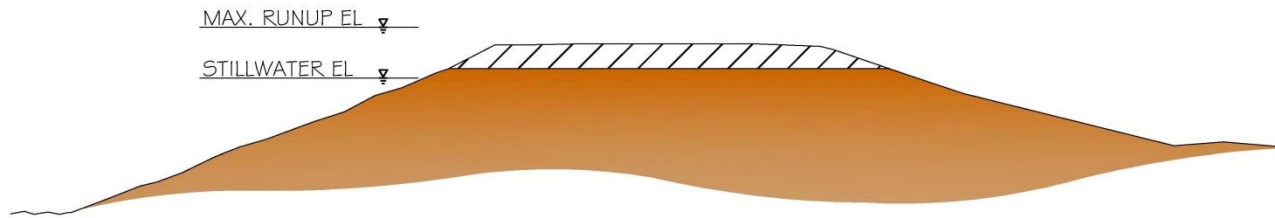
Used for roughly 15 percent of the improved six miles



# Proposed Levee Improvements

## Raise the Existing Earthen Levee

Used for roughly 15 percent of the improved six miles

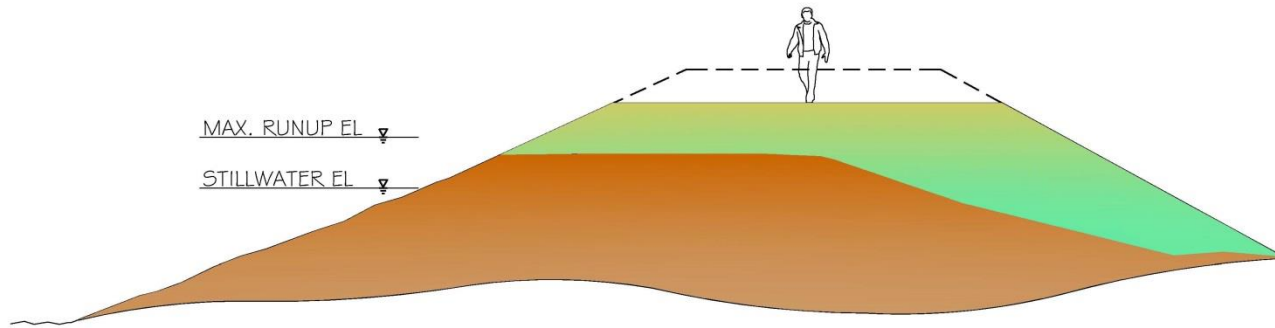


Top foot of soil (plus or minus) is removed.

# Proposed Levee Improvements

## Raise the Existing Earthen Levee

Used for roughly 15 percent of the improved six miles

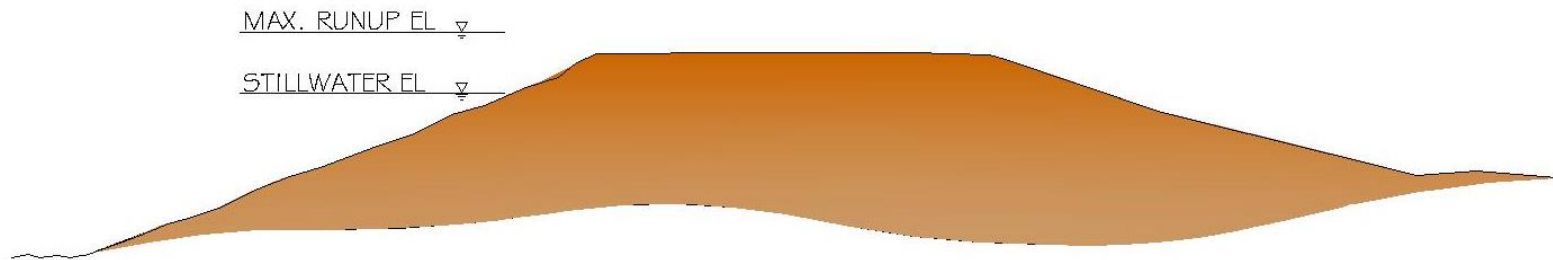


Engineered fill added to levee to meet FEMA requirements plus 2 feet of sea level rise with allowance for settlement.

# Proposed Levee Improvements

## Add or Replace Structural Floodwall

Used for roughly 15 percent of the improved six miles



Used in constrained rights-of-way where sheet pile cannot be driven and the existing level of flood protection is not compromised during construction.

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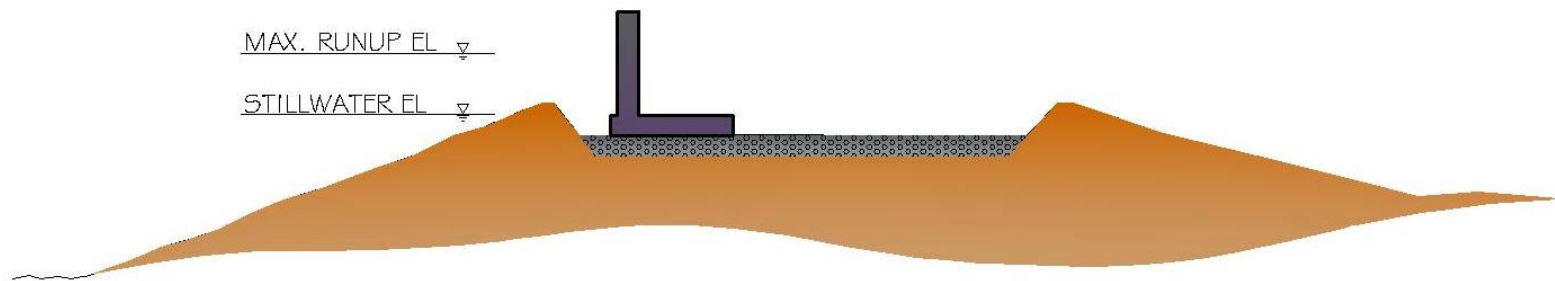


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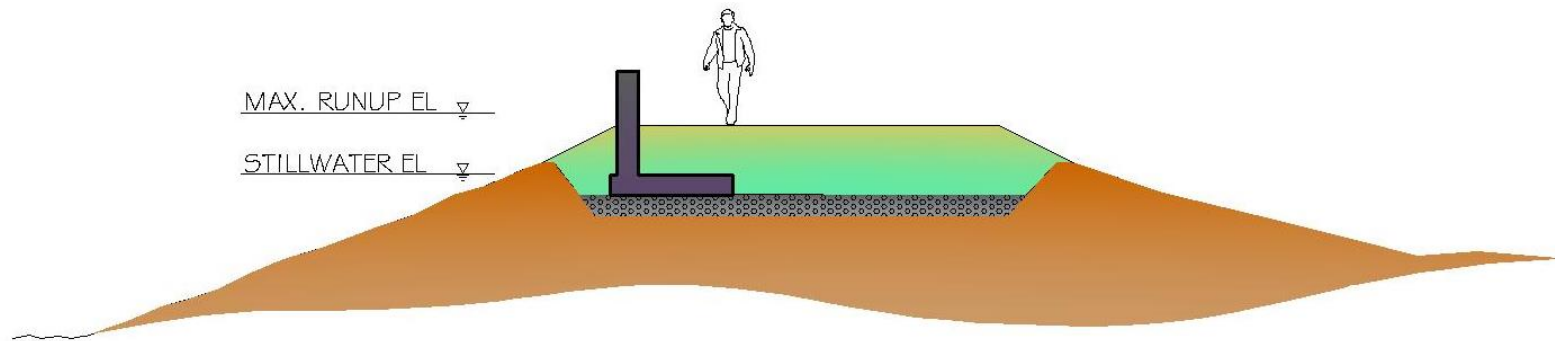


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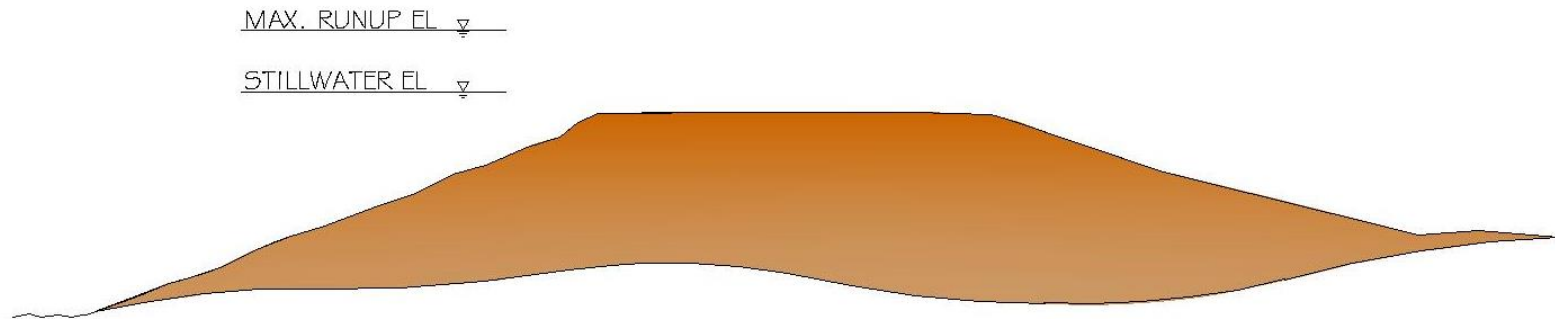


Used in constrained rights-of-way where sheet pile cannot be driven and the existing level of flood protection is not compromised during construction.

# Proposed Levee Improvements

## Hybrid Design

Used for roughly 70 percent of the improved six miles



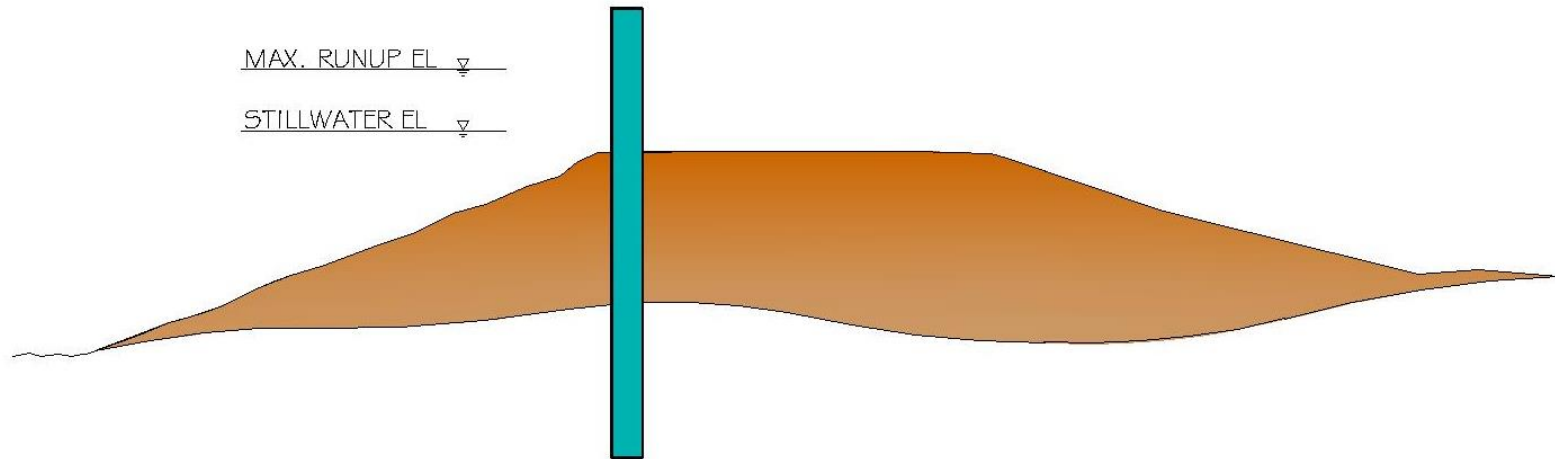
Used in constrained rights-of-way where sheet pile can be driven and the existing level of flood protection would be compromised during construction by building a conventional flood wall.



# Proposed Levee Improvements

## Hybrid Design

Used for roughly 70 percent of the improved six miles

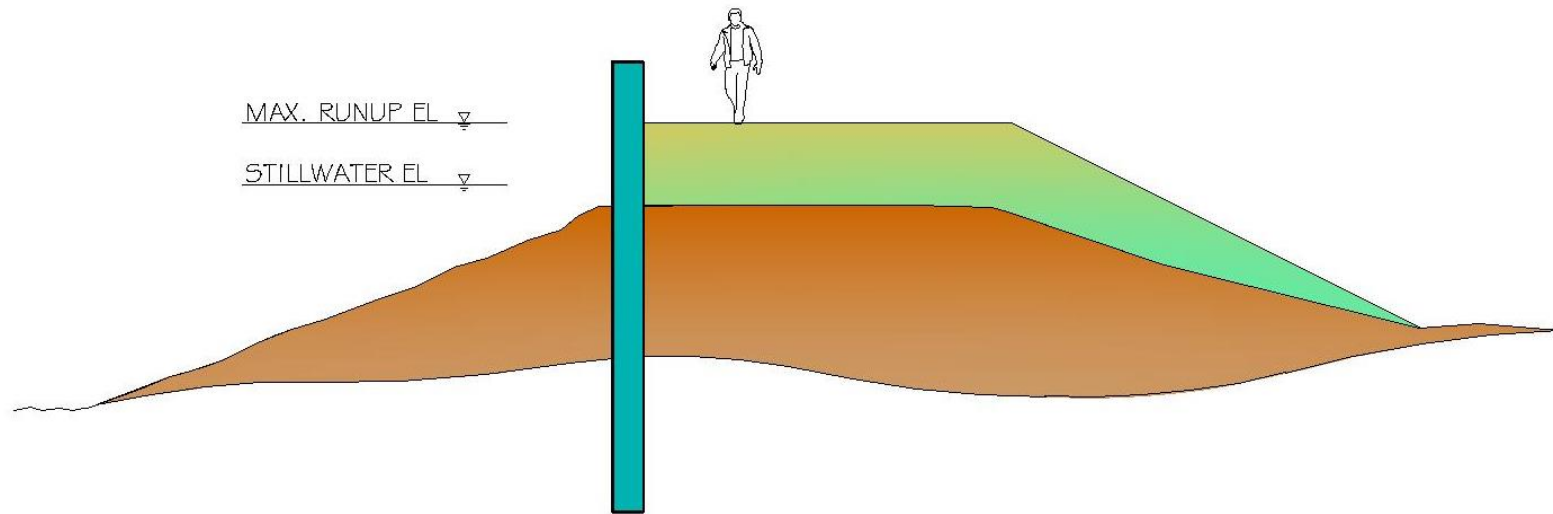


Flood protection is provided once sheet pile is driven to structurally-required depth.

# Proposed Levee Improvements

## Hybrid Design

Used for roughly 70 percent of the improved six miles



Fill to widen Bay Trail and maintain relatively short adjacent wall.

# How much will this cost?

Project Alternative	Estimated Cost
1. FEMA Accreditation Only <sup>1</sup>	\$60 million
2. 2050 SLR <sup>2</sup>	\$90 million
3. 2100 SLR <sup>3</sup>	\$170 million

1. Does not meet regulatory requirements for permitting.
2. Assumes 80-year project life, possibly with future adaptation.
3. Not selected.

# Project Impacts



# Project Impacts

2050 SLR Project Scenario



# Project Benefits

## ☐ FEMA Accreditation!

- 9,000 parcels in Foster City
- 8,000 parcels in San Mateo

## ☐ Bay Trail Improvements

- Widened to meet current Bay Trail Guidelines (18 feet)
- Better access to Trail and Bay (ADA-compliant)

## ☐ New Native Landscaping

## ☐ New Trail Amenities

# Ongoing Design Concerns

## ☐ Aesthetics

- Views from adjacent properties and streets
- View from Bay and across Belmont Slough

## ☐ Graffiti

- Sheet piling fascia
- Coatings

## ☐ Disruption During Construction

- Bay Trail detour
- Noise and vibration (potential for “silent press” method)
- Existing utilities within levee footprint

# Adaptation to Future Sea Level Rise

The project as designed is resilient to predicted sea level rise through 2050 with 99.5 percent confidence. How can it be adapted to possibly higher sea level rise beyond 2050?

- Build another project in the future if and when it is needed
- Build a project designed for 2100 high range SLR now
- Adapt to rising sea level over time
  - Foundation depth for 2100 SLR now; add wall height later
  - Future anchor walls
  - Future offshore solutions

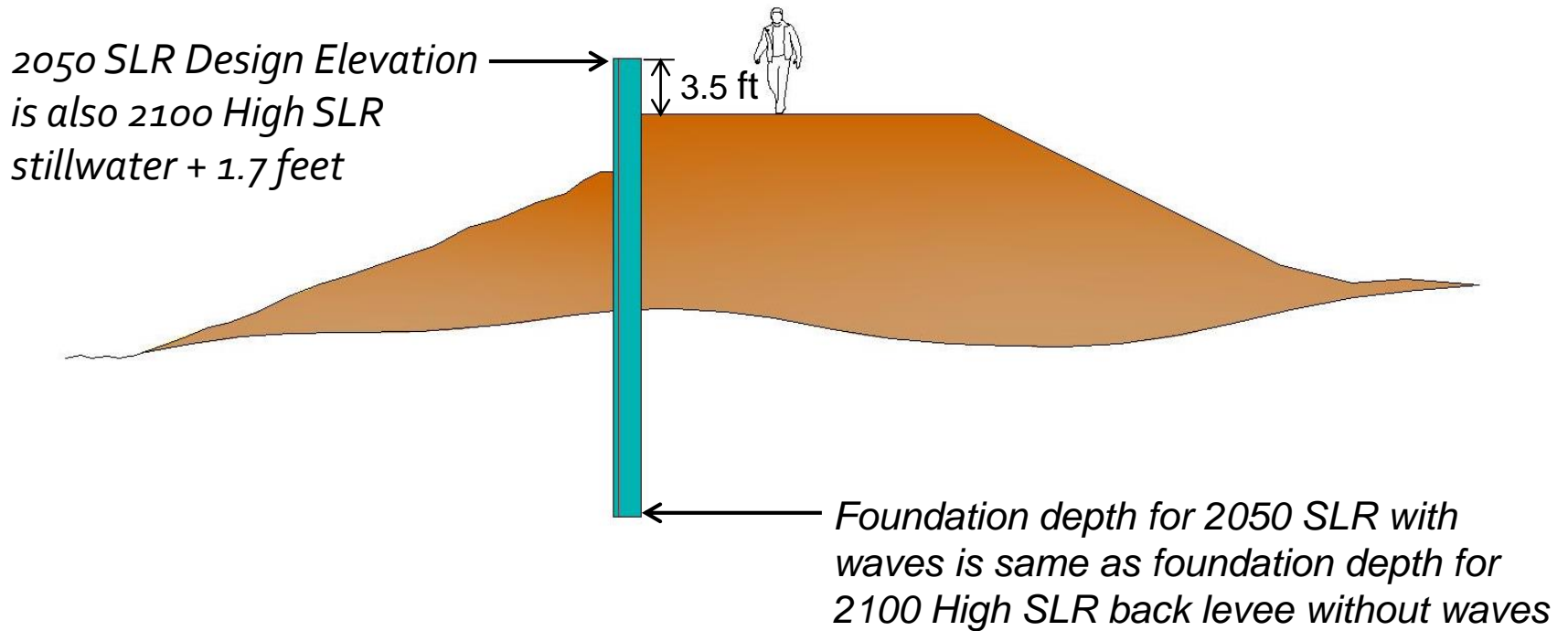


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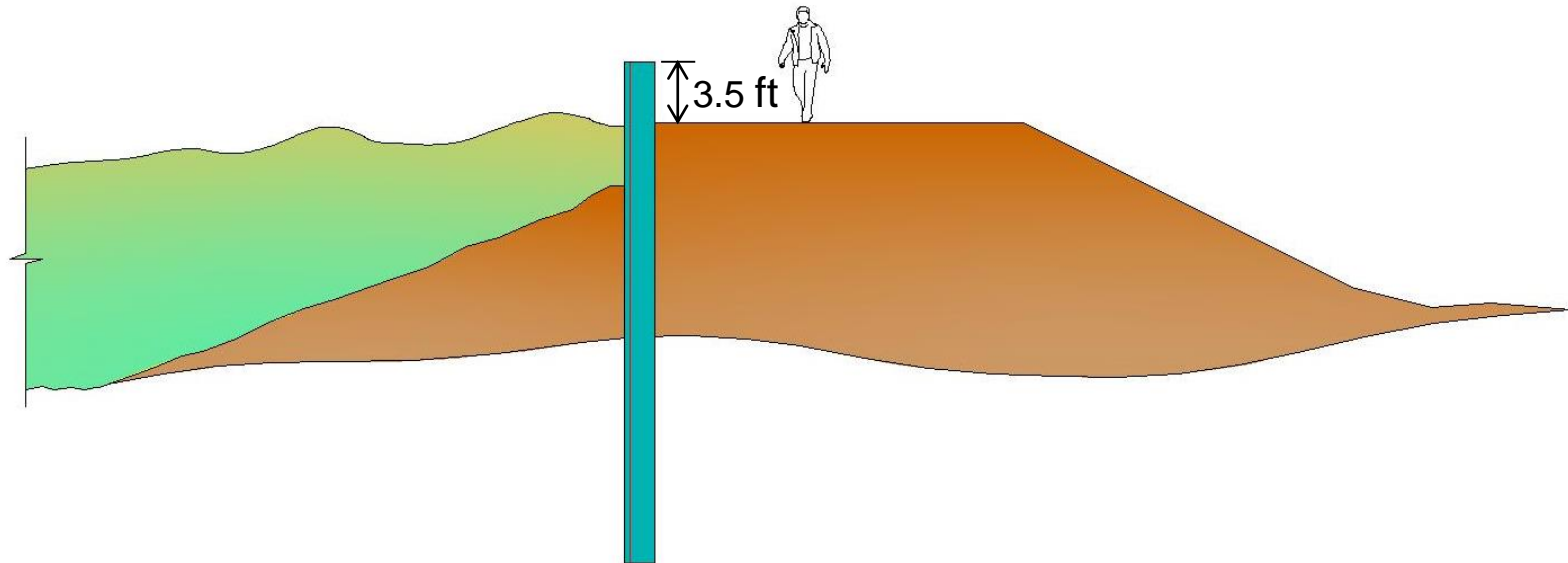
- ~~Build another project in the future if and when it is needed~~
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- Adapt to rising sea level over time
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  - ~~Future anchor walls~~
  - Future offshore solutions

# Those Darn Waves....

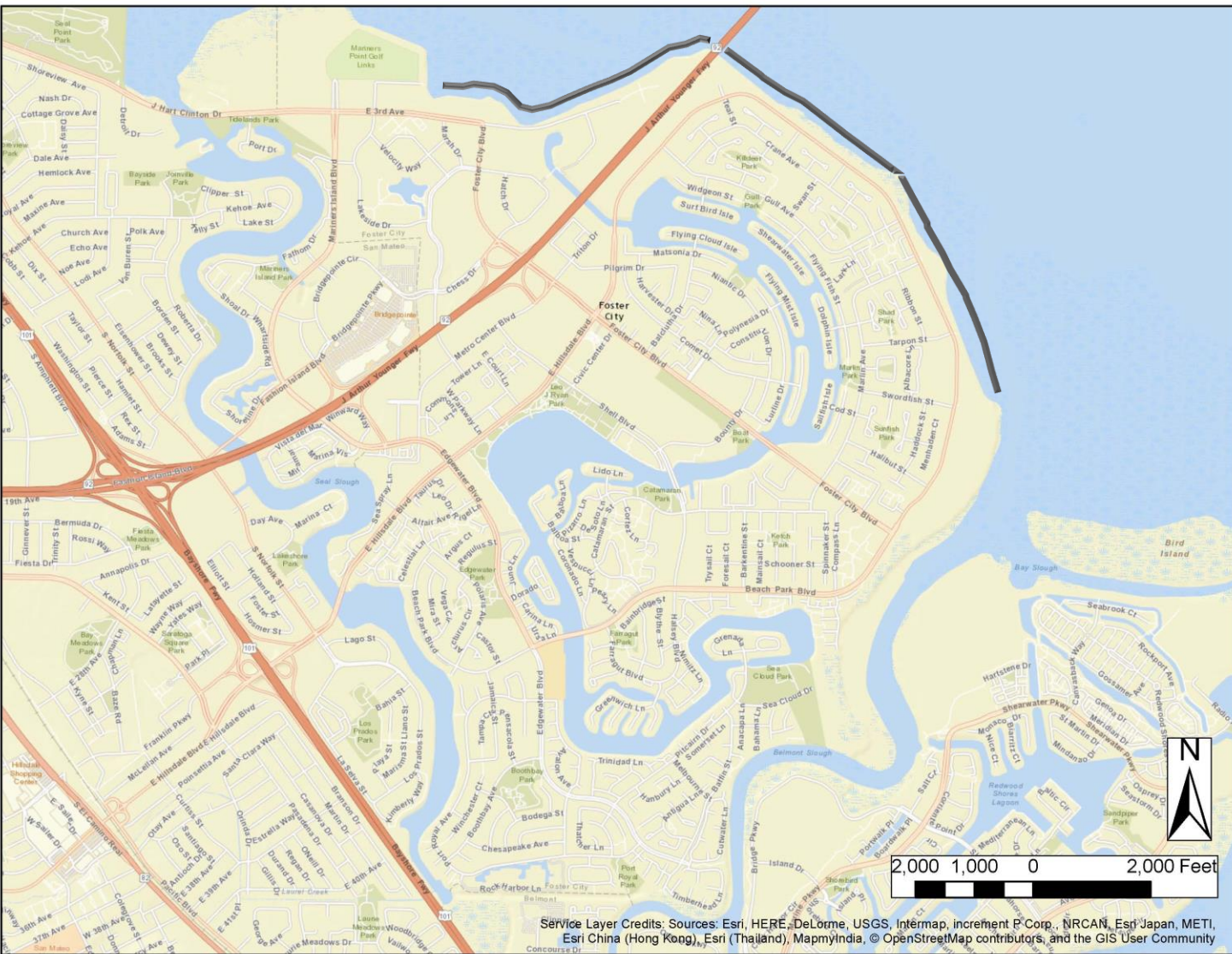


# Adaptive Construction in Future

*Adaptively build up offshore breakwater and beach forms*



# Future Adaptation to Rising Sea Levels



# Future Adaptation



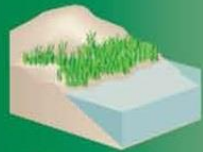
Source: NOAA

## GREEN - SOFTER TECHNIQUES

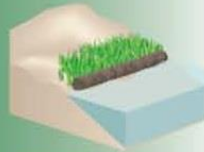
## GRAY - HARDER TECHNIQUES

### *Living Shorelines*

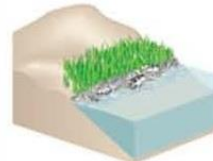
### *Coastal Structures*



**VEGETATION ONLY** - Provides a buffer to upland areas and breaks small waves. Suitable for low wave energy environments.



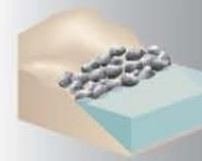
**EDGING** - Added structure holds the toe of existing or vegetated slope in place. Suitable for most areas except high wave energy environments.



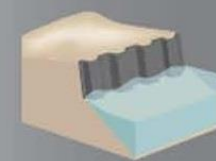
**SILLS** - Parallel to vegetated shoreline, reduces wave energy, and prevents erosion. Suitable for most areas except high wave energy environments.



**BREAKWATER** - (vegetation optional) - Offshore structures intended to break waves, reducing the force of wave action, and encourage sediment accretion. Suitable for most areas.



**REVETMENT** - Lays over the slope of the shoreline and protects it from erosion and waves. Suitable for sites with existing hardened shoreline structures.



**BULKHEAD** - Vertical wall parallel to the shoreline intended to hold soil in place. Suitable for high energy settings and sites with existing hard shoreline structures.

# Project Accomplishments to Date

July 2014	FEMA Completes Coastal Flood Study (CCAMP)
August 2014	City Surveys Existing Levees
March 2015	Detailed Evaluation of CCAMP Results
July 2015	Levee Protection Planning Study
August 2015	Presentation to Regulatory Agencies and Government Officials
October 2016	Basis of Levee Design
November 2016	Draft Environmental Impact Report
April 2017	Final Environmental Impact Report
May 2017	Council Directs Staff to Proceed with Design
July 2017	Begin Ballot Measure Polling
August 2017	60% Design Documents
September 2017	Ballot Measure Polling Completed



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