

Cargill pond berms wave runup and overtopping analysis - update

Jeremy Mull, PE

Coastal Engineering Manager

Jeremy.Mull@aecom.com

September 11, 2024

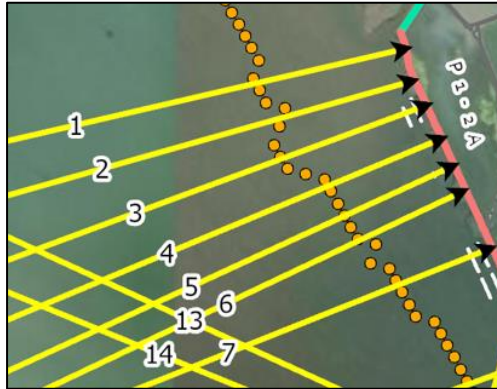
Background

- Cargill prepared a SLR Assessment in 2020/2021 to support its long-term operations and BCDC 10-year O&M permit renewal
- Assessment included:
 - Mapping of shoreline and inland berms and assets
 - Evaluation of SLR impacts through 2100
 - Identification of berm segments vulnerable to storm tide overtopping
 - Vulnerability and risk assessment for Cargill assets, operations, and environment
 - Conceptual phased SLR adaptation approach and adaptation considerations
- December 2022 – BCDC requested that Cargill evaluate impacts of wave runup and overtopping with SLR on bayfront berms based on requests from ECRB
- August 2023: Cargill presented preliminary wave runup methods and findings to ECRB
- 2023-2024: Wave Runup and Overtopping Analysis memo prepared and submitted to BCDC

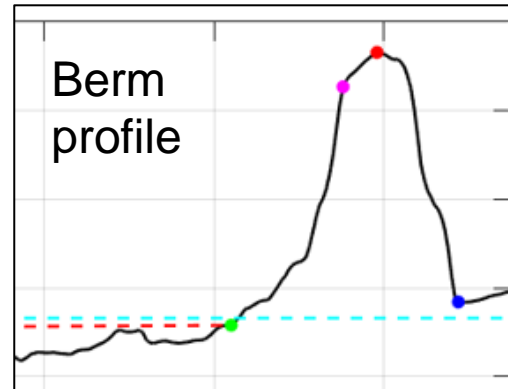
Purpose of Wave Runup and Overtopping Assessment

- Prior SLR assessment focused on impacts of high tide and “storm tide” overtopping of berms
- **What this assessment is:**
 - Evaluation of the potential for wave runup and overtopping on Cargill’s berms for existing and future conditions with SLR under a no-action scenario
 - Development of wave runup and overtopping metrics evaluated and mapped spatially for each SLR scenario:
 - Duration of berm toe exceedance & wave height >1 ft (average hours per year)
 - Frequency of berm crest overtopping (return period storm event)
 - Results are helping Cargill identify and prioritize maintenance for berm segments that may experience increased exposure to wave impacts due to SLR
 - Helps inform development of a long-term adaptation management plan for berms

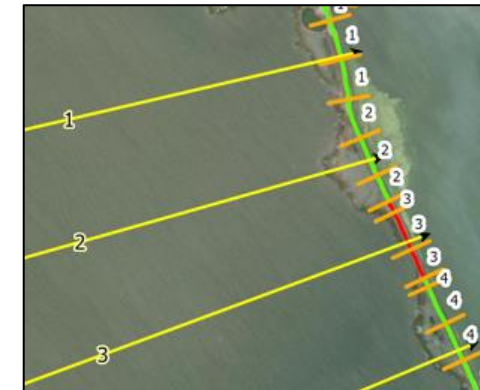
Approach Overview



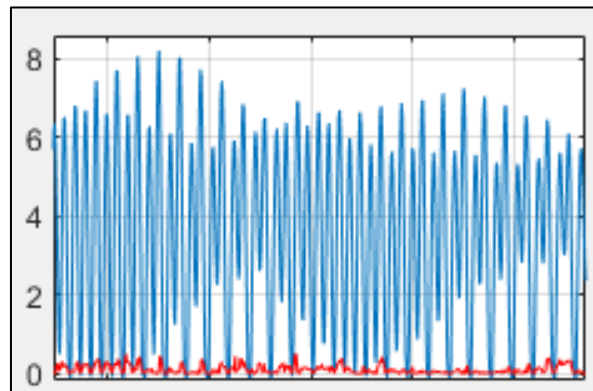
(1) Wave analysis transect layout



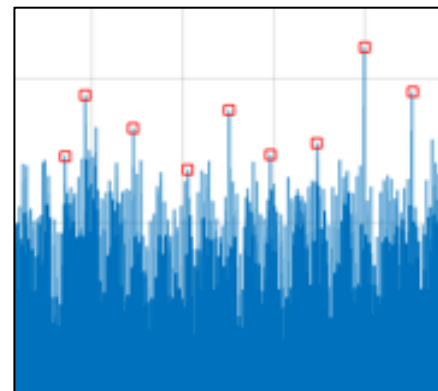
(2) Topo/bathy profile extraction & feature ID



(3) Assign representative transect to each berm segment



(4) Compile water level & wave model output data



(5) Calculate TWL hindcast & perform statistical analysis



(6) Tabulate berm exposure metrics & map the results

Calculating Wave Runup (Total Water Level) on Cargill Berms

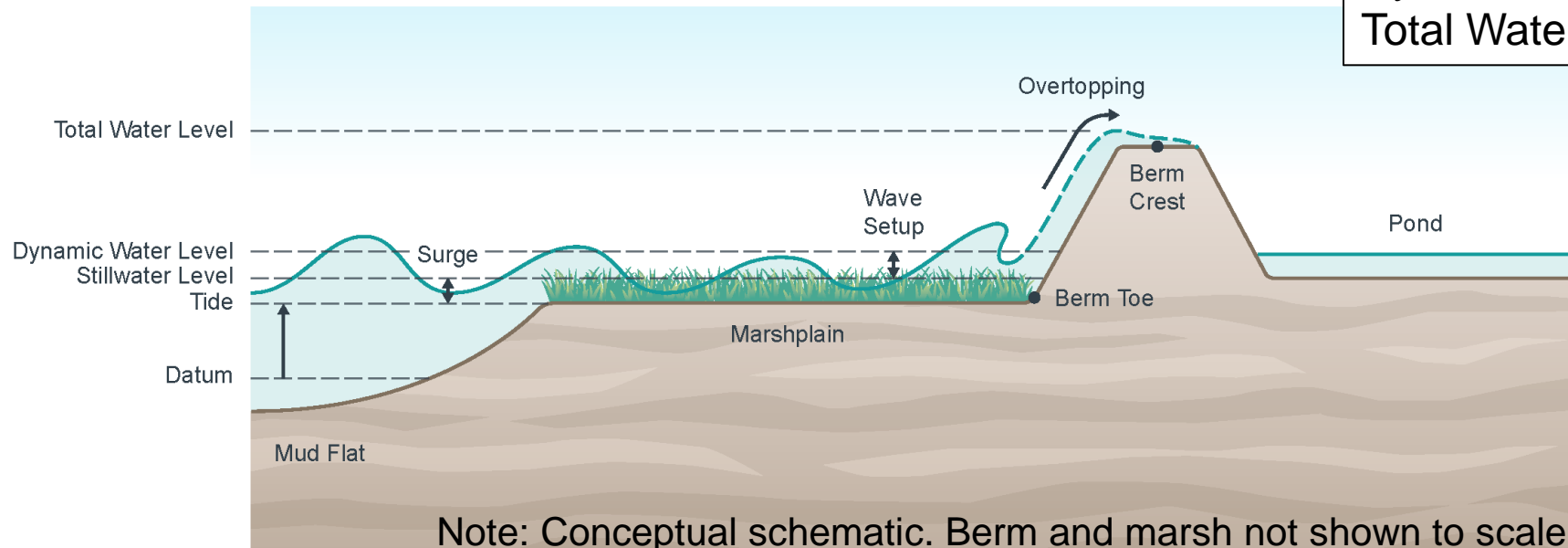
- Astronomical tide (predicted tide): **+6 to 8 ft**
- Surge components: atmospheric pressure, wind setup, El Niño effects: **+1 to 3 ft**
- Wave components: wave setup + wave runup: **+2 to 5 ft**
- Extreme TWL events (existing): **+10 to 15 ft NAVD88**

Terminology

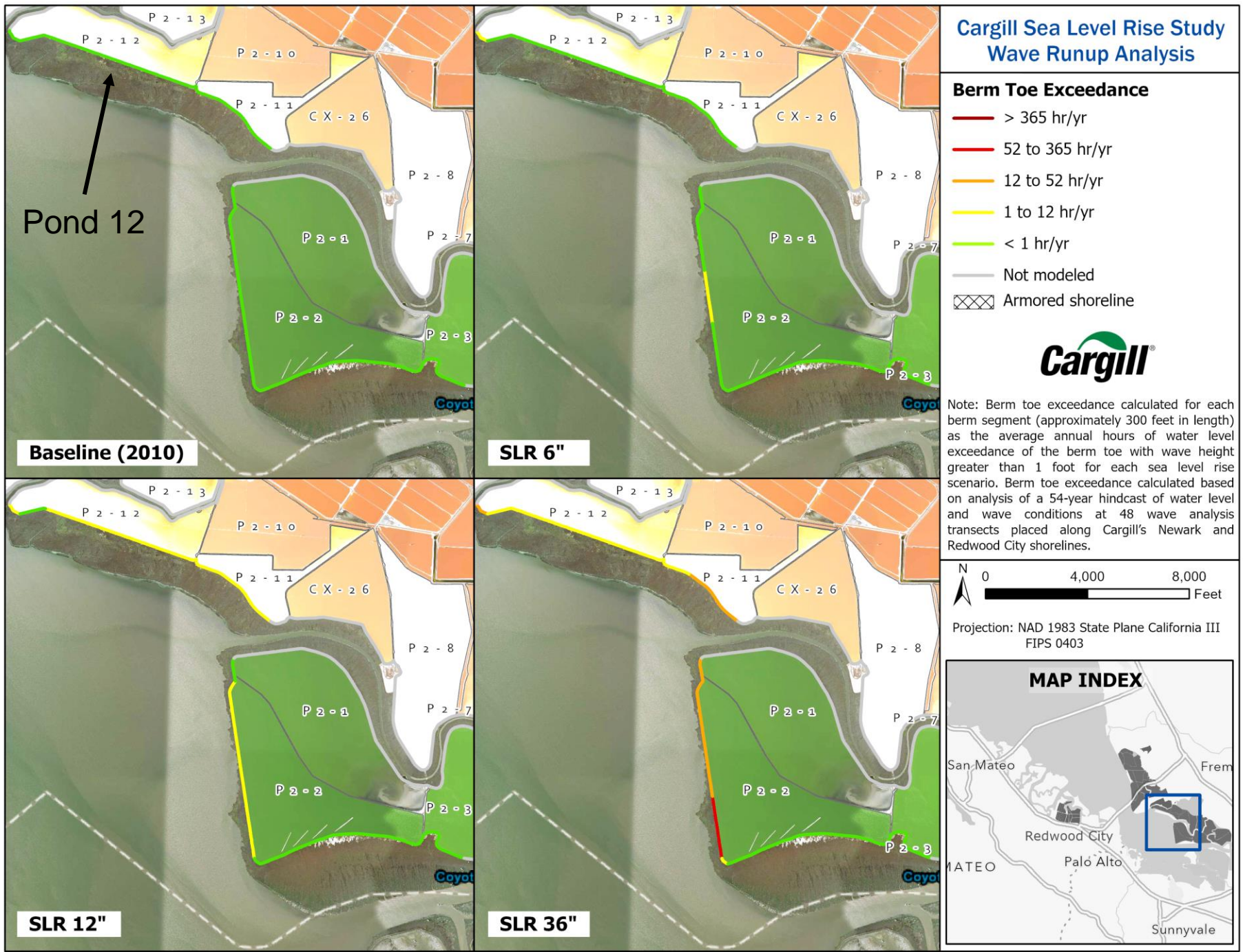
Stillwater Level: $SWL = \text{Tide} + \text{surge}$

Dynamic Water Level: $DWL = SWL + \text{setup}$

Total Water Level: $TWL = SWL + \text{setup} + \text{runup}$



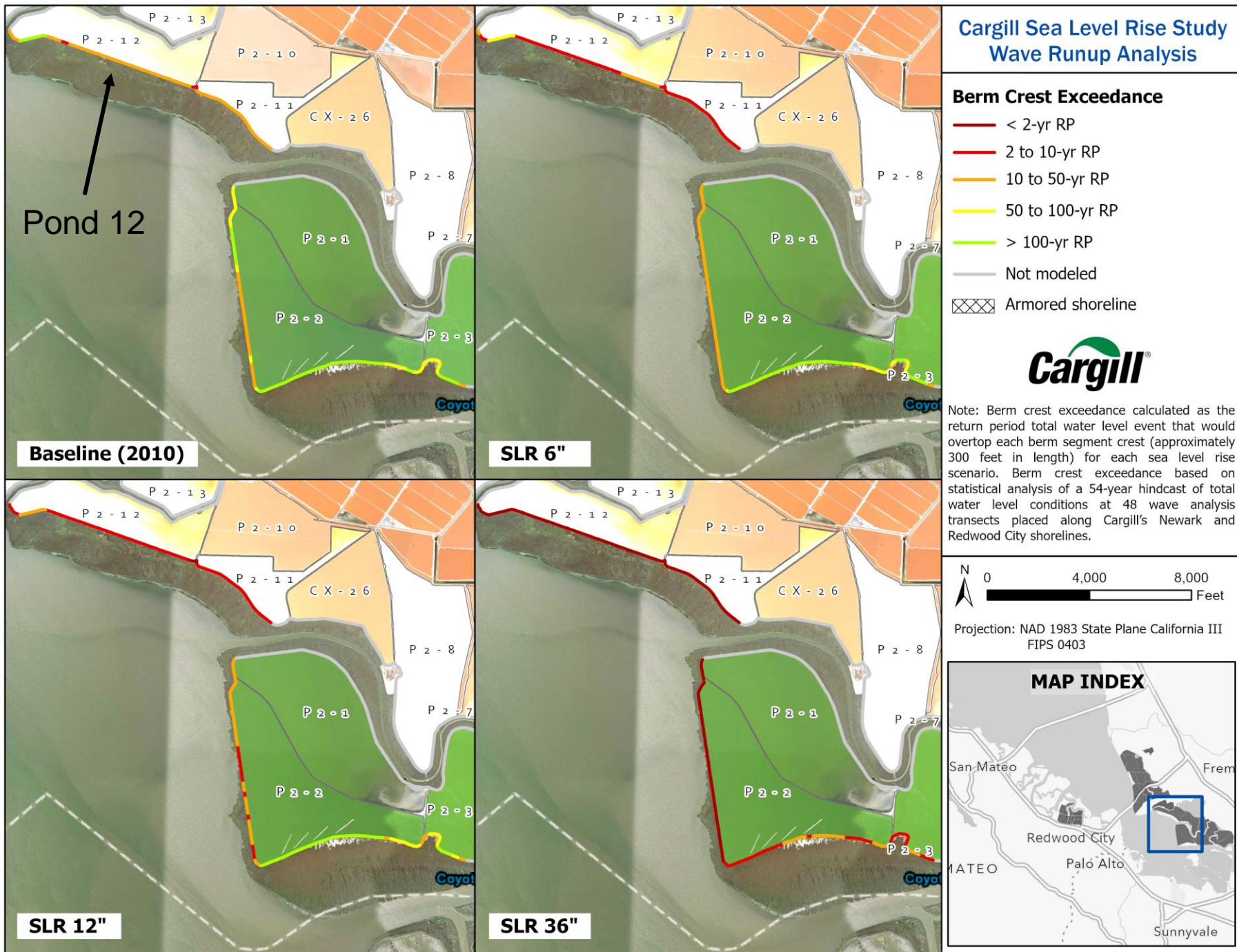
Future Conditions:
 $SWL_{SLR} = SWL + SLR$
 \rightarrow Re-run TWL analysis



Frequency of berm toe exceedance Newark Ponds Plant 2

Average annual number of hours where TWL exceeds berm toe and wave height >1 ft.

Sea Level Rise (inches)	"As early as" (Int-High)	"Likely by" (Int)
6"	2035	
12"	2050	2055
36"	2080	2100



Frequency of berm crest overtopping Newark Ponds Plant 2

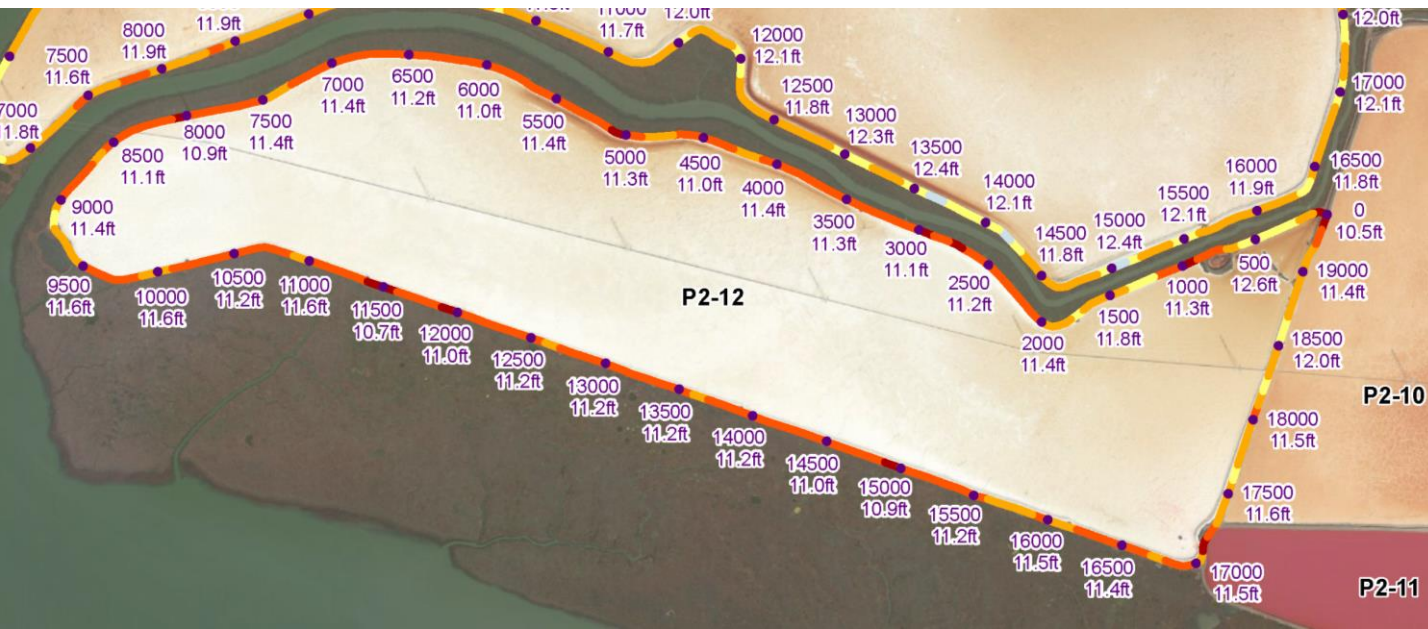
Return period TWL event that would result in berm crest overtopping.

Sea Level Rise (inches)	"As early as" (Int-High)	"Likely by" (Int)
6"	2035	
12"	2050	2055
36"	2080	2100

OPC (2024)

Summary of Results at MSS Ponds (Pond P2-12) Under No-Action Scenario

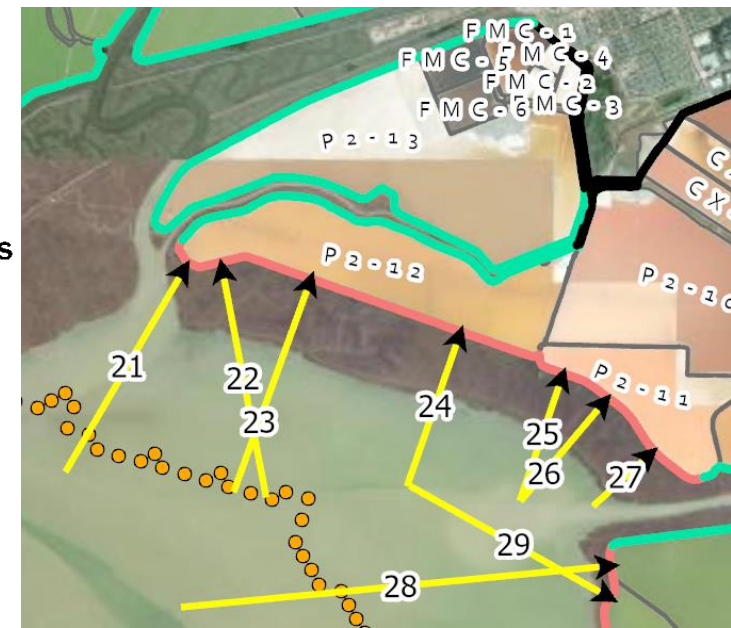
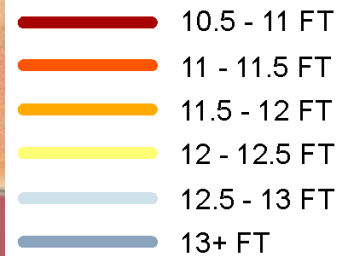
- Transects 21, 22, 23, and 24
- Existing bayfront crest elevations generally range from 11.0 to 12.0 ft NAVD88
- Majority of Pond P2-12 berm crests are >100-year SWEL (~11 ft NAVD88)
- **Baseline conditions:** Wave OT occurs for 10-yr storm (10% annual chance) and greater; 100-yr TWL is 11-13 ft NAVD88
- **Future conditions (6" SLR):** Wave OT occurs for 5-yr storm (20% annual chance) and greater; 100-yr TWL is 12-13 ft NAVD88



Berm Elevation Points
(500ft Intervals)

● Berm Elevation Points

Average Berm Elevations
(100ft Segments)



How will this information be used by Cargill?

- Cargill will identify specific areas for inspection and maintenance, prioritizing segments that are more vulnerable to potential wave overtopping, while continuing its robust monitoring, inspection, and maintenance program
- Cargill will increase berm crest elevations of both P2-12 and P2-13 to 11.5 ft NAVD88 by 2034
- Cargill will estimate overtopping rates at the MSS ponds and evaluate whether overtopping could result in scour impacts to berm stability
- Cargill will develop a long-term adaptation management plan during the next M&O permit period for the entire solar salt system

AECOM Delivering a
better world