

SAFER Bay Project

ECRB Meeting 10/23/2026

Geotechnical and Geology Issues

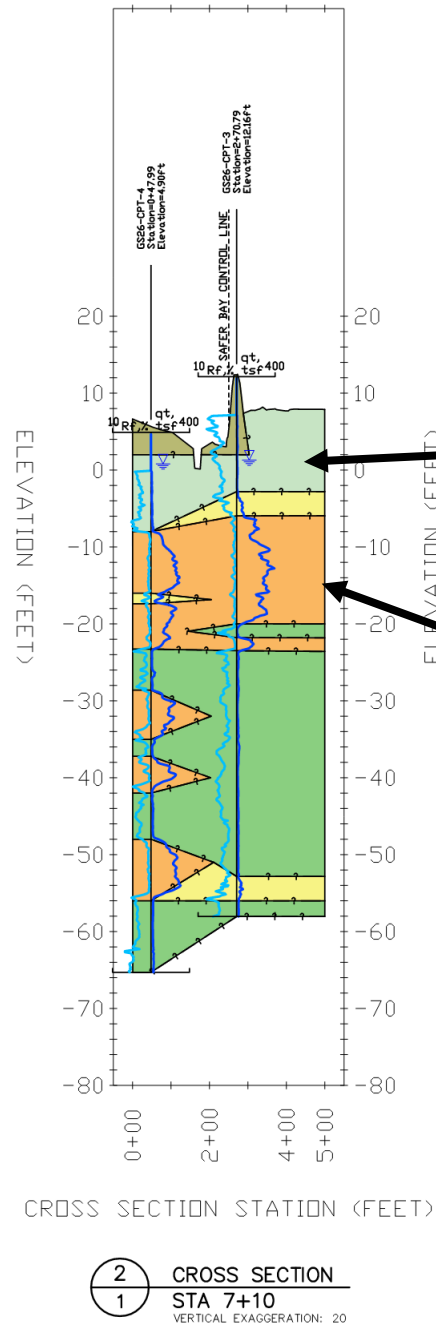
Historic Geology Considerations for EPA Reach

- ECRB Comment: the ECRB flagged the risk of underconsolidated soils overlying sand lenses in the East Palo Alto geological profile, as well as the potential for elevated pore pressures related to these sand lenses. The ECRB recommended that additional pore pressure measurements be taken orthogonal to the levee footprint to better characterize this condition.
- The design teams have gathered information on the dry and wet sides of the levees at accessible locations with the purpose of developing seepage models for gradient evaluation. The marsh on the wet side, and the developments on the dry side, restrict access to perform explorations. In the upcoming ECRB meeting, the design team will present the information we have gathered for the geologic conditions orthogonal to the levee including the design cross sections and the results of seepage analyses which evaluated exit gradients through the overlying young bay muds. It should be noted that for much of the levee alignment, the dry side includes fill to create drainage swales that will also counteract upward gradients. Also, the overlying young bay muds are generally thick when compared to the hydraulic levee height. Additional pore pressure measurements are not able to be collected at this time.

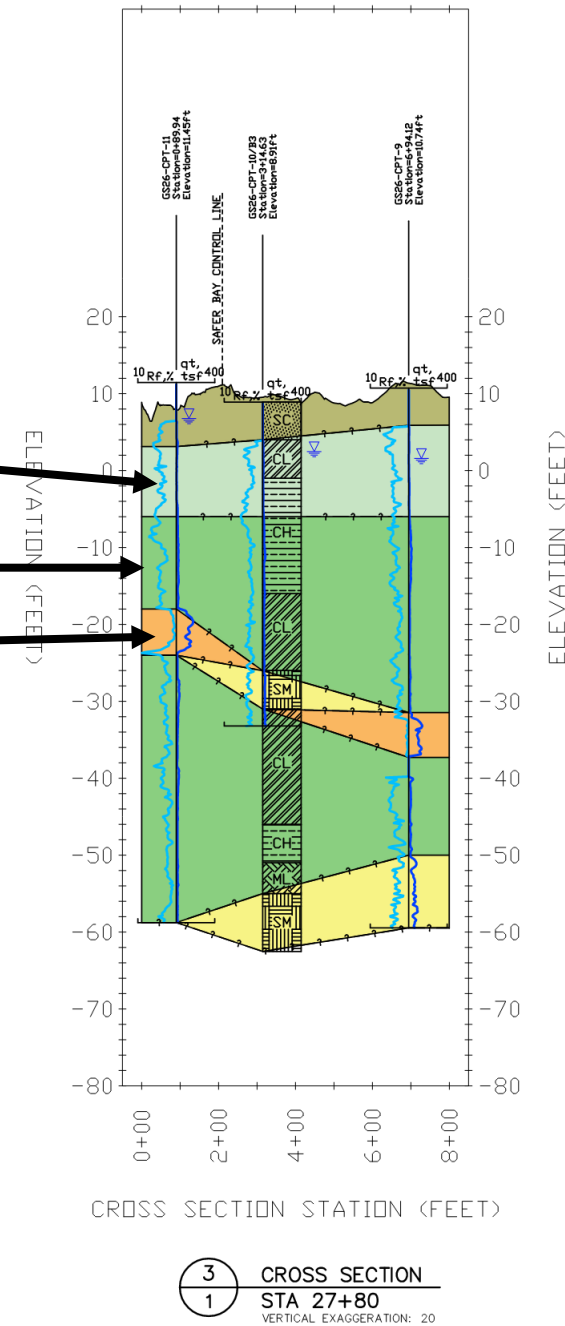


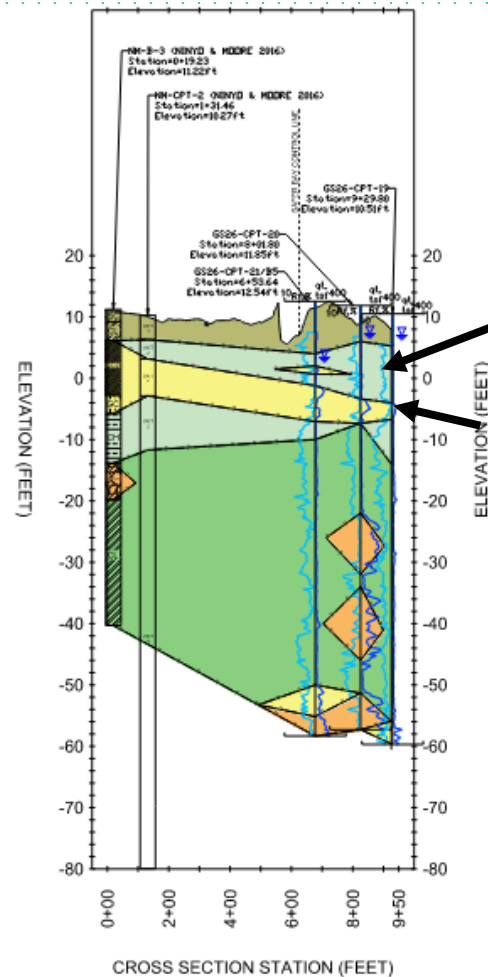
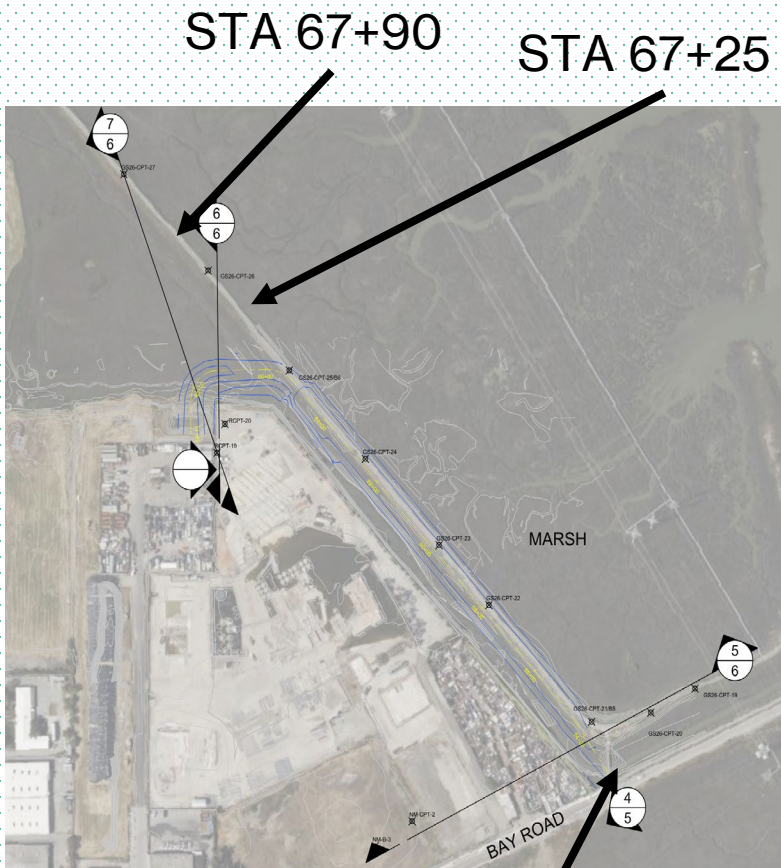
STA
27+80

STA 7+10



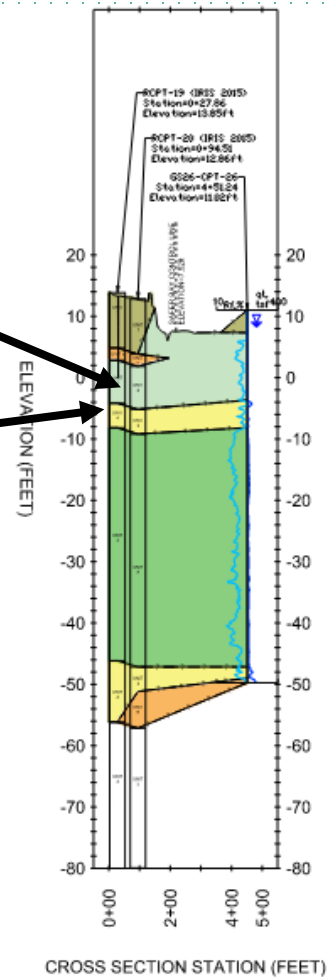
YBM
OBC
Sand





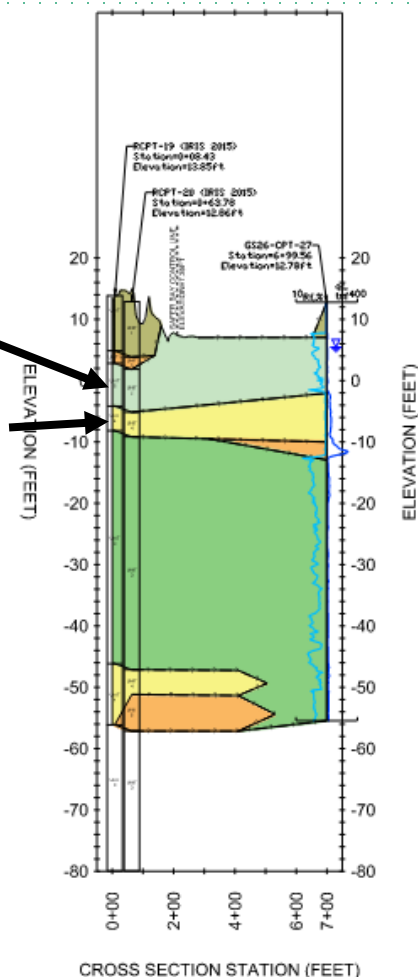
YBM

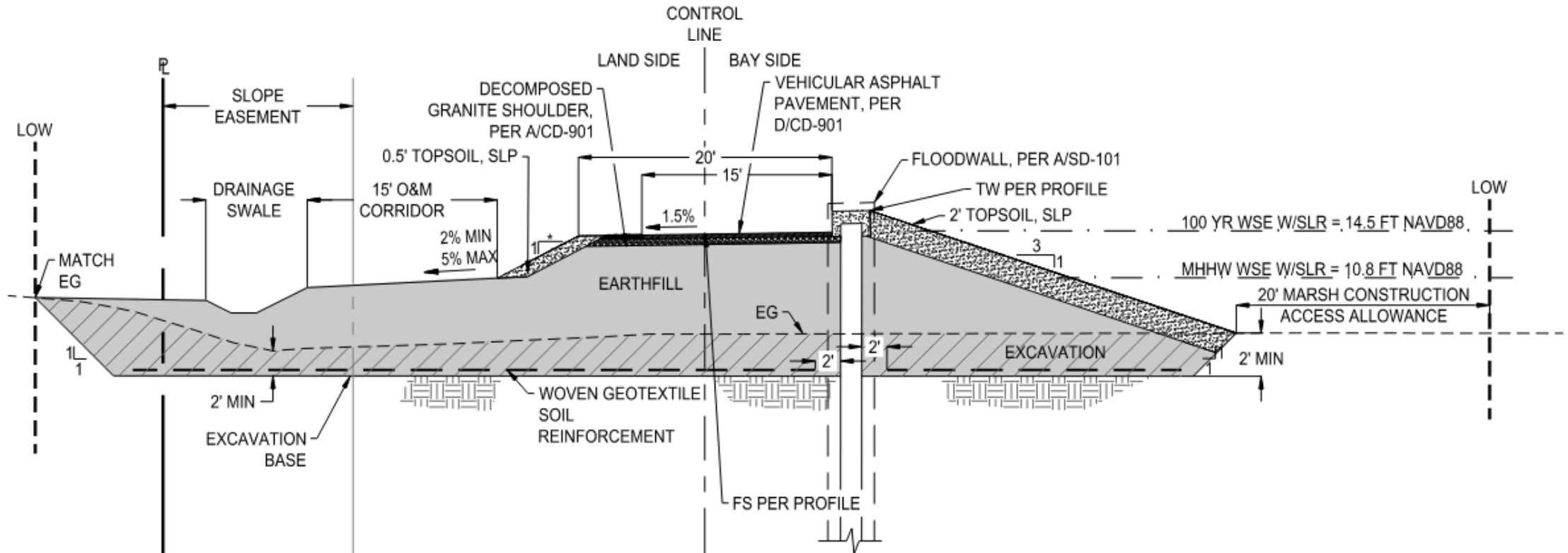
Sand



YBM

Sand





 EXCAVATION
 * VARIES SEE NOTE 6

G TYPICAL SECTION STA 34+00 - 51+45

SCALE: 1" = 10'

Seepage Analysis Type	STA 54+50				
	Critical Gradient Location	Minimum Required Factor of Safety ⁽¹⁾	Critical Exit Gradient	Average Vertical Exit Gradient, i_c	Factor of Safety
Steady-State Seepage Extreme	Landside Toe	1.0	0.8	0.3	3.1
	Landside Drainage Swale	1.0	0.8	0.4	1.8
Steady-State Seepage Unusual	Landside Toe	1.6	0.8	0.1	5.8
	Landside Drainage Swale	1.6	0.8	0.3	2.8

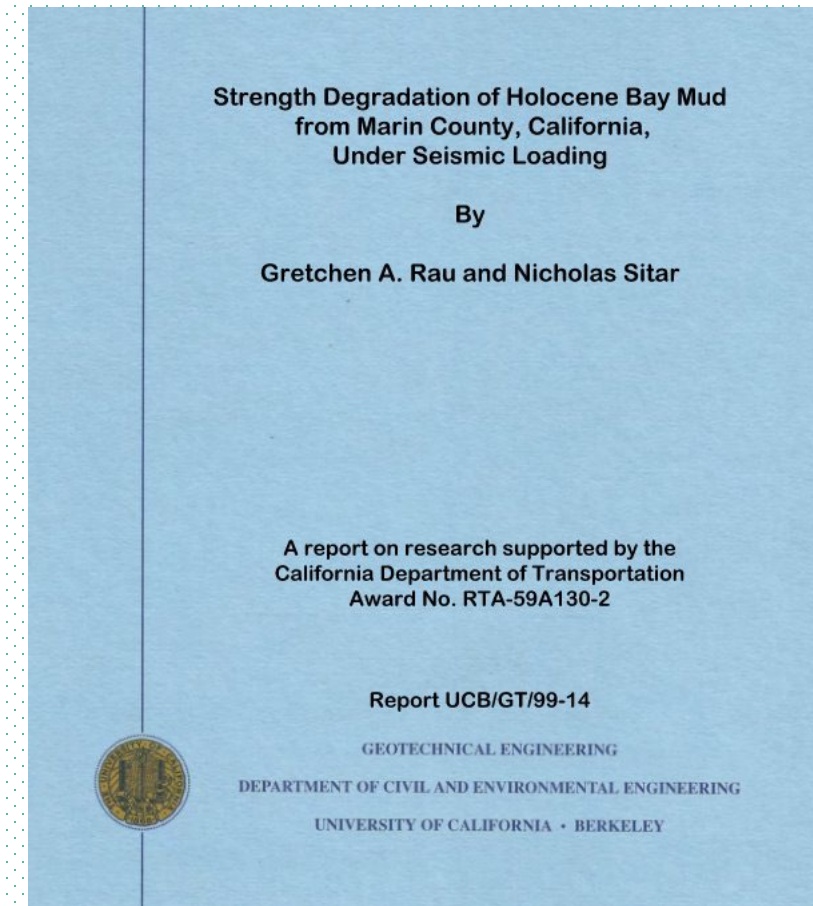
STA 61+00				
Critical Gradient Location	Minimum Required Factor of Safety ⁽¹⁾	Critical Exit Gradient	Average Vertical Exit Gradient	Factor of Safety
Landside Toe	1.0	0.8	0.03	32.1
150ft Landside of Alignment	1.0	0.8	0.1	6.5
Landside Toe	1.6	0.8	0.01	128.5
Landside Drainage Swale	1.6	0.8	0.03	28.9
150ft Landside of Alignment	1.4	0.8	0.1	8.8

STA 67+25				
Critical Gradient Location	Minimum Required Factor of Safety ⁽¹⁾	Critical Exit Gradient	Average Vertical Exit Gradient	Factor of Safety
Landside Toe	1.0	0.8	0.2	4.7
Landside Drainage Swale	1.0	0.8	0.3	3.2
Landside Toe	1.6	0.8	0.1	10.2
Landside Drainage Swale	1.6	0.8	0.2	5.2

Soil Properties

- ECRB Comment: In order to determine dynamic strength of soils at the project site, the ECRB pointed to simple shear test data in a UC Berkeley PhD dissertation as a useful reference for the project's ongoing seismic analysis.
- Confirmed, a 10% reduction in nominal strength for YBM unit is considered to account for cyclic degradation
- Reduction based on "Strength Degradation of Holocene Bay Mud from Marin County, California, Under Seismic Loading by G. A. Rau and Nicholas Sitar, Report UCB/GT/99-14"

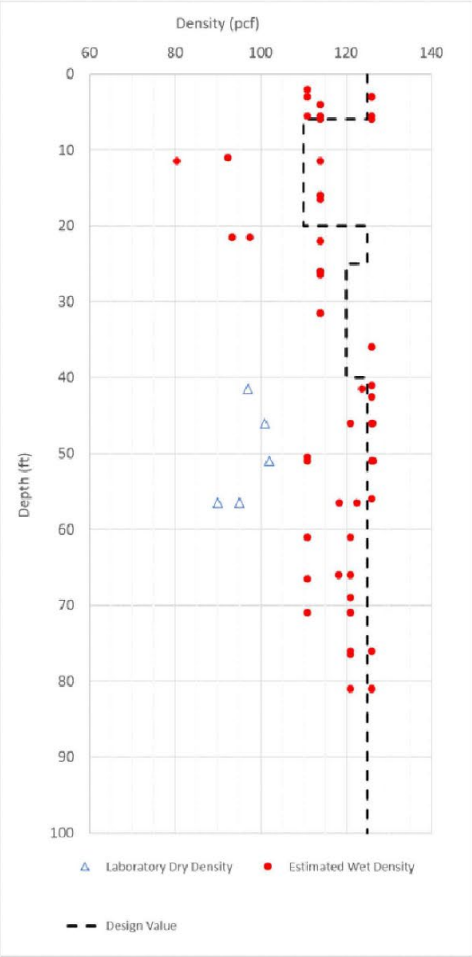
The post-cyclic monotonic strengths are within $\pm 10\%$ of the monotonic strengths of specimens that had not undergone cyclic loading. There were no clear effects of varying



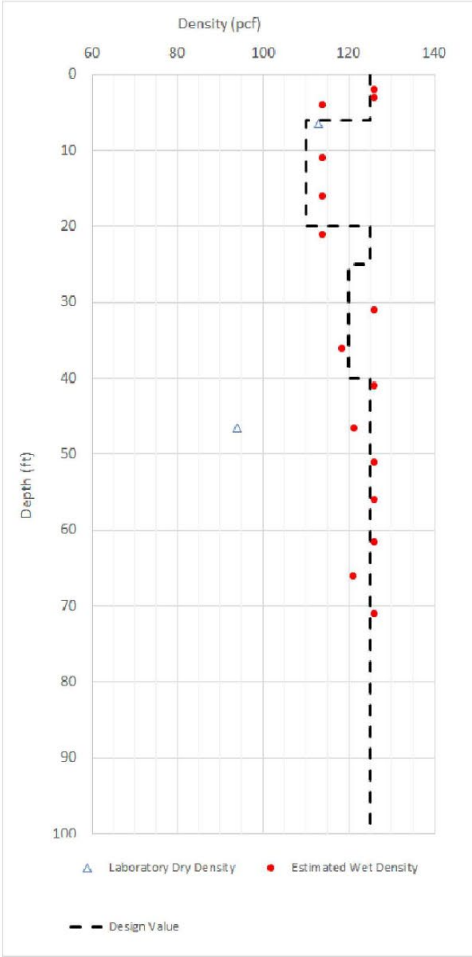
Soil Properties – Menlo Park

- ECRB Comment: The ECRB requested that information related to how soil properties were derived from historic exploration data be provided to the ECRB. BCDC staff recommends that this documentation be provided in the form of an updated Basis of Design report.
- The next series of slides shows plots of material parameters based subsurface data in the vicinity of the cross-section being analyzed and includes:
 - Density
 - Undrained Shear Strength
 - Drained Friction Angle
 - Hydraulic Conductivity

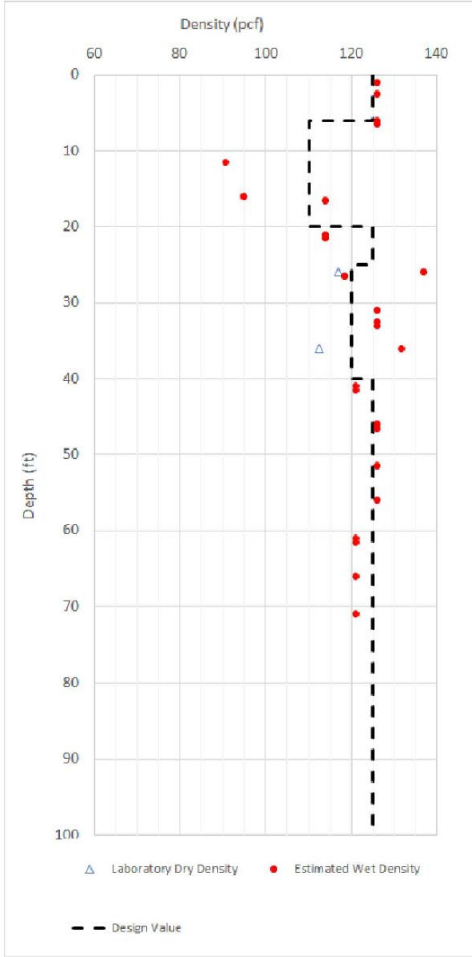
Soil Properties - Density



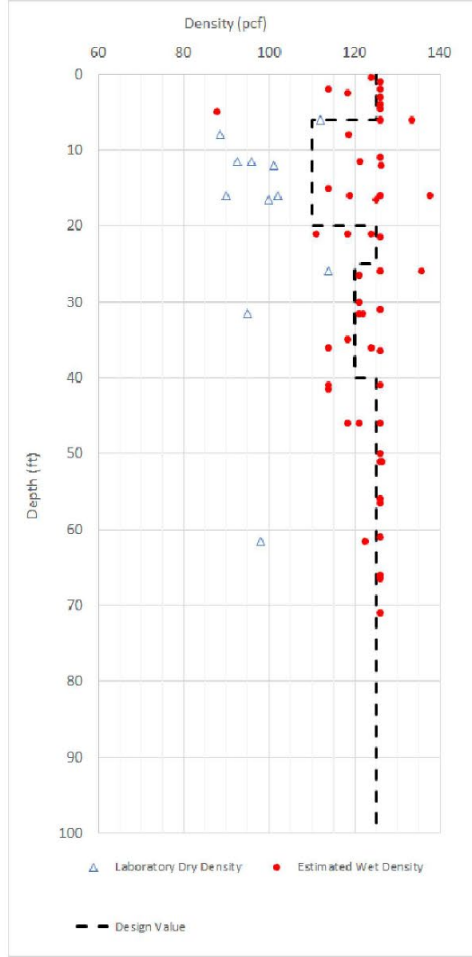
CROSS SECTION 1
STA190+00 TO STA240+00



CROSS SECTION 2
STA240+00 TO STA260+00



CROSS SECTION 3
STA260+00 TO STA295+00

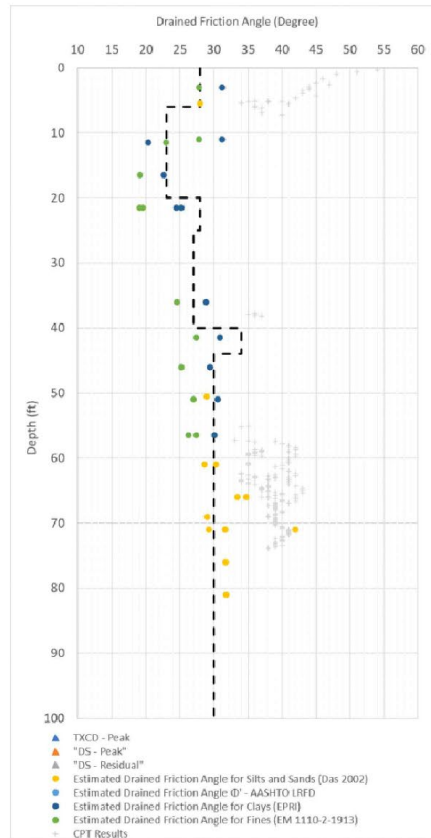


CROSS SECTION 4
STA295+00 TO STA361+00

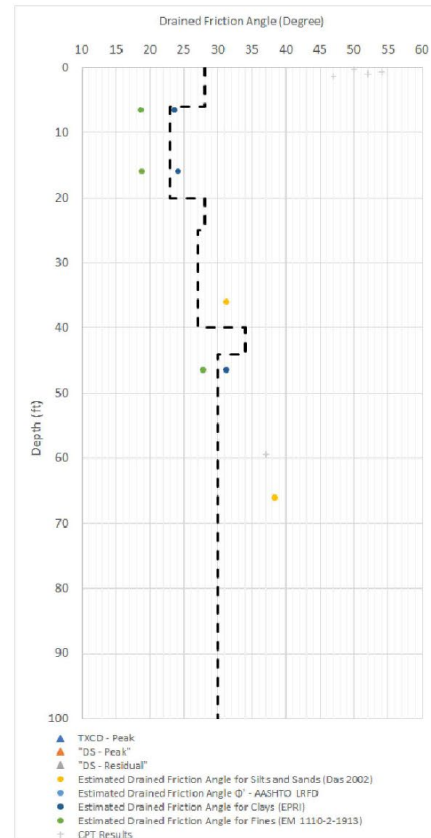
Soil Properties – Undrained Shear strength



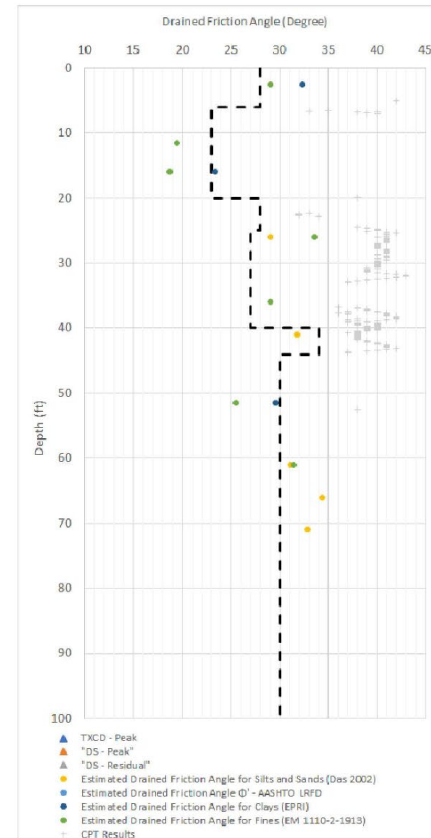
Soil Properties – Drained Friction Angle



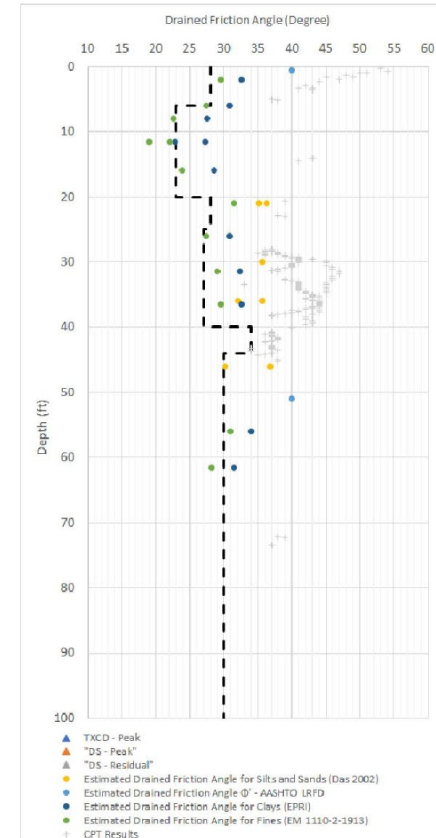
CROSS SECTION 1
STA190+00 TO STA240+00



CROSS SECTION 2
STA240+00 TO STA260+00

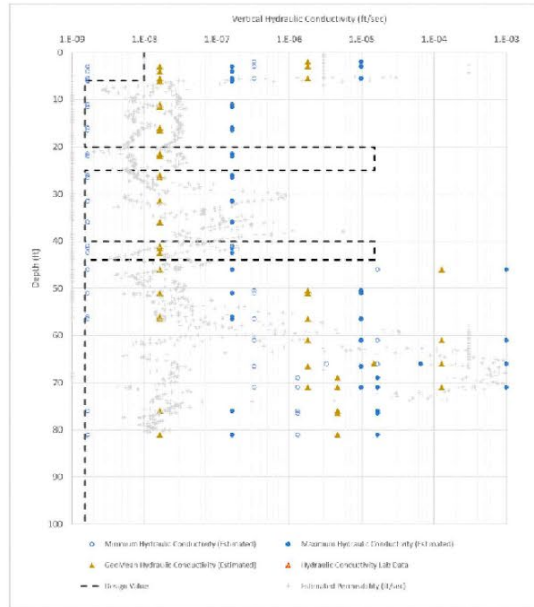


CROSS SECTION 3
STA260+00 TO STA295+00

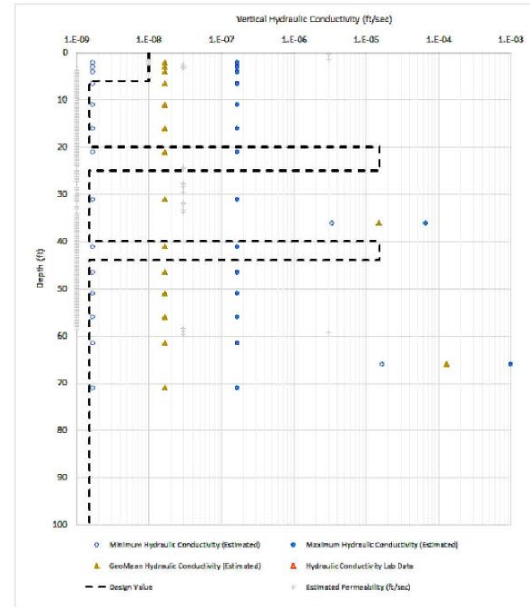


CROSS SECTION 4
STA295+00 TO STA361+00

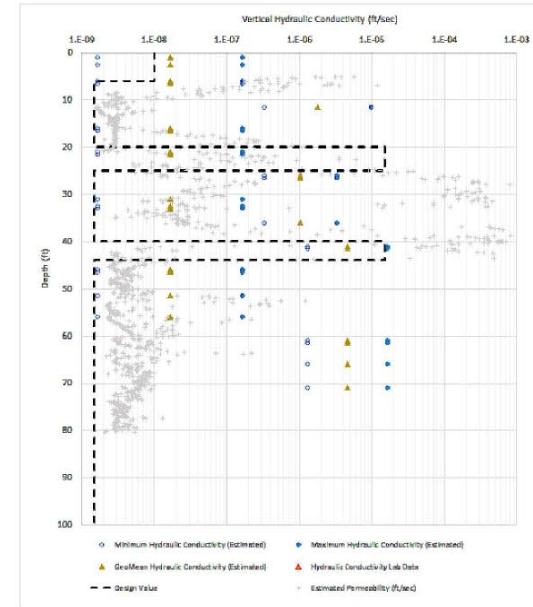
Soil Properties – Hydraulic Conductivity



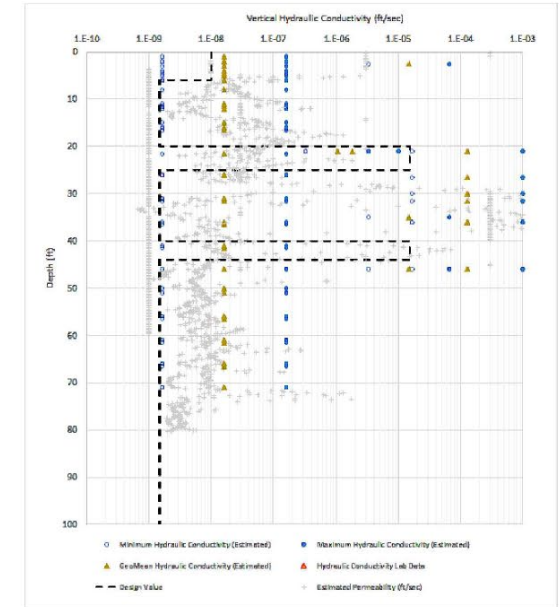
XS1 CROSS SECTION 1
STA190+00 TO STA240+00



XS2 CROSS SECTION 2
STA240+00 TO STA260+00



XS3 CROSS SECTION 3
STA260+00 TO STA295+00



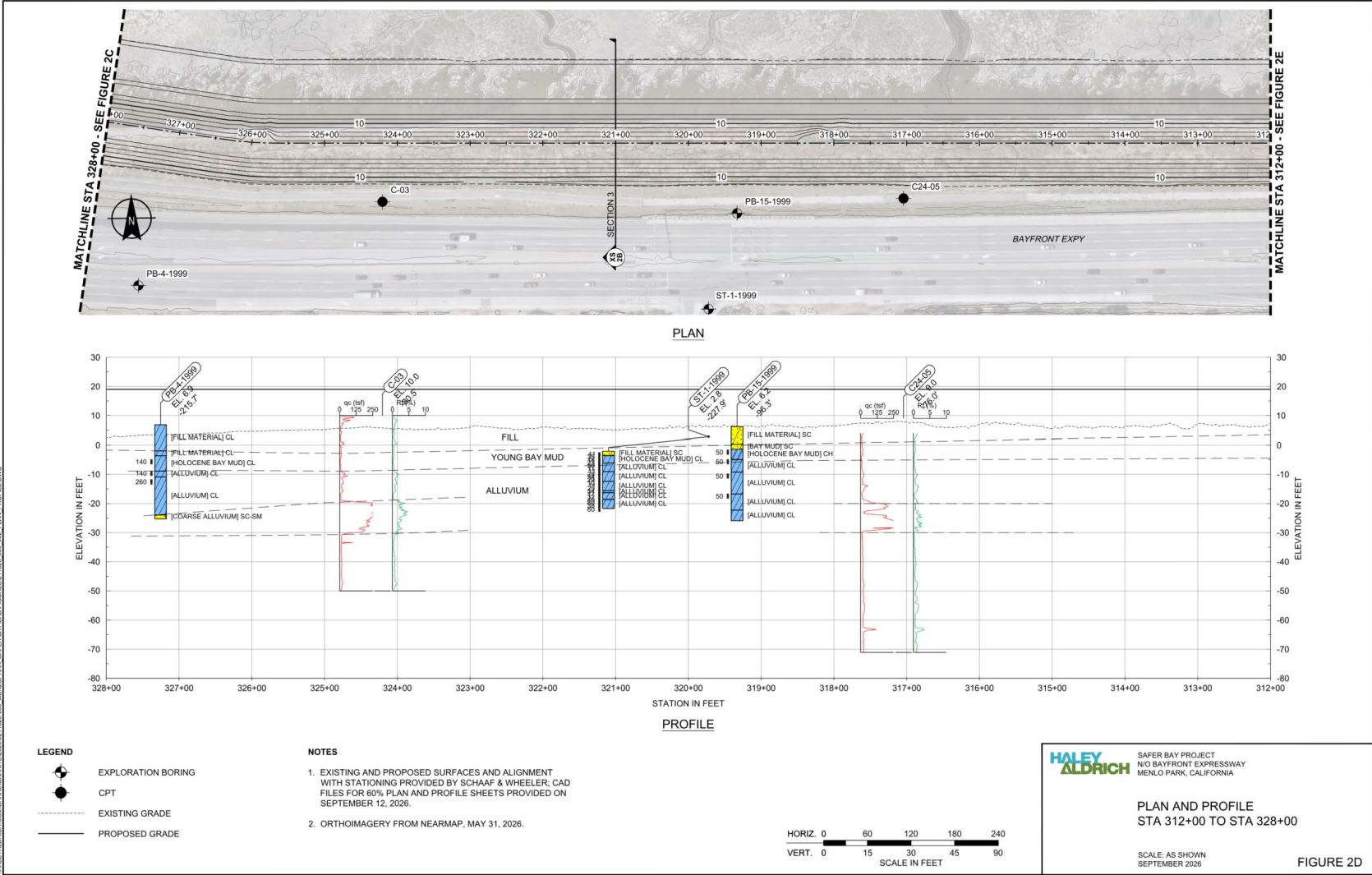
XS1 CROSS SECTION 4
STA295+00 TO STA361+00

Soil Stratigraphy

- ECRB Comment: The ECRB requested that a longitudinal geological profile for the Menlo Park project reaches under review be provided to the ECRB. BCDC staff recommends that this documentation be provided in the form of an updated Basis of Design report.
- The next series of slides are longitudinal profiles at our analysis cross sections. Profiles for the full Menlo Park alignment are in our draft BOD. As noted previously, four typical sections at Project Stations 217+00, 245+00, 280+00, and 321+00, and representing each of the three project reaches, were selected for analysis based on height of new fill, thickness of Bay Mud, and the presence of significant sand layers.

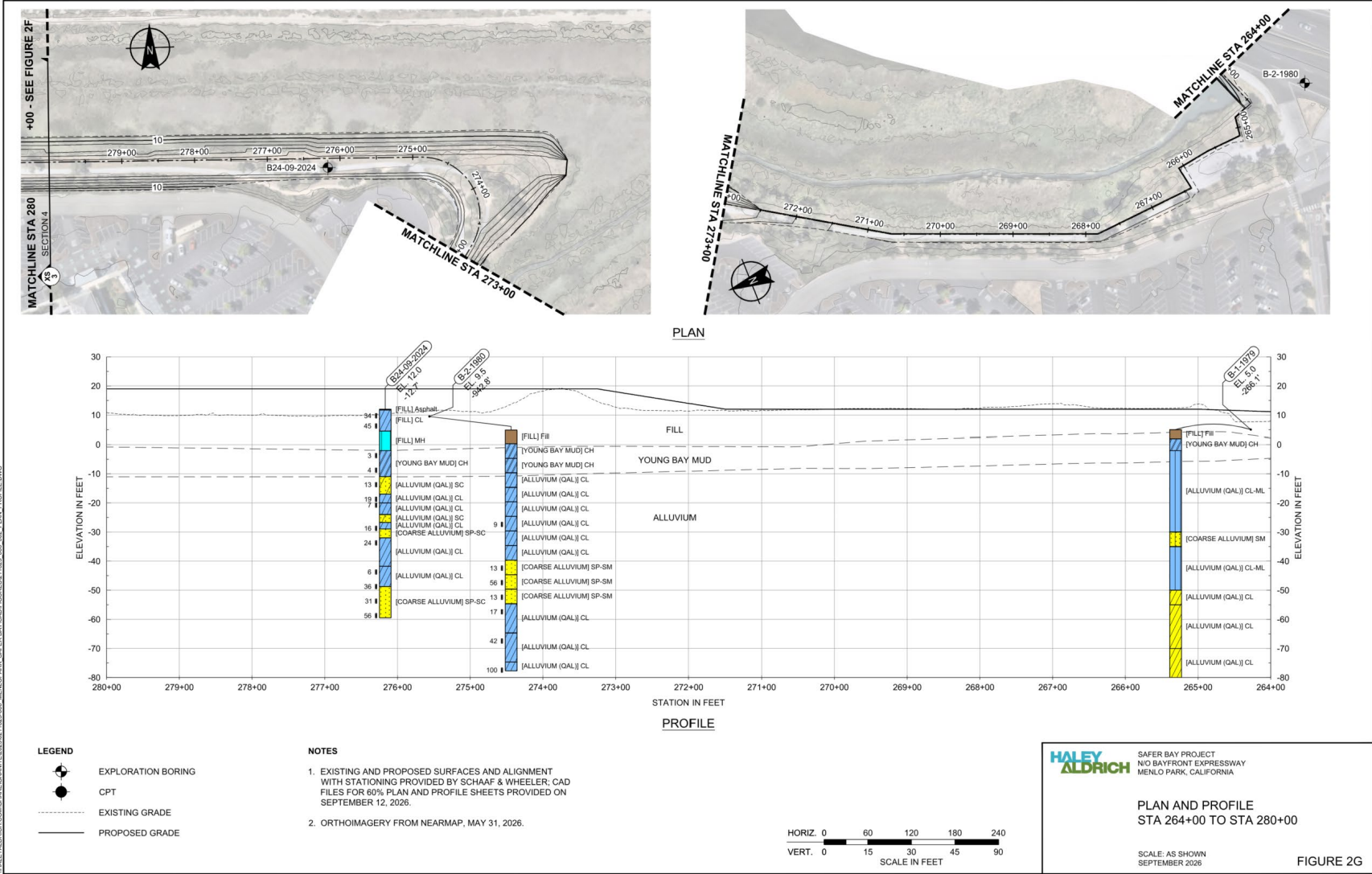
Soil Stratigraphy

- Sta 321+00



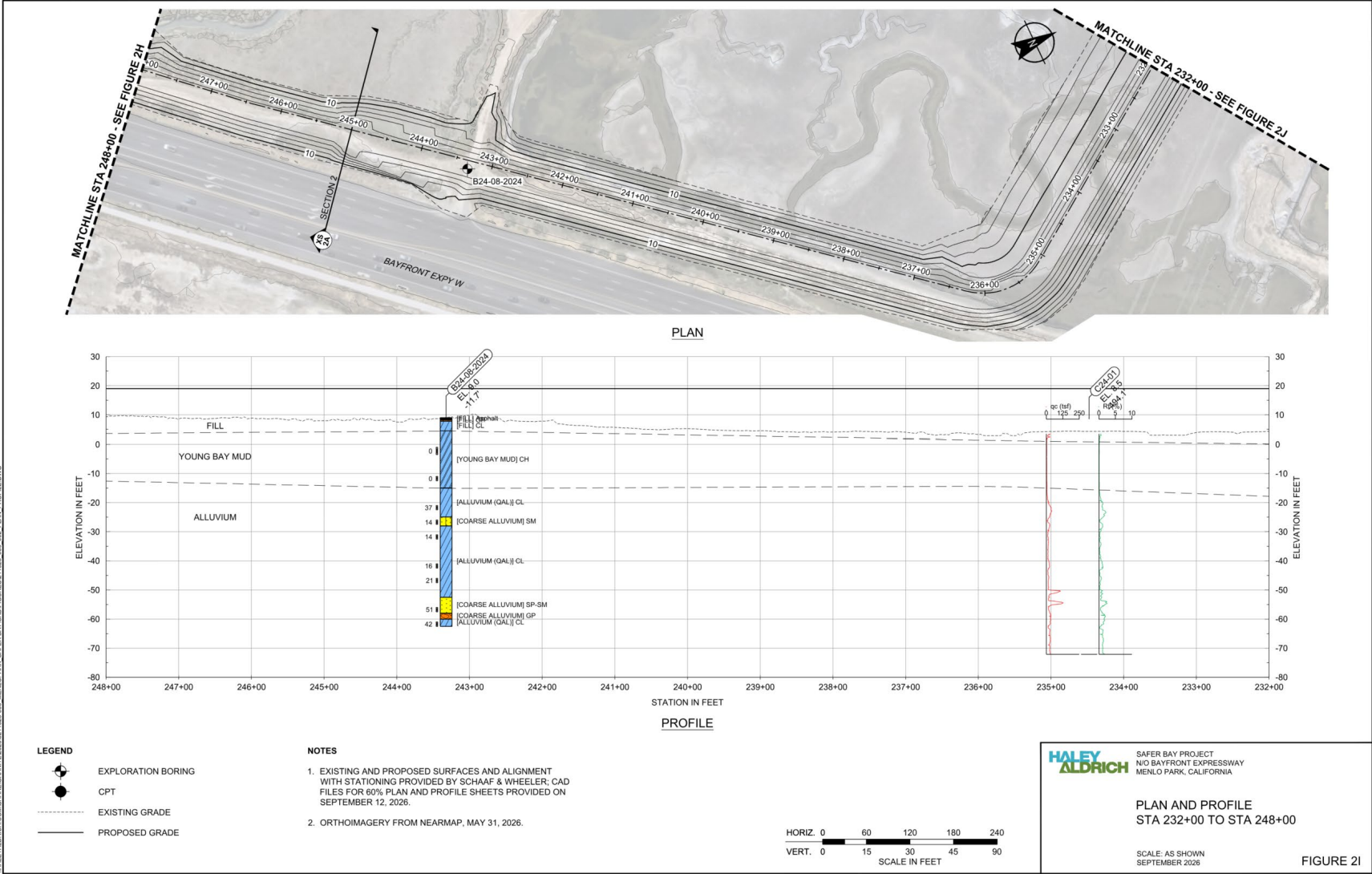
Soil Stratigraphy

- Sta 280+00



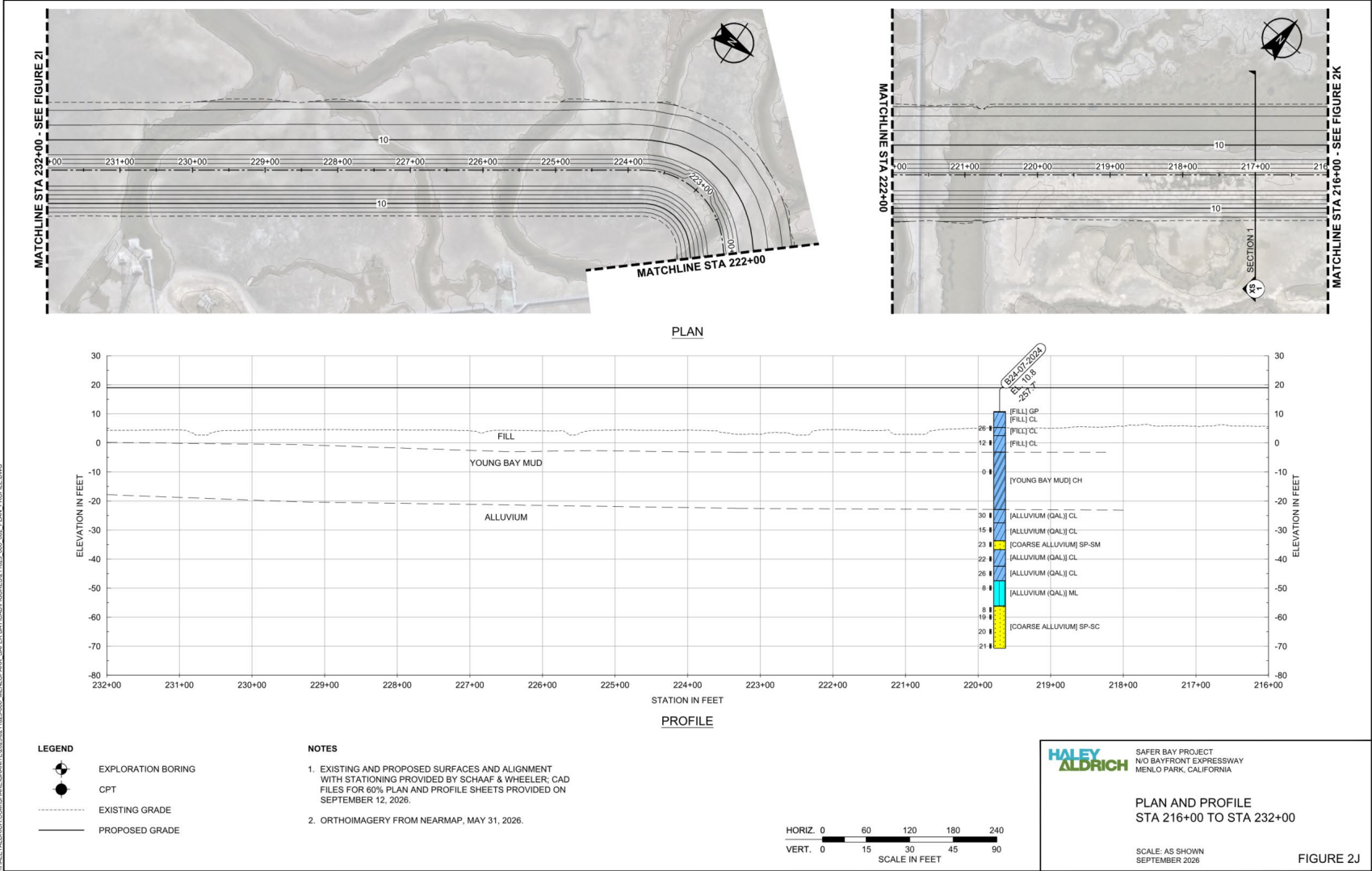
Soil Stratigraphy

- Sta 245+00



Soil Stratigraphy

- Sta 217+00

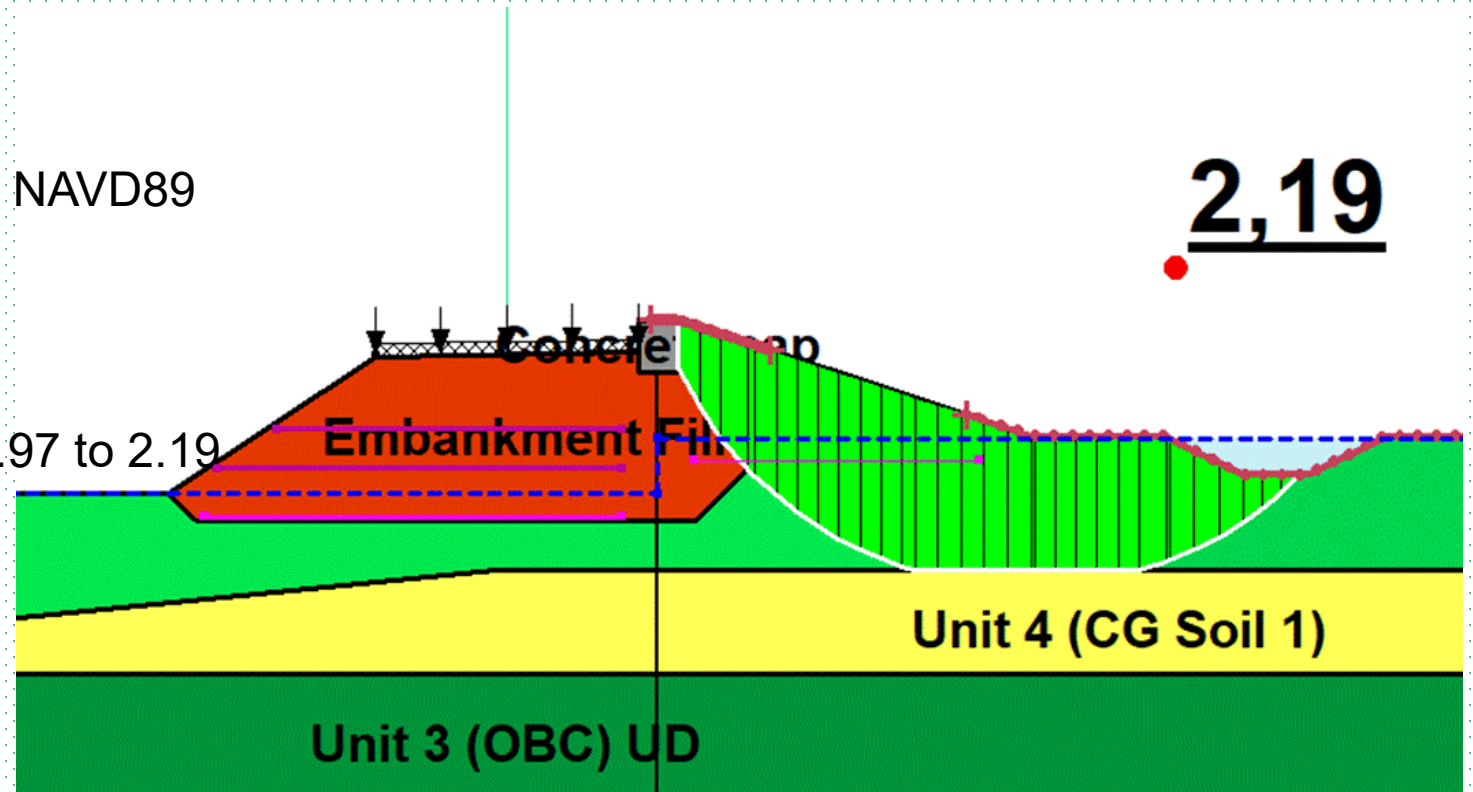


Additional Loading Scenario

- ECRB Comment: For both the slope stability analysis and sheet pile wall design, the ECRB required that a more conservative combined loading scenario be evaluated: low tide on the Bayside paired with a high groundwater table on the landside. BCDC staff recommends that documentation of this additional analysis be provided in the form of an updated Basis of Design report.

Additional Loading Scenario

- Additional slope stability analysis was performed consisting of low water conditions on the bayside and a high groundwater table on the landside.
- Groundwater levels
 - Landside = ground surface
 - Waterside water level = 7.3 ft NAVD89
- Factor of Safety
 - Landside = no change
 - Waterside = increased from 1.97 to 2.19

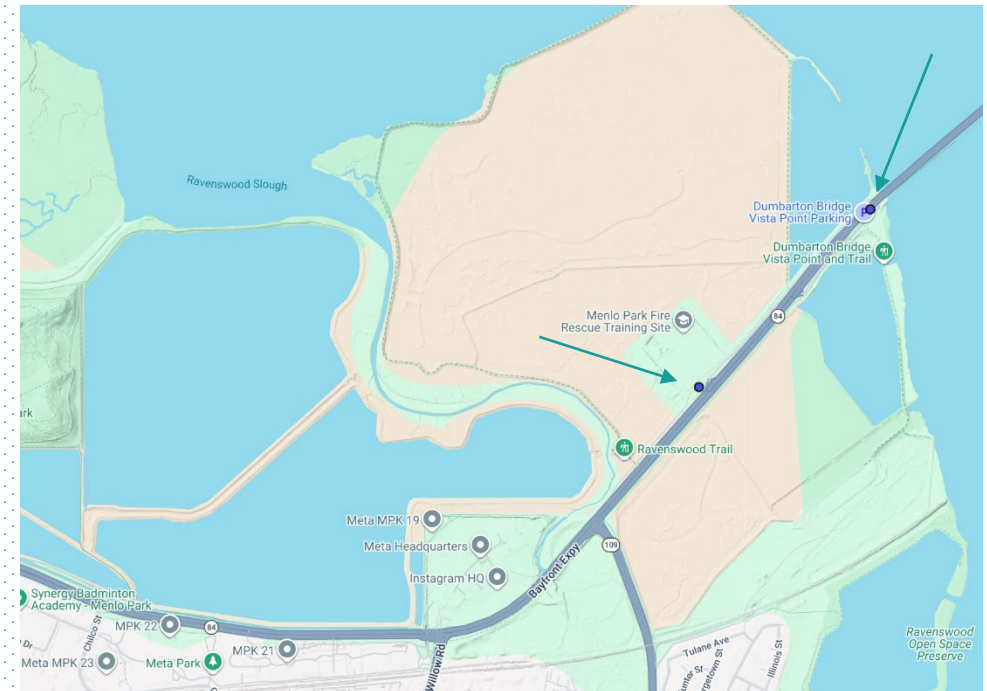


Migration of Contaminants

- ECRB Comment: Along the East Palo Alto project reach, the ECRB raised the risk of contaminant migration from pile driving at sites with known soil contamination, and suggested that the project team consider supporting the retaining wall on the deep soil mixing (DSM) columns rather than driven piles.
- Response: DSM was considered in lieu of piles for portions of the EPA reaches, however, deemed financially impractical.

Seismic Instrumentation

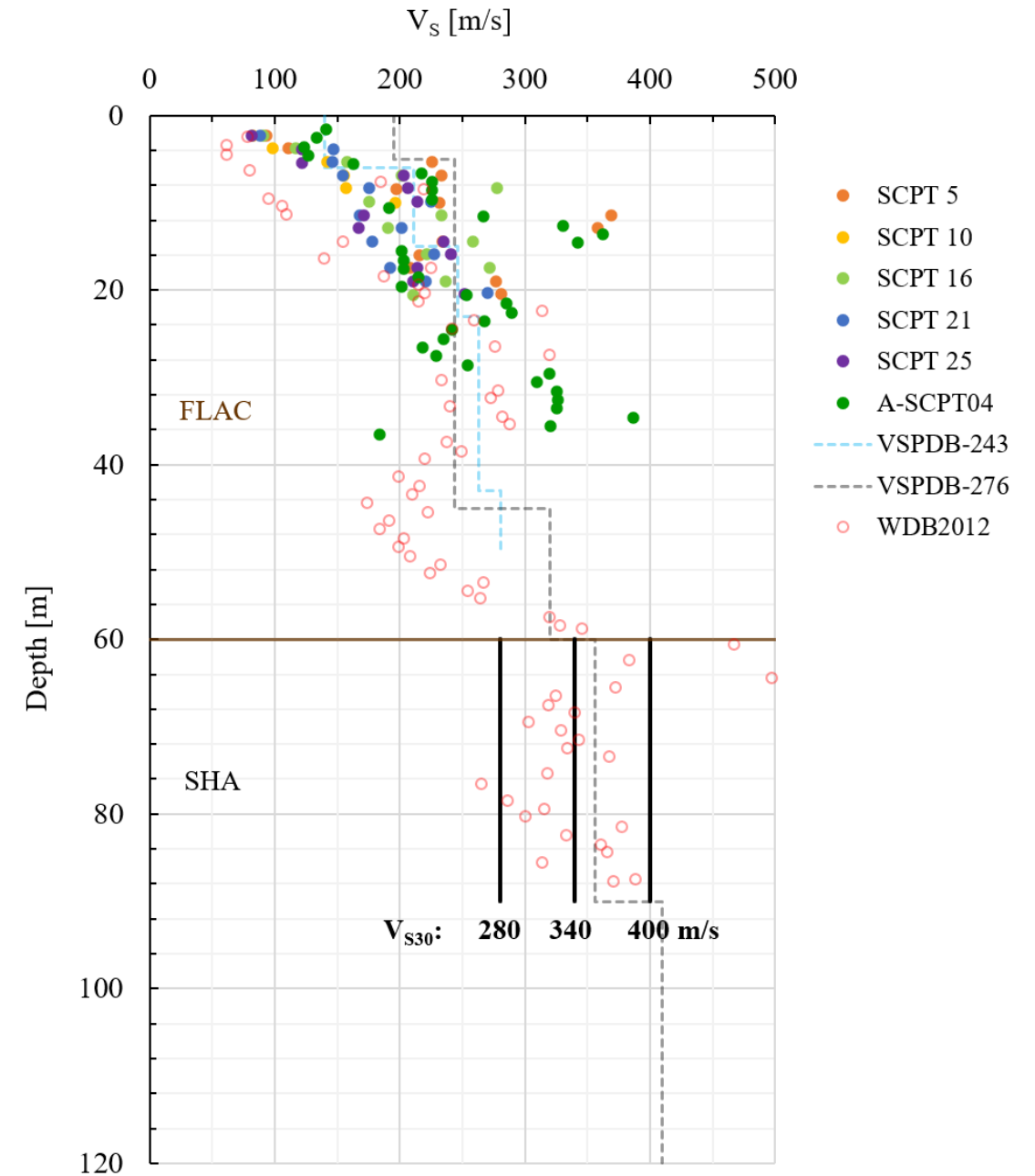
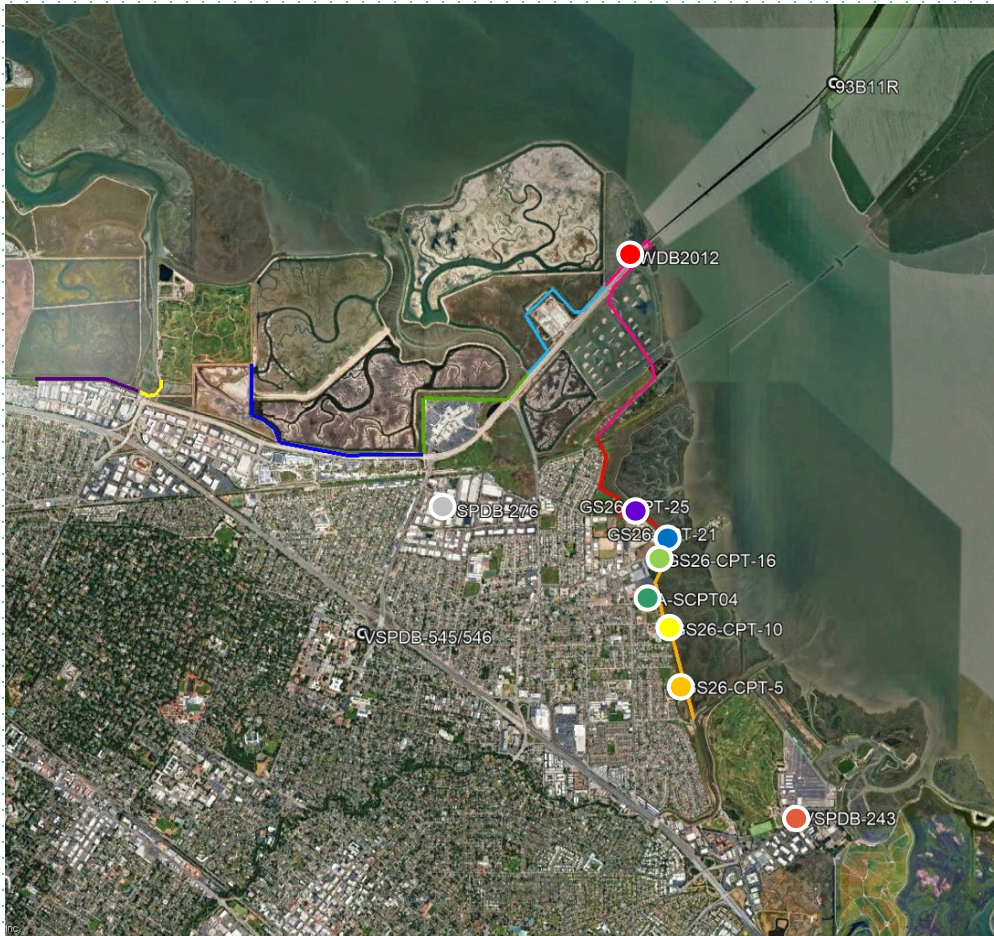
- ECRB Comment: The ECRB requested that the project team consider coordinating with the California Geological Survey to install seismometers at the project site.
- Response: The project team has begun this coordination. Determination of installing a seismometer will consider installation and maintenance cost, locations available within the project site, and availability of nearby seismometers already within the CGS network. There are currently 2 installations in the immediate Menlo Park vicinity.



Seismic Analysis Results

- ECRB Comment: The ECRB requested to review the outputs of the project's ongoing seismic analysis, including FLAC modeling results. BCDC staff recommends that this documentation be provided in the form of an updated Basis of Design report.
- Haley & Aldrich are just beginning this work and are unable to present anything at this time.
 - BOD has results from pseudo-static evaluations.

Site Characterization



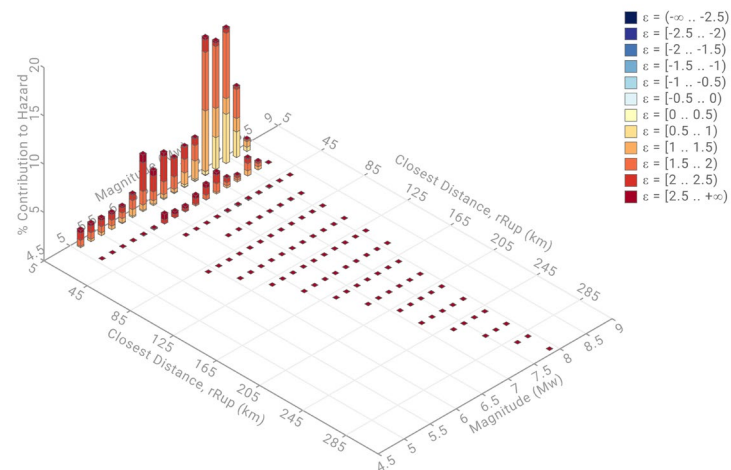
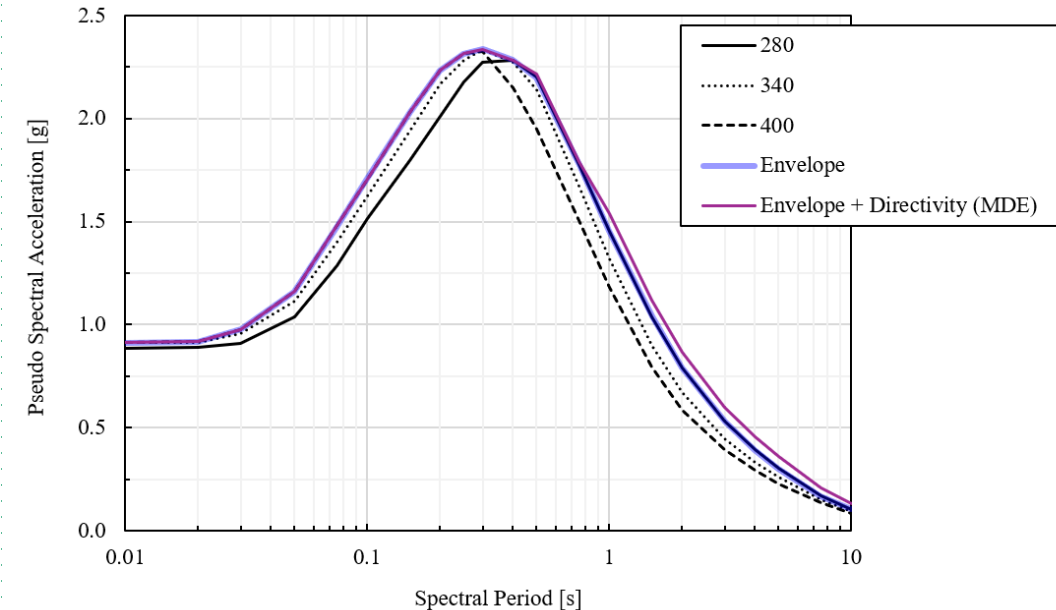
Seismic Hazard - MDE

Target Response Spectrum

- Probabilistic 2,475-yr UHS (RotD50)
- USGS 2023 NSHM (R2)
- V_{S30} 280, 340, 400 m/s (envelope UHS)
- With directivity adjustment factors from NHR3

Disaggregation

- 2,475-yr, $T = 0.25$ sec



Source	Contribution to Hazard	Mean Mag	Mean R_{RUP} [km]
Faults	84.9%	7.6	14.9
San Andreas (Peninsula)	55.9%	7.8	12.1
Hayward (south)	12.9%	7.2	19.3
Monte Vista – Shannon	2.9%	7.4	9.9
San Gregorio (north)	2.7%	7.8	26.2
Calaveras (north)	1.4%	7.5	28.7
Gridded Seismicity	15.1%	6.1	9.1
Total Mean (all sources)	-	7.3	14.0

Select 5 TH for San Andreas and 2 TH for Hayward



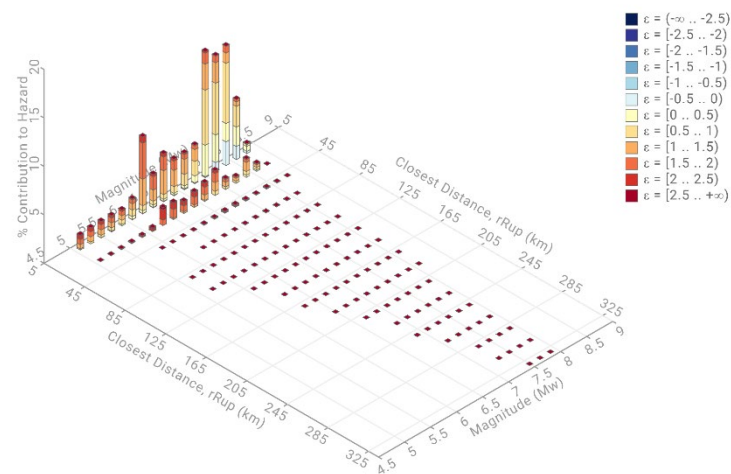
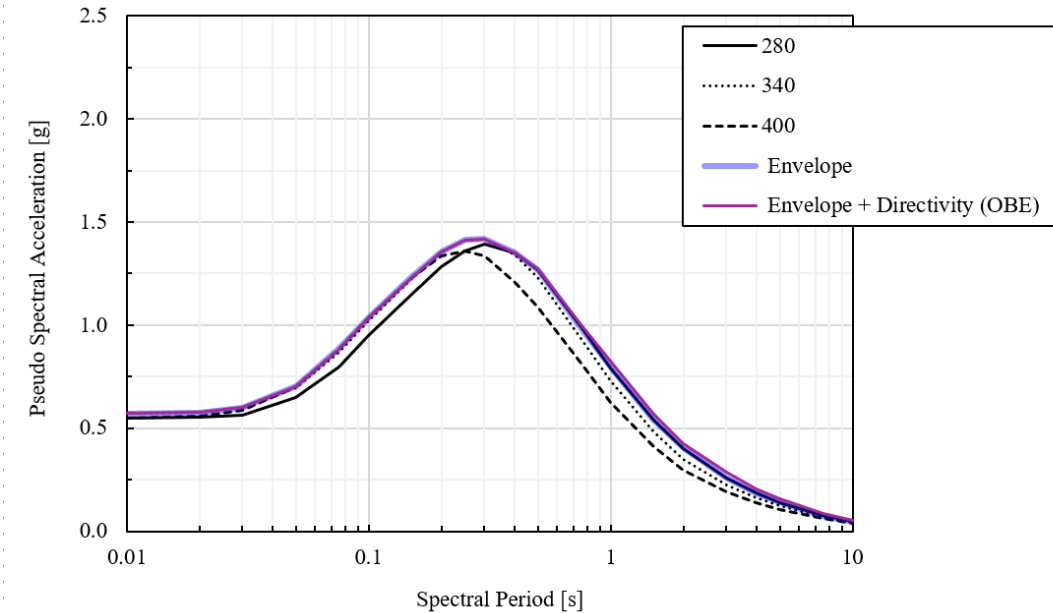
Seismic Hazard - OBE

Target Response Spectrum

- Probabilistic 475-yr UHS (RotD50)
- USGS 2023 NSHM (R2)
- V_{S30} 280, 340, 400 m/s (envelope UHS)
- With directivity adjustment factors from NHR3

Disaggregation

- 475-yr, $T = 0.25$ sec



Source	Contribution to Hazard	Mean Mag	Mean R_{RUP} [km]
Faults	83.5%	7.4	16.7
San Andreas (Peninsula)	45.0%	7.7	12.1
Hayward (south)	20.0%	7.1	19.3
San Gregorio (north)	3.3%	7.7	26.2
Monte Vista – Shannon	2.1%	7.4	9.9
Calaveras (north)	2.1%	7.3	28.7
Gridded Seismicity	17%	6.0	12.0
Total Mean (all sources)	-	7.1	16.0

Select 5 TH for San Andreas and 2 TH for Hayward



Seismic Hazard - Aftershock

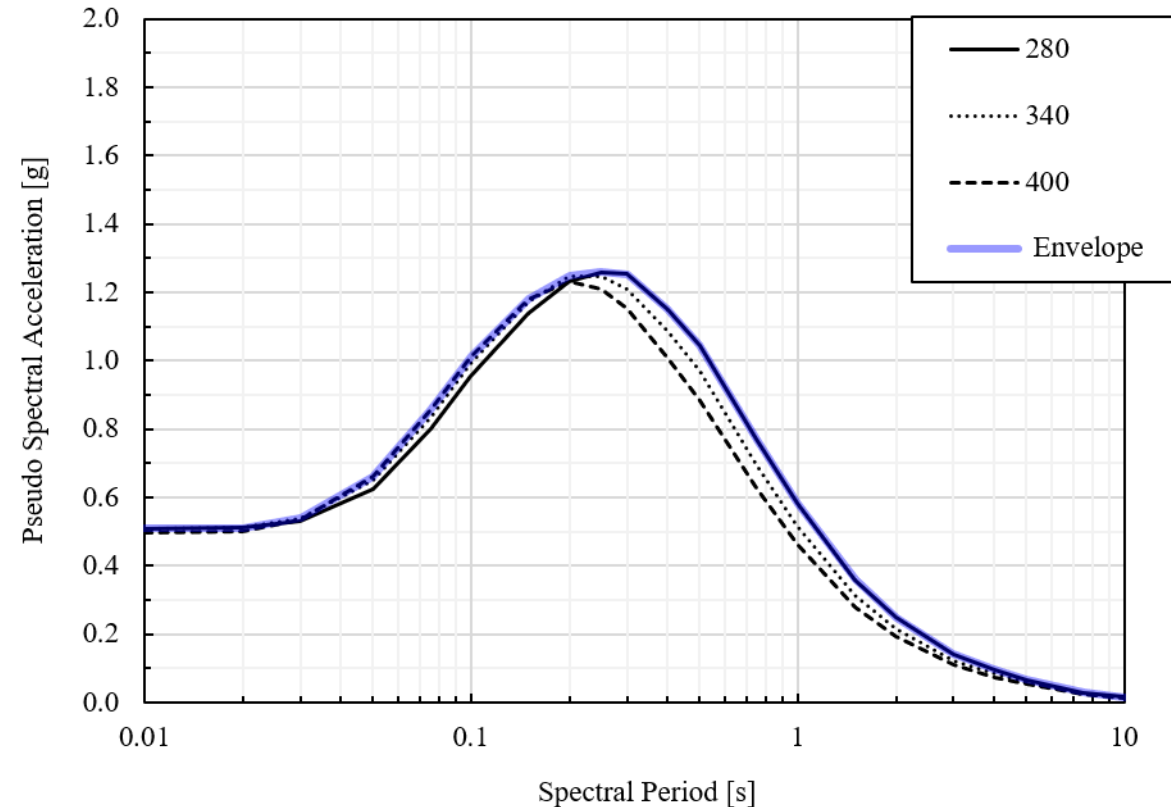
Used for Judgement for Cases near Criteria – Not Design Basis

Target Response Spectrum

- Probabilistic 10% probability of exceedance in 10 days (RotD50)
- V_{S30} 280, 340, 400 m/s (envelope UHS)

Disaggregation

- 10% poe in 10 days
- $T = 0.25$ sec
- Mean $M = 6.4$, $R_{RUP} = 14$ km



Advanced FLAC analysis: purpose

The analysis links earthquake-driven deformation to two project decisions: expected damage and continued flood protection until repairs.

TWO DESIGN EVENTS

OBE **475-year** Remain serviceable after the event

MDE **2,475-year** No breach or catastrophic flooding; repairable if required

WHAT THE MODEL RESOLVES

- Liquefaction, pore-pressure generation and dissipation, cyclic degradation, and reconsolidation (post liquefaction) settlement
- Soil–sheet-pile interaction and permanent horizontal and vertical movement

CURRENT ANALYSIS STATUS

SoBR ACS1: preliminary MDE results complete • **SoBR ACS3 / ACS5 and NoBR ACS6: work underway**



Interpreting the current ACS1 results

PRELIMINARY ACS1 MDE FINDING

2.7 ft

Average (among 7 THs)
minimum settlement (among
three top trail points)

Worst TH2 minimum crest settlement: 3.1 ft

HOW TO READ THE RESULT SET

- Slides 13–15 show ACS1 vertical settlement (Dy) for MDE Time Histories 1–7.
- The summary considers the average response across motions and the minimum-settlement point at the levee trail.

ACCEPTANCE THRESHOLDS

OBE $\leq$ 1.0 ft

MDE $\leq$ 3.4 ft

PROJECT-LEVEL INTERPRETATION

Expected damage / movement

- Average minimum trail settlement across the seven motions is 2.7 ft.
- TH2 worst: 3.1 ft minimum trail settlement; its cross-section average is 3.5 ft and pile-cap settlement is 4.0 ft.

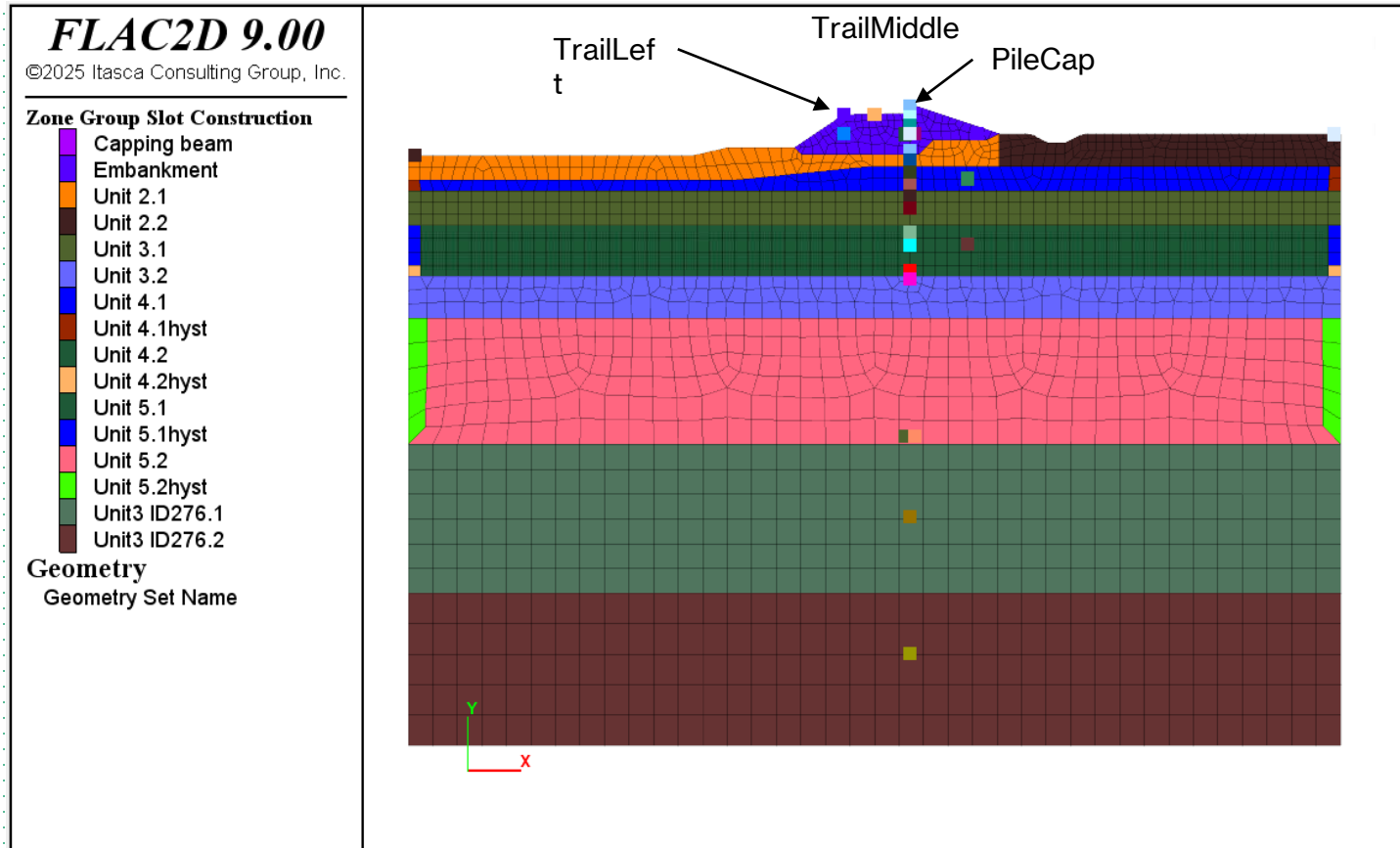
Flood protection until repairs

The current ACS1 crest-settlement metric is within the 3.4 ft MDE criterion. The plots do not establish OBE performance or confirm post-seismic hydraulic-barrier and sheet-pile structural acceptability.

Evidence still required

- OBE results with final time histories
- ACS3, ACS5, and ACS6 advanced results
- Residual deformation, sheet-pile demand, and hydraulic-barrier verification

Seismic Analysis Results - EPA



Notes on soil models:

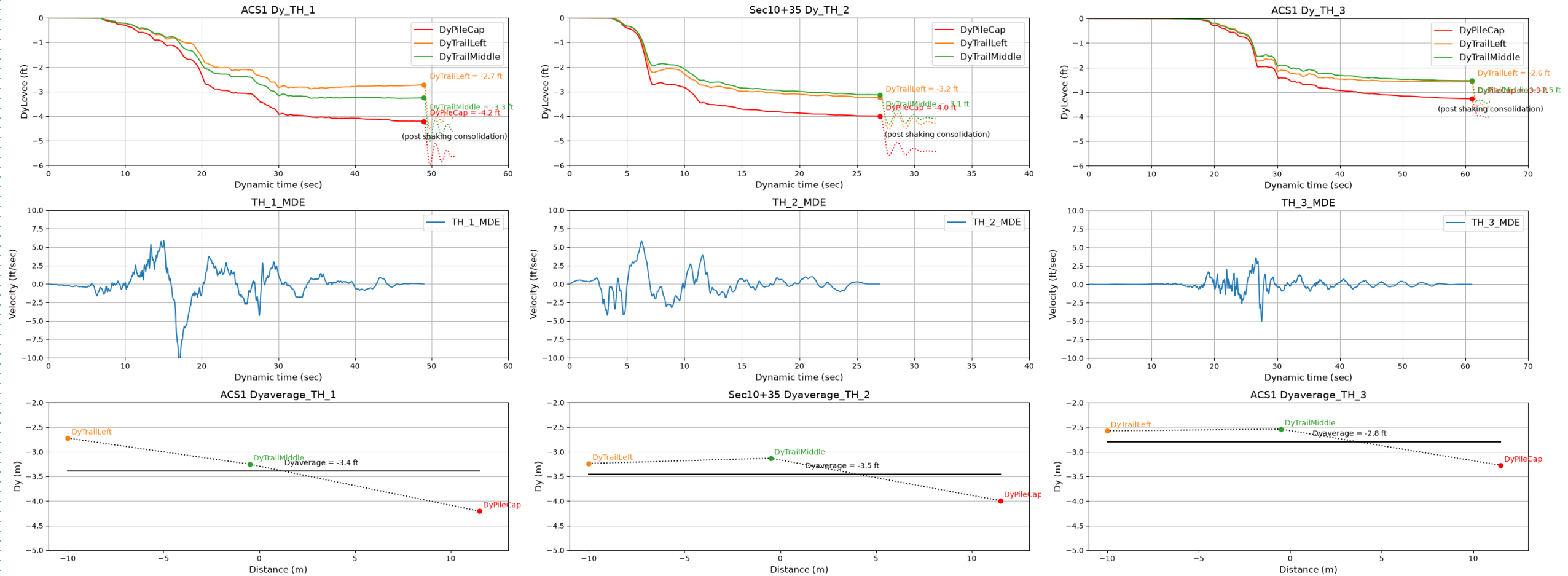
All fine grained soil units and coarse grained units on the free field boundaries are modelled with UBCHyst UDM model provided by ITASCA (Noesgaard et al 2011). Exponent stiffness parameter is calibrated to match strength compatible modulus degradation/damping curves (Darendeli, 2001; Groholski et al, 2016).

For YBM unit a reduction factor of 0.9 is applied to the nominal (undrained) strength to account for cyclic degradation.

Coarse grained soil units are modelled using PM4sand (V3.1) model UDM provided for ITASCA by Boulanger and Ziotopoulou. Calibration targets the CSR-N curve obtained by empirical correlations (Idriss and Boulanger, 2005) calibrating primary parameters D_r and h_{p0} and secondary parameter h_o and strength compatible degradation/damping curves (Darendeli, 2001; Groholski et al, 2016).

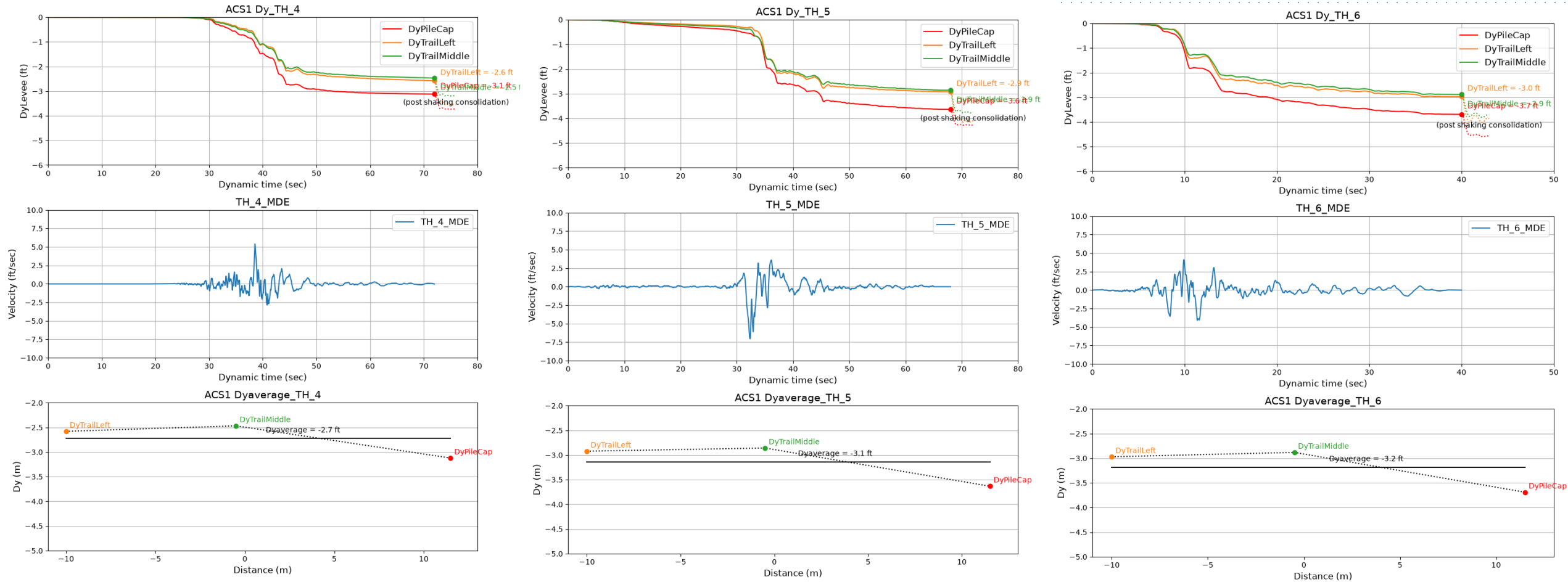
Lowest layer (Unit3 ID276.2) is modelled as linear elastic with a reduction factor 0.8 on G_o that is compatible with 0.65 of the peak shear strain (0.09%). Modulus reduction curve compatible with Unit 3 is considered.

Seismic Analysis Results - EPA



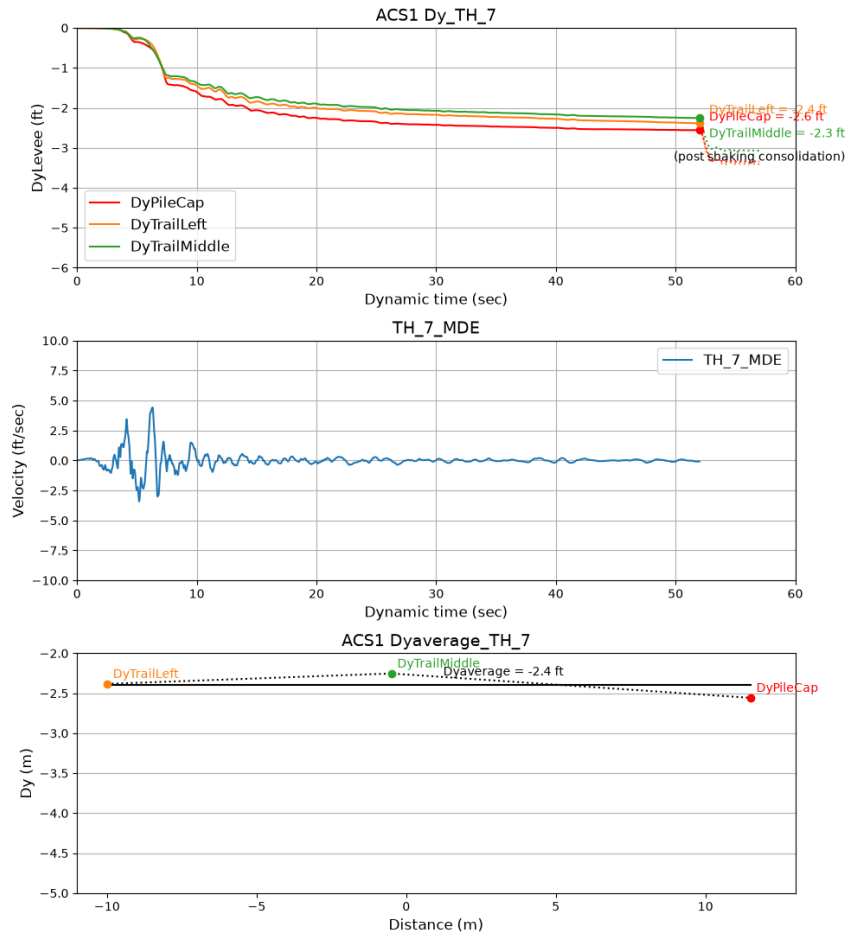
*Dy: vertical settlement (MDE Time Histories 1-3)

Seismic Analysis Results - EPA

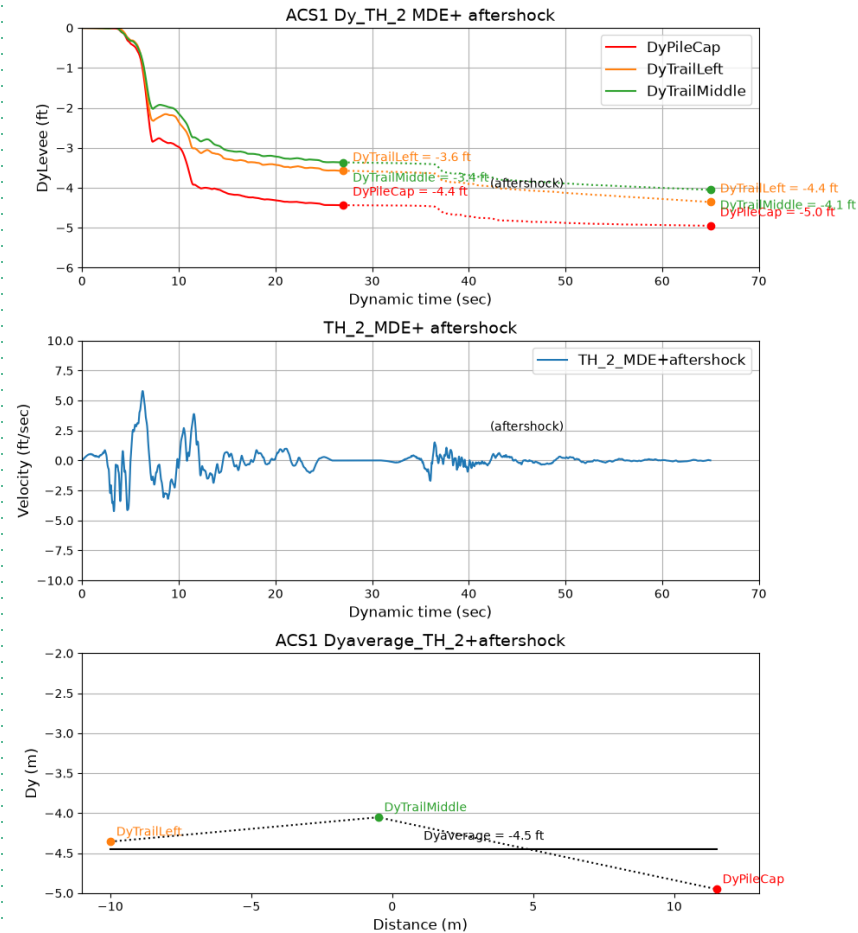


*Dy: vertical settlement (MDE Time Histories 4-6)

Seismic Analysis Results - EPA



*Dy: vertical settlement
(MDE Time History 7)



Most damaging MDE Time History (TH2) with aftershock: max allowable displacement (-3.4 ft) at middle trail following mainshock; failure (-4.1 ft) following aftershock

Seismic Analysis Results - EPA

Summary of MDE Time History results ACS1

THs	DyTrailLeft (ft)	DyTrailRight (ft)	DyPileCap (ft)	Average (ft)	Minimum (ft)
TH1	-2.7	-3.3	-4.2	-3.4	-2.7
TH2	-3.2	-3.1	-4.0	-3.5	-3.1
TH3	-2.6	-2.5	-3.3	-2.8	-2.5
TH4	-2.6	-2.5	-3.1	-2.7	-2.5
TH5	-2.9	-2.9	-3.6	-3.1	-2.9
TH6	-3.0	-2.9	-3.7	-3.2	-2.9
TH7	-2.4	-2.3	-2.6	-2.4	-2.3
				average (ft)	average (ft)
				-3.0	-2.7

- the average response among the provided ground motions should be considered
- trail points are within threshold for all MDE THs
- the point at the top of the levee experiencing the minimum settlement should be considered as it could (temporarily) stop the water
- these results are preliminary

Reconsolidation settlements (post shaking) ACS1

THs	DyTrailLeft PostConsol (ft)	DyTrailMiddle PostConsol (ft)	DyTrailPileCap PostConsol (ft)	Average (ft)	Minimum (ft)
TH1	-1.3	-1.3	-1.4	-1.4	-1.3
TH2	-0.7	-0.7	-1.0	-0.8	-0.7
TH3	-1.0	-0.9	-0.7	-0.9	-0.7
TH4	-1.0	-0.7	-0.6	-0.8	-0.6
TH5	-1.2	-0.9	-0.6	-0.9	-0.6
TH6	-0.9	-0.8	-0.9	-0.9	-0.8
TH7	-1.0	-0.8	-0.8	-0.9	-0.8
				average (ft)	average (ft)
				-0.9	-0.8

- reconsolidation settlements are 0.8-0.9 (ft) and lead to final settlements in exceedance of 3.4 (ft). This does not imply a post earthquake immediate risk due to consolidation time
- these results are preliminary

Seismic Analysis Results – Menlo Park

- ECRB Comment: The ECRB requested to review the outputs of the project's ongoing seismic analysis, including FLAC modeling results. BCDC staff recommends that this documentation be provided in the form of an updated Basis of Design report.
- Menlo Park is still in early days setting up and running its FLAC models. Results of pseudo-static analyses using the Bray-Travasariou Method are summarized in the table below.

Cross Section/STA	Embankment Side	Return Period	PGA (g)	M _w	K _h	K _y	Crest Height (ft)	Seismic Displacement (D, in)
X1/190+00 to 240+00	Land Side (LS)	475	0.481	7.06	0.120	0.209	18	9.30
X1/190+00 to 240+00	Water Side (WS)	475	0.481	7.06	0.120	0.208	7.5	3.37
X1/190+00 to 240+00	Landside (LS)	2475	0.733	7.18	0.183	0.209	18	20.93
X1/190+00 to 240+00	Waterside (WS)	2475	0.733	7.18	0.183	0.208	7.5	8.94
X2/240+00 to 260+00	Landside (LS)	475	0.481	7.07	0.120	0.216	11	4.94
X2/240+00 to 260+00	Waterside (WS)	475	0.481	7.07	0.120	0.189	7.5	7.77
X2/240+00 to 260+00	Landside (LS)	2475	0.735	7.07	0.184	0.216	11	11.68
X2/240+00 to 260+00	Waterside (WS)	2475	0.735	7.07	0.184	0.189	7.5	17.06
X2B/295+00 to 361+00	Landside (LS)	475	0.480	7.13	0.120	0.407	11.5	1.44
X2B/295+00 to 361+00	Waterside (WS)	475	0.480	7.13	0.120	0.377	13.5	2.19
X2/295+00 to 361+00	Landside (LS)	2475	0.739	7.28	0.185	0.407	11.5	3.86
X2/295+00 to 361+00	Waterside (WS)	2475	0.739	7.28	0.185	0.377	13	5.55
X3/259+00 to 295+00	Landside (LS)	475	0.479	7.14	0.120	0.414	8.5	0.89
X3/259+00 to 295+00	Waterside (WS)	475	0.479	7.14	0.120	0.409	10.5	1.23
X3/259+00 to 295+00	Landside (LS)	2475	0.739	7.3	0.185	0.414	8.5	2.79
X3/259+00 to 295+00	Waterside (WS)	2475	0.739	7.3	0.185	0.409	10.5	3.59

Structural Issues

Sheet Wall Pile Acceptance Criteria

- ECRB Comment: The ECRB requested that sheet pile wall acceptance criteria be more clearly defined in an updated Basis of Design report.

Summary of EPA sheet Pile Wall Acceptance Criteria

Flooding Load Cases

- Sheet pile wall to remain completely elastic with no permanent deflection.

Seismic Load Cases

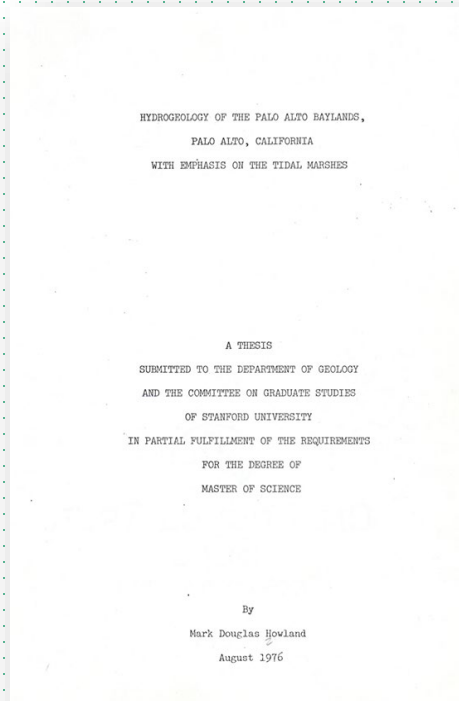
- OBE (475 yr return period) - Remain serviceable after the event
- MDE (2475 yr return period) - No breach or catastrophic flooding; repairable if required
- Acceptable Crest Elevation Settlement post seismic event
 - OBE $\leq 1\text{ft}$
 - MDE $\leq 3.4\text{ ft}$

Coastal Issues

Changes in Foreshore

- ECRB Comment: The ECRB recommended that the project team look further into how the foreshore elevation rises with the tide and how this affects wave heights and runup.

Monitoring studies of marsh ground surface elevation do not show a dependence on tidal water levels



Vertical movement of the ground surface and the piezometers with the tides was monitored. The piezometers were surveyed from a gravel road raised above the marsh located several hundred feet to the north of the piezometer set-up. Surveying of the piezometers and ground surface showed that neither moved at any time when they were monitored.

Sea Level Rise Adaptation Plan

- ECRB Comment: The ECRB requested an adaptation plan for sea level rise beyond the project's current 3.5' design objective. The ECRB requested that this plan include consideration of flattening Bayside levee slopes (e.g. from 3:1 to 5:1) and clearly-defined monitoring and thresholds, such as marsh accretion monitoring with interventions if accretion underperforms relative to design assumptions. BCDC staff recommends that this issue is addressed through the Sea Level Rise Risk Assessment and Adaptation Plan required as part of BCDC's permitting process and through the project's sea level rise permit conditions.

As part of the Sea Level Rise Risk Assessment and Adaptation Plan for its BCDC application and in collaboration with BCDC staff, the project will provide an adaptation plan for sea level rise beyond 3.5 ft. This approach acknowledges small chance of exceeding 3.5 ft SLR during the project's design life and the dependence on outboard conditions. To inform timing and type of future adaptation, monitoring will include consideration of the outboard conditions.

Engineer of Record

- ECRB Comment: The ECRB requested that the name of the coastal engineer of record for the project is provided to the ECRB.

ESA's revised coastal hazard analysis has been stamped by its author, a CA Professional Engineer.

SAFER Design Criteria and Exceedance Probabilities

SLR Projections for San Francisco

Design life



YEAR	LOW	INT-LOW	INTERMEDIATE	INT-HIGH	HIGH
2020	0.2	0.2	0.2	0.3	0.3
2030	0.3	0.4	0.4	0.4	0.4
2040	0.4	0.5	0.6	0.7	0.8
2050	0.5	0.6	0.8	1.0	1.3
2060	0.6	0.8	1.1	1.5	2.0
2070	0.7	1.0	1.4	2.2	2.9
2080	0.8	1.2	1.8	3.0	4.1
2090	0.9	1.4	2.4	3.8	5.3
2100	1.0	1.6	3.1	4.8	6.5
2110	1.0	1.8	3.8	5.6	7.8
2120	1.1	2.0	4.4	6.4	9.0
2130	1.2	2.2	4.9	7.0	9.9
2140	1.3	2.4	5.4	7.6	10.8
2150	1.3	2.6	6.0	8.1	11.7

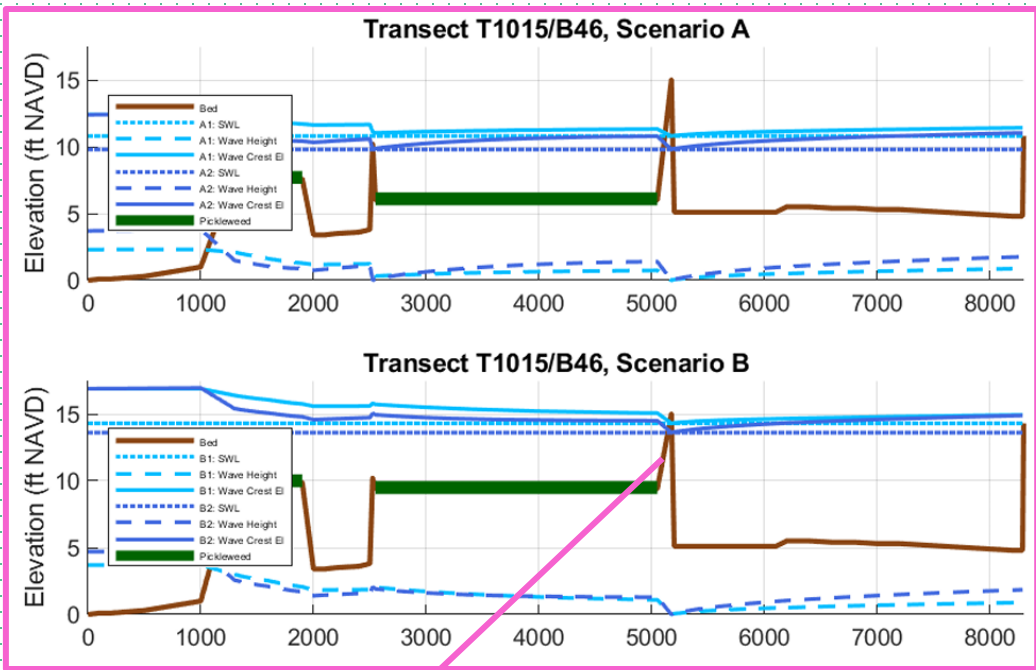
Loss of FEMA accreditation, crest above 1% SWL

Crest below 1% SWL

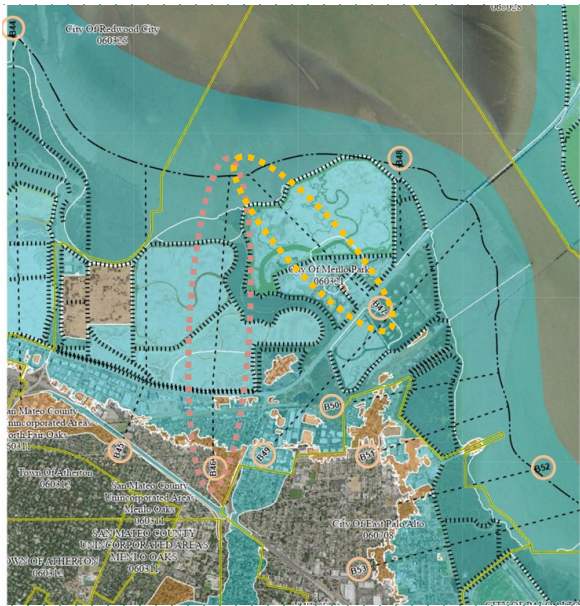
Exceedance Probabilities

Global Mean Surface Air Temperature 2081-2100	1.5°C	2.0°C	3.0°C	4.0°C	5.0°C	Low Confidence Processes, Low Warming	Low Confidence Processes, High Warming
Low Scenario	92%	98%	99.5%	99.9%	>99.9%	90%	99.5%
Intermediate-Low Scenario	97%	50%	82%	97%	99.5%	49%	96%
Intermediate Scenario	0.5%	2%	5%	10%	23%	7%	49%
Intermediate-High Scenario	0.1%	0.1%	0.1%	1%	2%	1%	20%
High Scenario	<0.1%	<0.1%	<0.1%	<0.1%	0.1%	<0.1%	8%

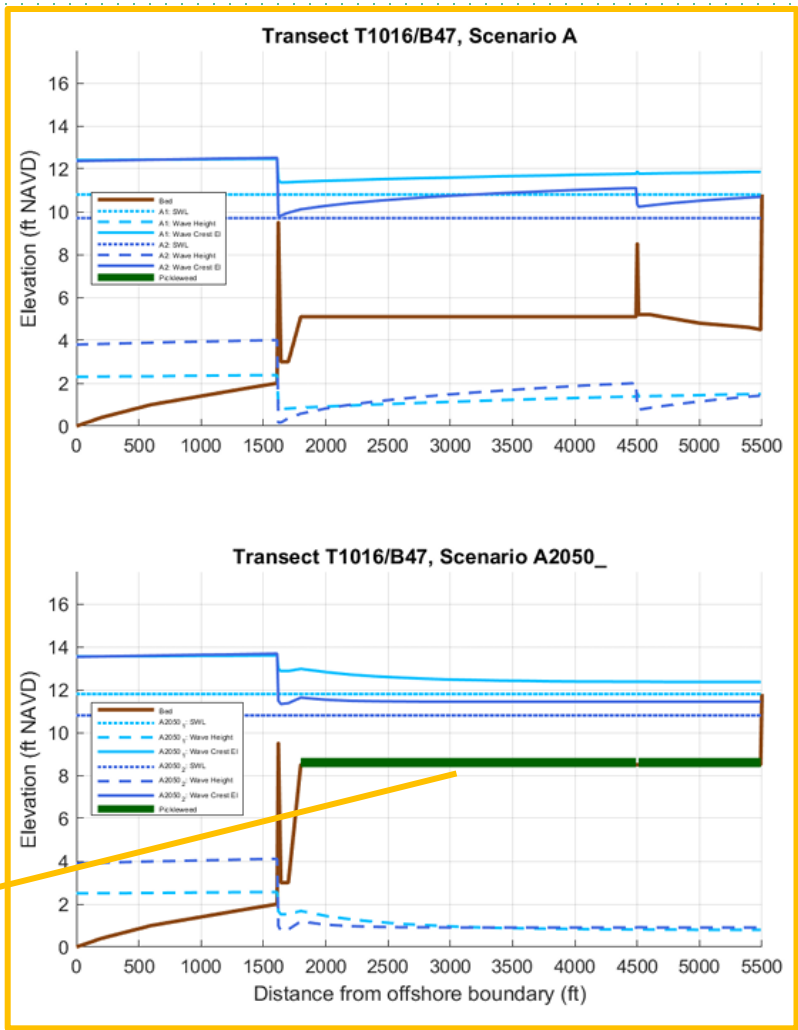
Design TWL Dependence on Outboard Conditions



Berm maintaining managed plover habitat



Restored tidal marsh



Engineer of Record

- ECRB Comment: The ECRB requested that the name of the coastal engineer of record for the project is provided to the ECRB.

ESA's revised coastal hazard analysis has been stamped by its author, a CA Professional Engineer.

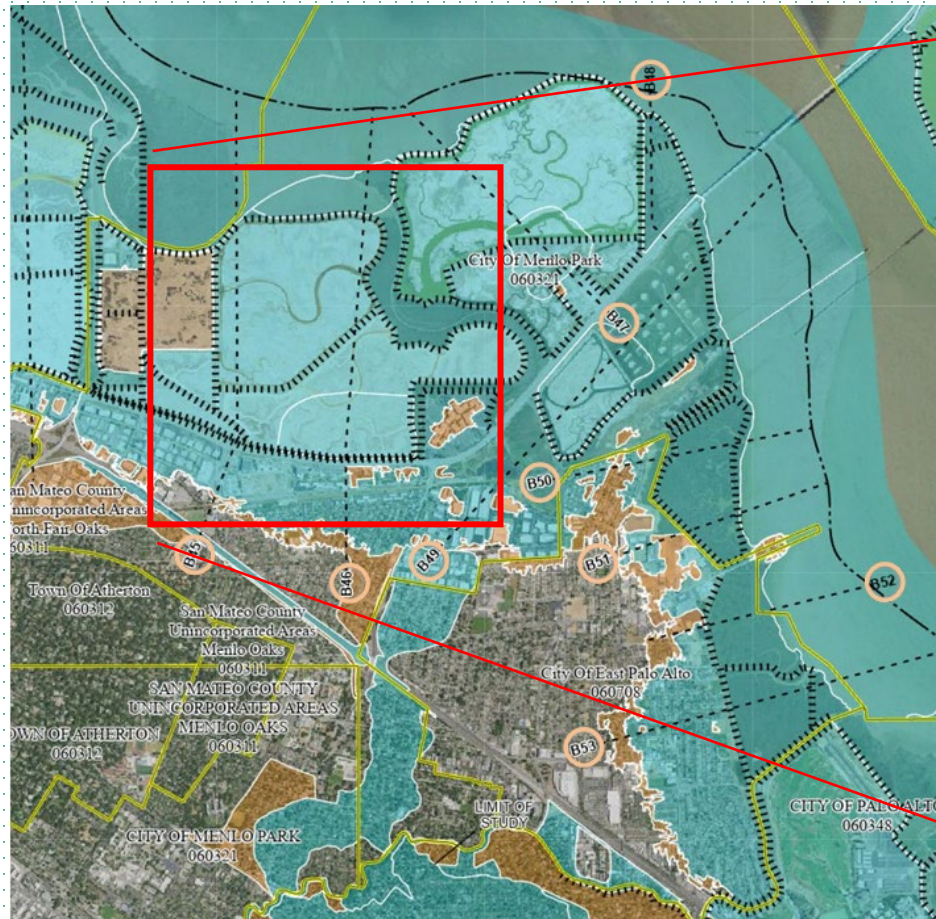
Updated Coastal Study

- ECRB Comment: The ECRB requested that the updated analysis presented at the meeting be provided as part of an updated ESA Coastal Wave Runup Study, including documentation of how this study was integrated with the FlowWest Coastal Hydraulics Study.

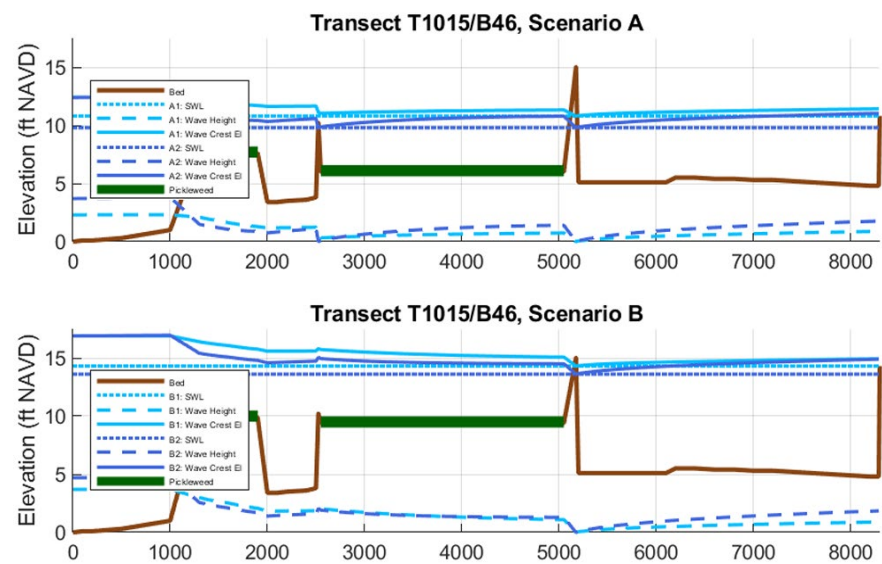
ESA's coastal hazard analysis has been updated to reflect revised wave modeling and wave runup calculations for the transects crossing Pond R3 and Pond R4. This includes updating the elevation of the berm crest between Pond R3 and R4 to its design elevation of 15 ft NAVD.

The FlowWest Coastal Hydraulics Study interpreted the same FEMA flood hazard studies as the ESA coastal hazard study but did not conduct new modeling to reflect the proposed project and future conditions with geomorphic change and sea level rise.

SBSP Pond R4 Restoration & R3/R4 Berm Improvements



Revised Wave Modeling and Wave Runup

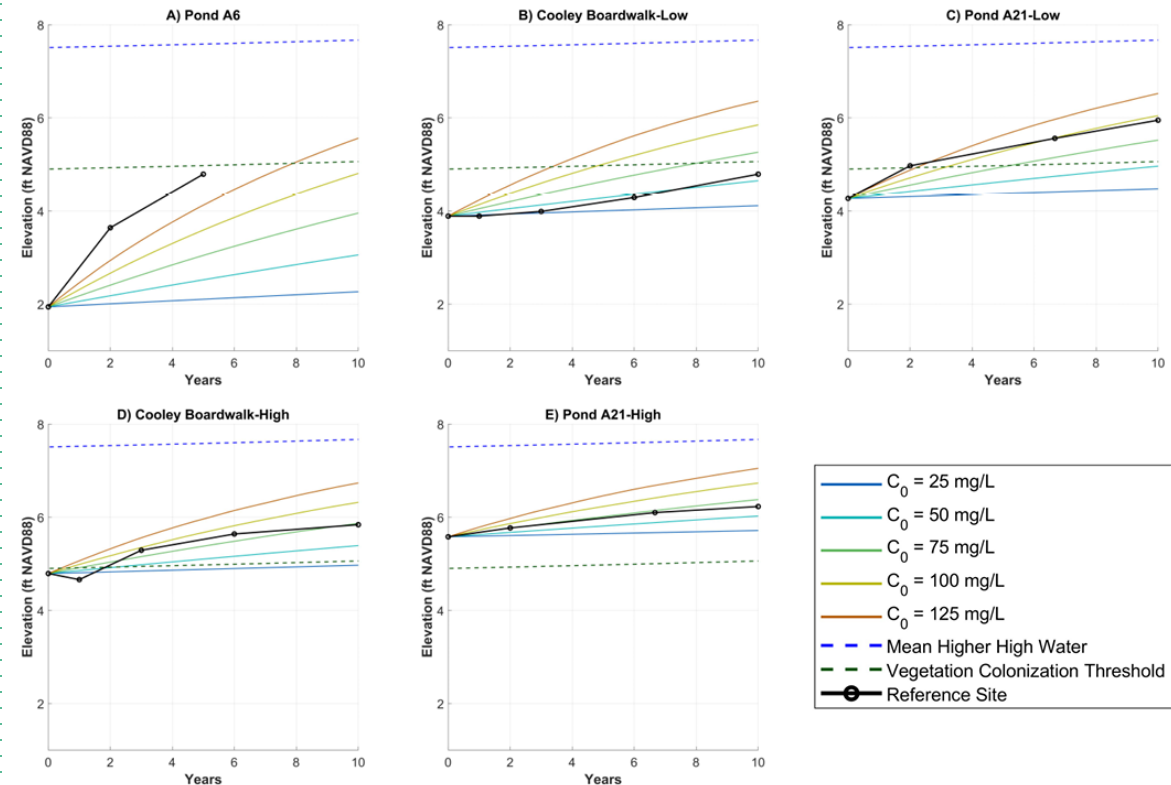
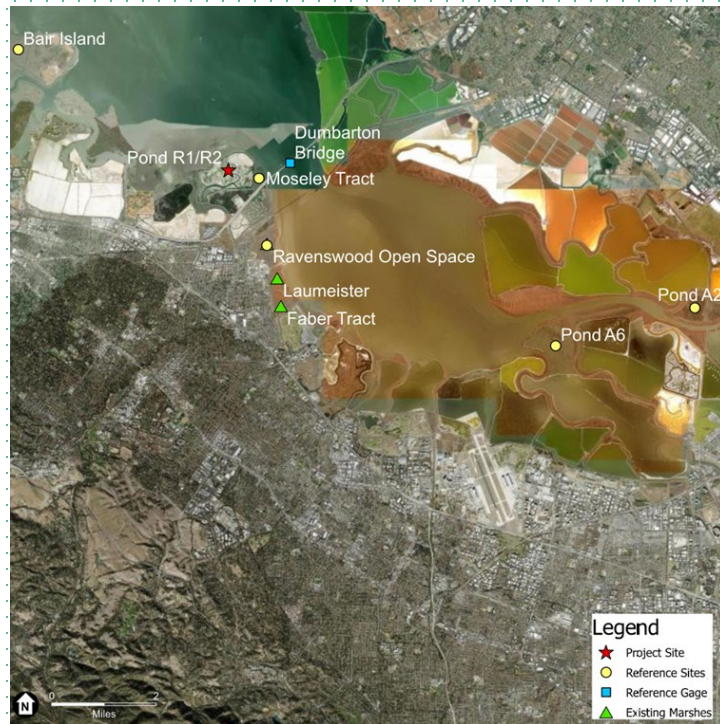


Transect	Scenario	SWL + 2 ft (ft NAVD)	TWL + 1 ft (ft NAVD)	Target Crest Elevation (ft NAVD)
B45 / 1014	A, +0 ft SLR	12.5	12.4	12.5
	B, +3.5 ft SLR	15.7	16.4	16.4
B46 / 1015	A, +0 ft SLR	12.8	13.4	13.4
	B, +3.5 ft SLR	15.6	17.6	17.6

Marsh Accretion Study

- ECRB Comment: The ECRB requested that the marsh accretion modeling underlying the coastal study's marsh accretion rate assumptions is provided to the ECRB.

Details of the marsh accretion modeling are provided in H.T. Harvey et al. (2026) Appendix A. Accretion rates from nearby reference sites were used to calibrate the accretion modeling.



Interior Drainage

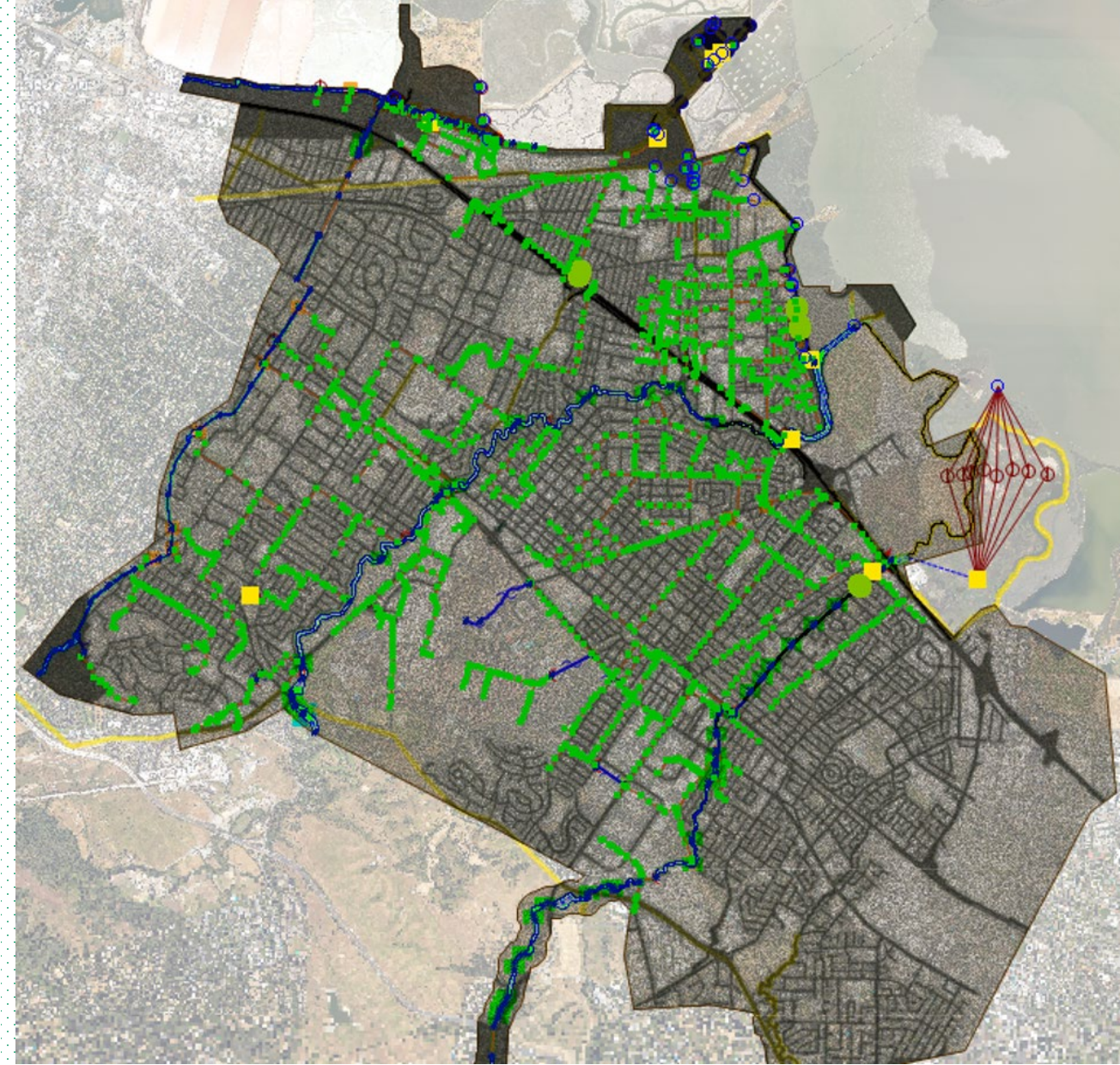
Rainfall Data Inputs

- ECRB Comment: The ECRB recommended that the interior drainage modeling account for changing rainfall intensity rather than relying solely on historical Intensity-Duration- Frequency (IDF) curves.

Methodology

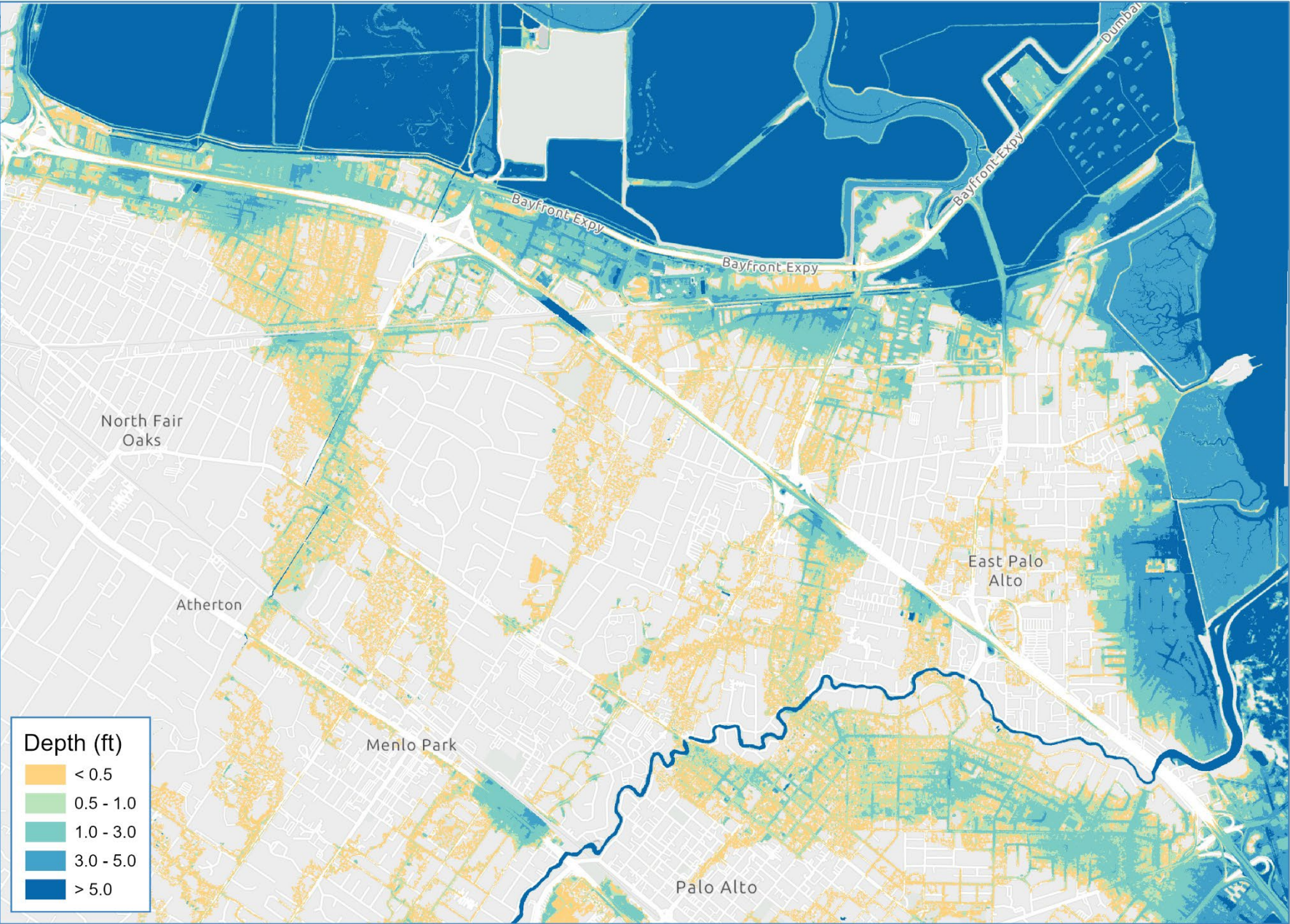
Integrated Catchment Model (ICM)

- East Palo Alto and Menlo Park design teams collaborated to create a unified Integrated Catchment Model (ICM) within East Palo Alto, Menlo Park, and Palo Alto. Watershed modeling is being performed directly for the San Francisquito Creek JPA.
- A statistically balanced Christmas 1955 3-day rainfall pattern using local MetStat IDF data is adopted as the 100-year storm.
- Antecedent moisture conditions and baseflow are based on calibration to flood-frequency analysis performed for the USGS streamflow gage at Stanford, with 84 years of systematic record.
- The calibrated ICM has been verified using the recorded NYE 2022 rainfall and runoff. (AMC adjusted)
- 100-year interior runoff against 10-year tide is an appropriate joint probability for mapping.
- The East Palo Alto and Menlo Park design teams have independently verified storm drain system and pumping characteristics.

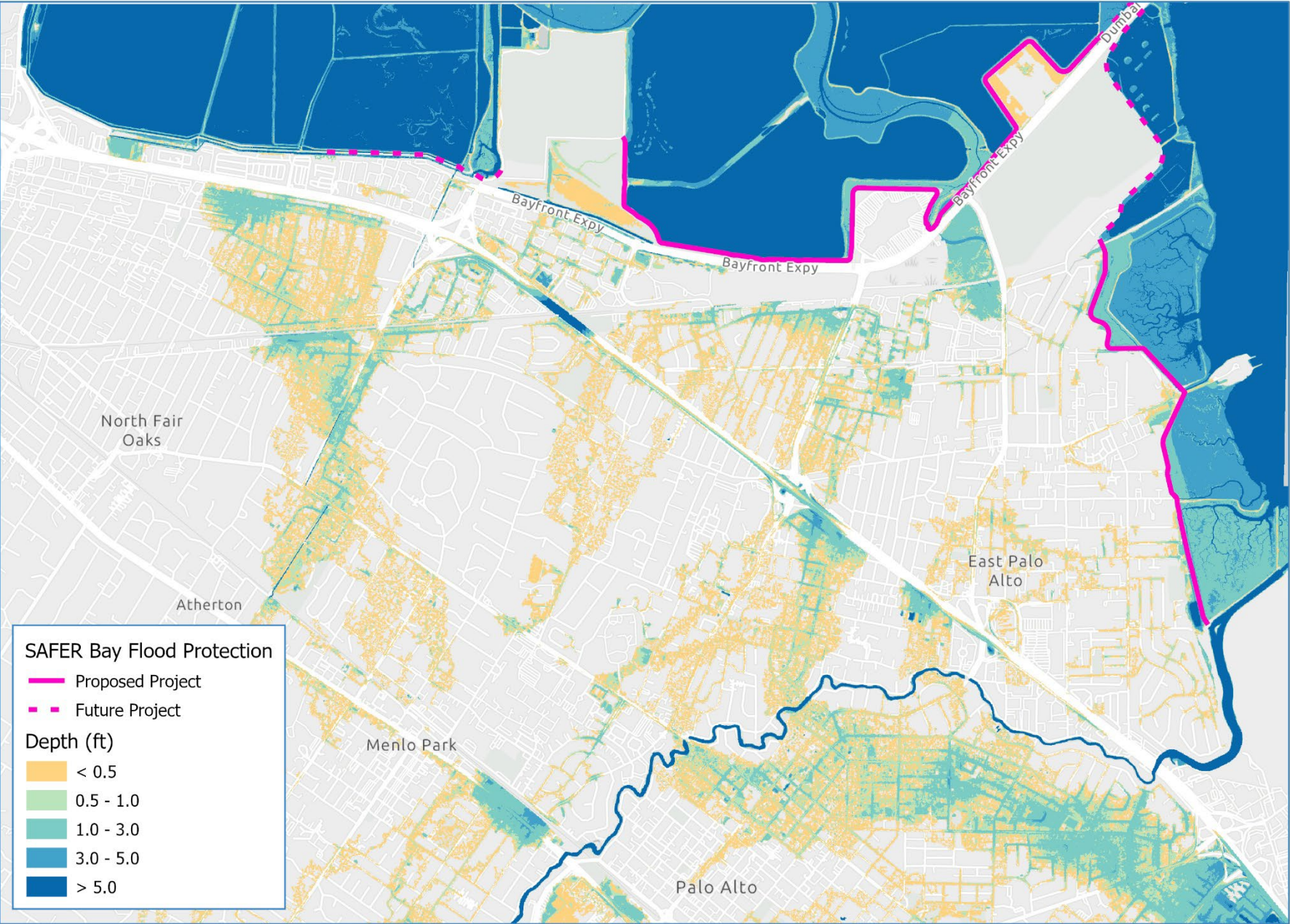


ICM Model Domain (Schaaf & Wheeler, 20

Compound Flooding
Integrated Catchment Model
(ICM)

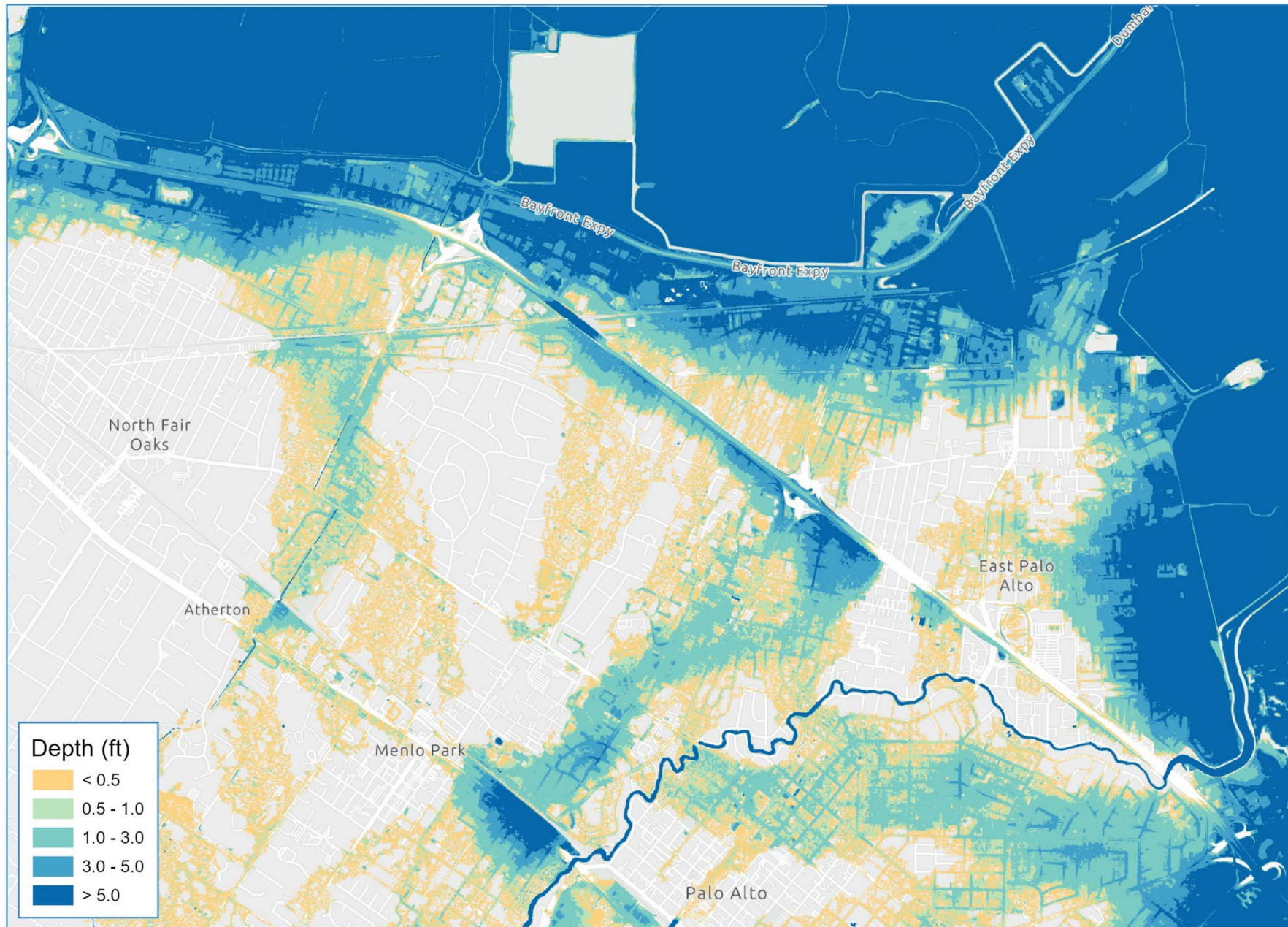


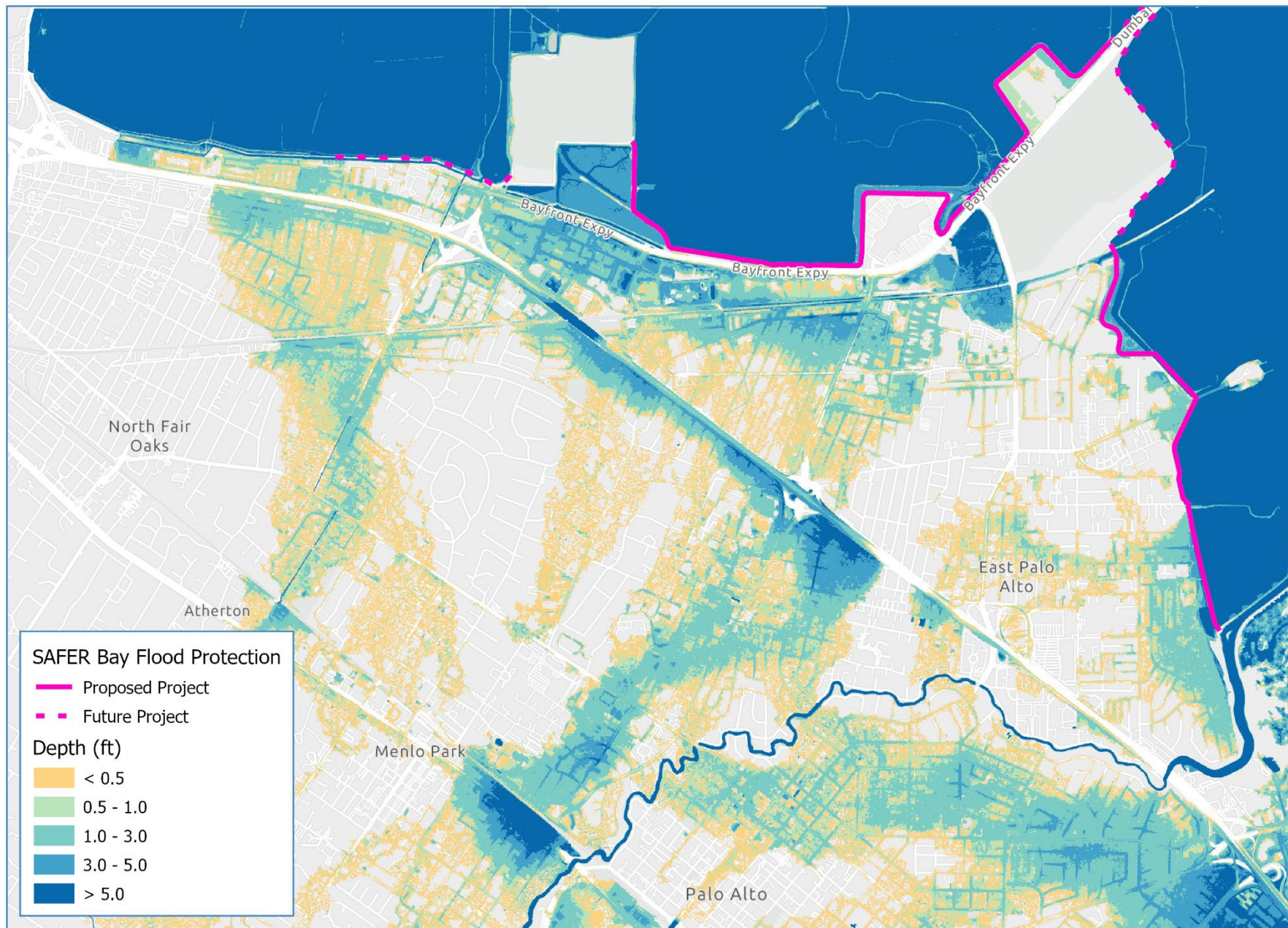
Interior Drainage
Integrated Catchment Model (ICM)



Compound Flooding with Climate Change *Integrated Catchment Model (ICM)*

- 3.5 feet of Sea Level Rise
- Rebalanced 72-hour storm pattern from Christmas 1955
 - SSP3-7.0 climate scenario
 - 3-hour rainfall plus 49.8%
 - 6-hour rainfall plus 44.6%
 - 24-hour rainfall plus 38.5%
- Does not consider future benefits from San Francisquito Creek projects.

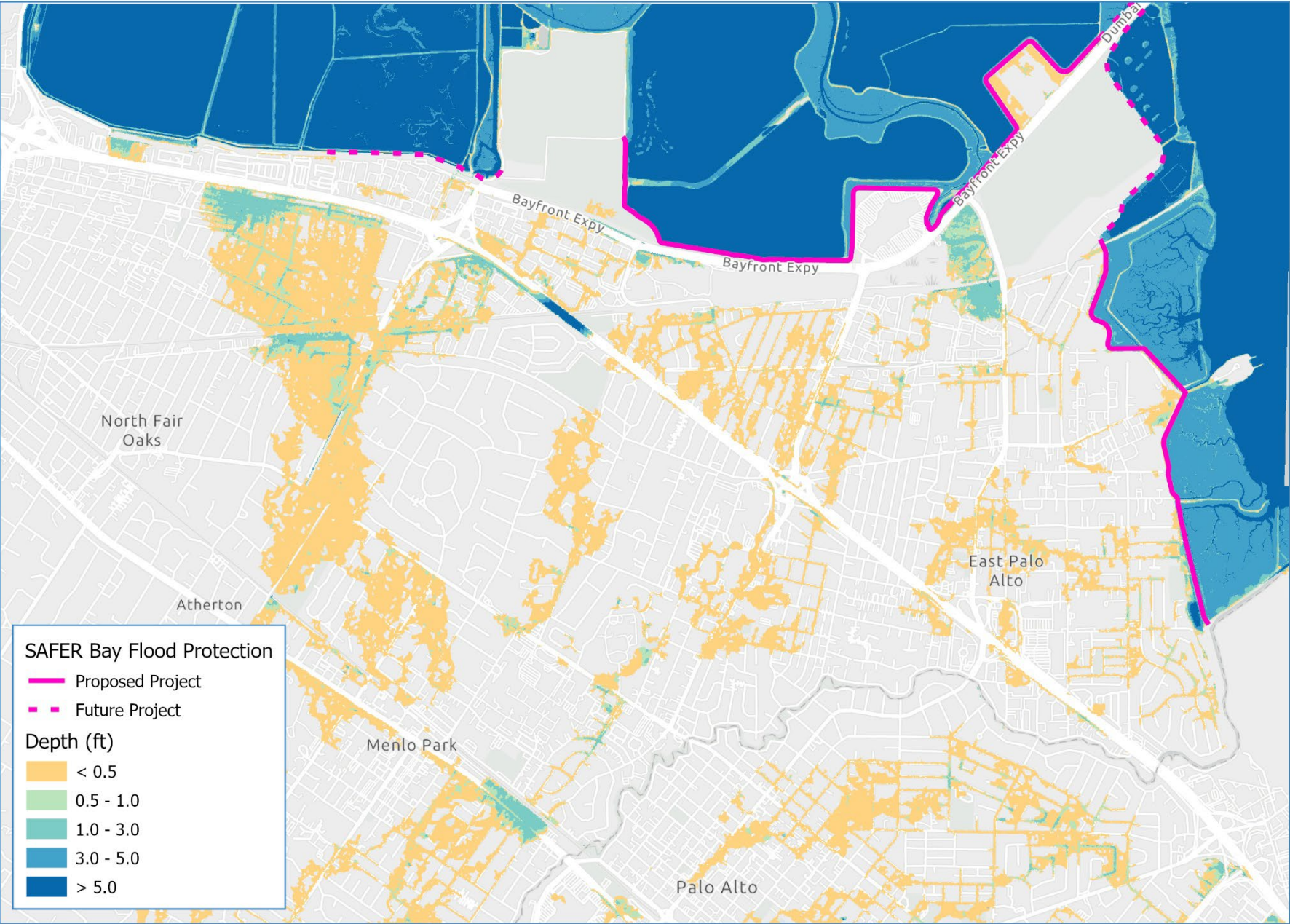


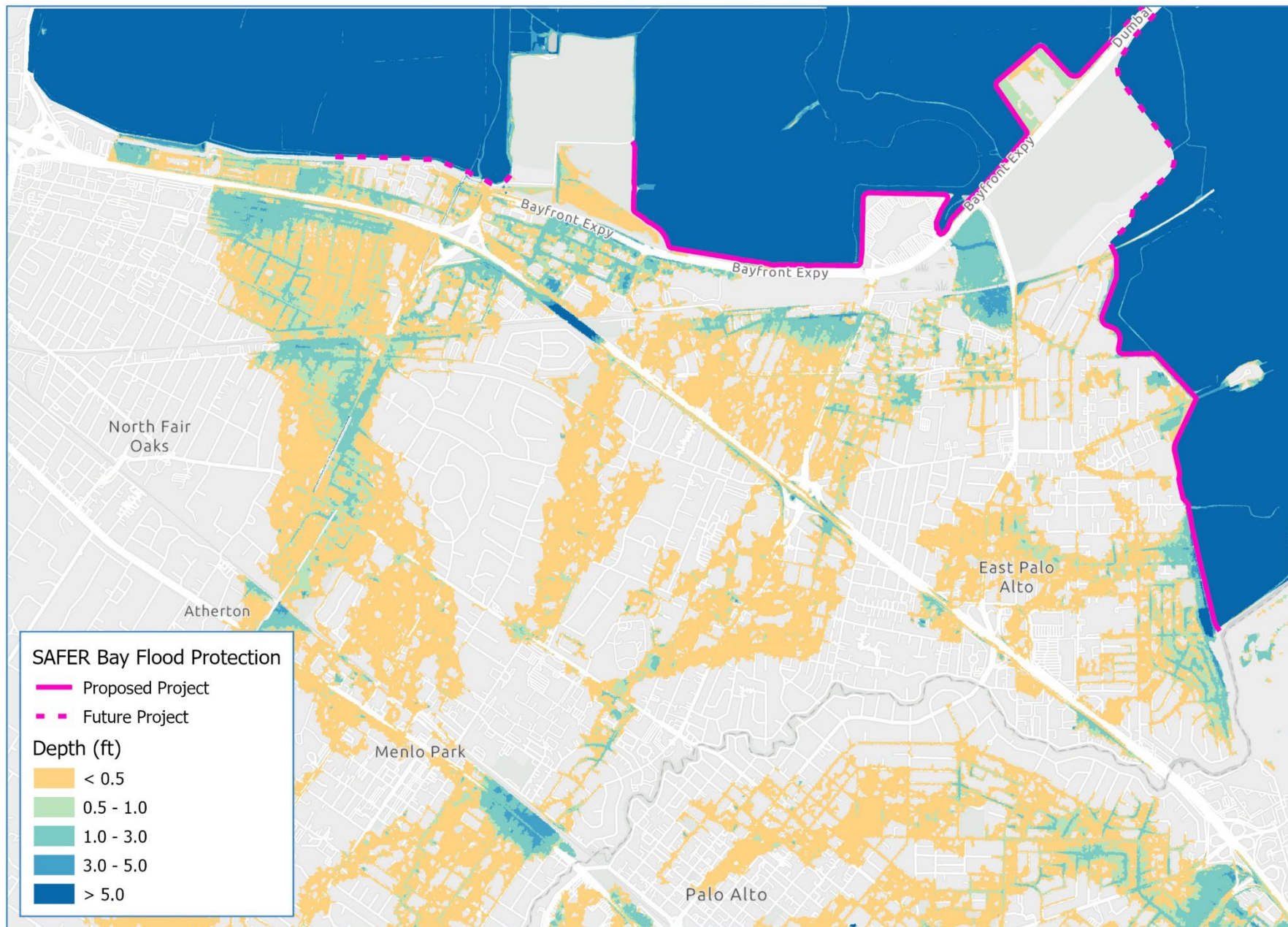


Interior Drainage with Climate Change *Integrated Catchment Model (ICM)*

- 3.5 feet of Sea Level Rise
- Rebalanced 72-hour storm pattern from Christmas 1955
 - SSP3-7.0 climate scenario
 - 3-hour rainfall plus 49.8%
 - 6-hour rainfall plus 44.6%
 - 24-hour rainfall plus 38.5%
- Does not consider future benefits from San Francisquito Creek projects.

Interior Drainage
Integrated Catchment Model
(ICM)



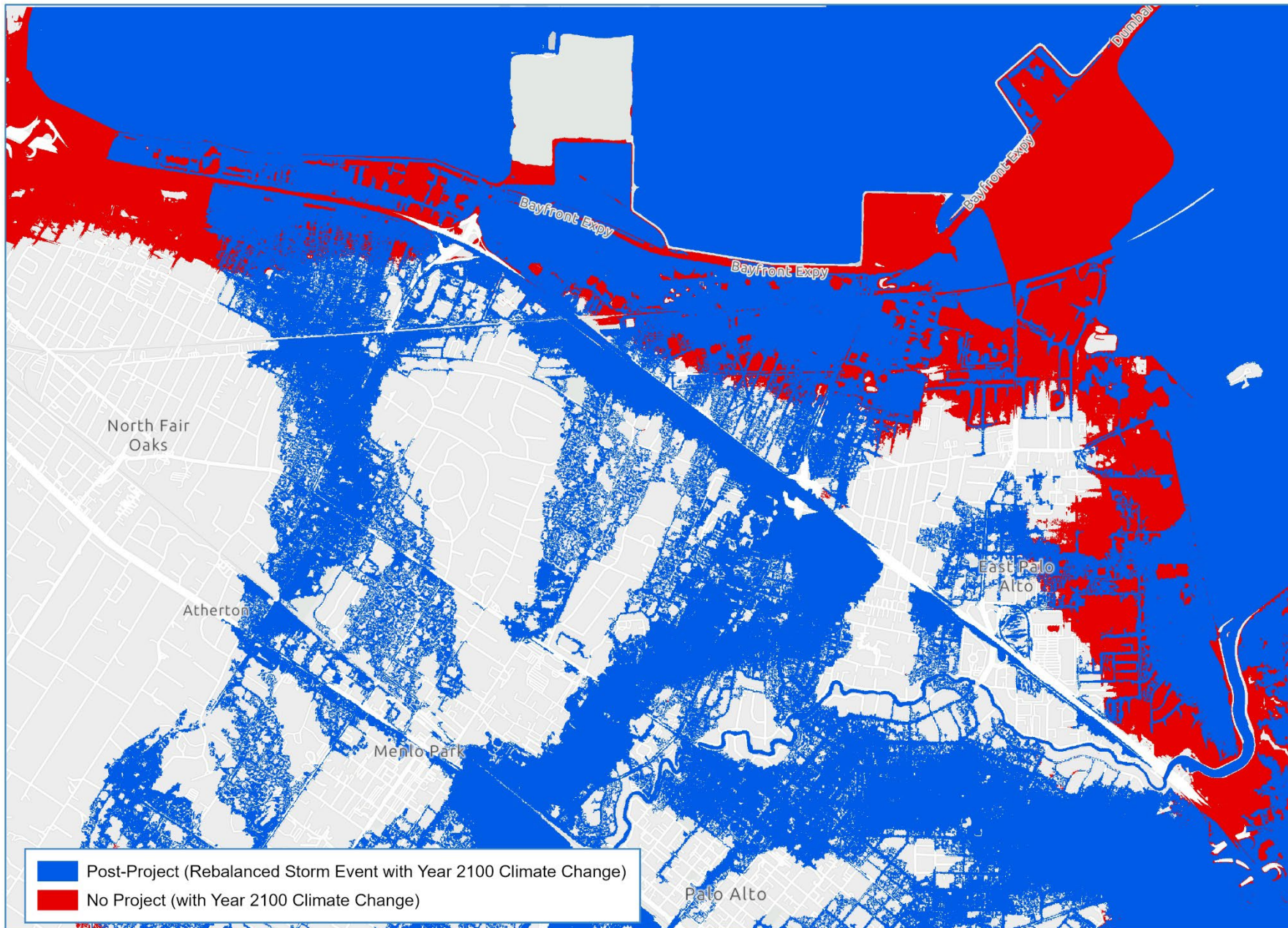


Interior Drainage with Climate Change *Integrated Catchment Model (ICM)*

- 3.5 feet of Sea Level Rise
- Rebalanced 72-hour storm pattern from Christmas 1955
 - SSP3-7.0 climate scenario
 - 3-hour rainfall plus 49.8%
 - 6-hour rainfall plus 44.6%
 - 24-hour rainfall plus 38.5%
- Does not consider future benefits from San Francisquito Creek projects.

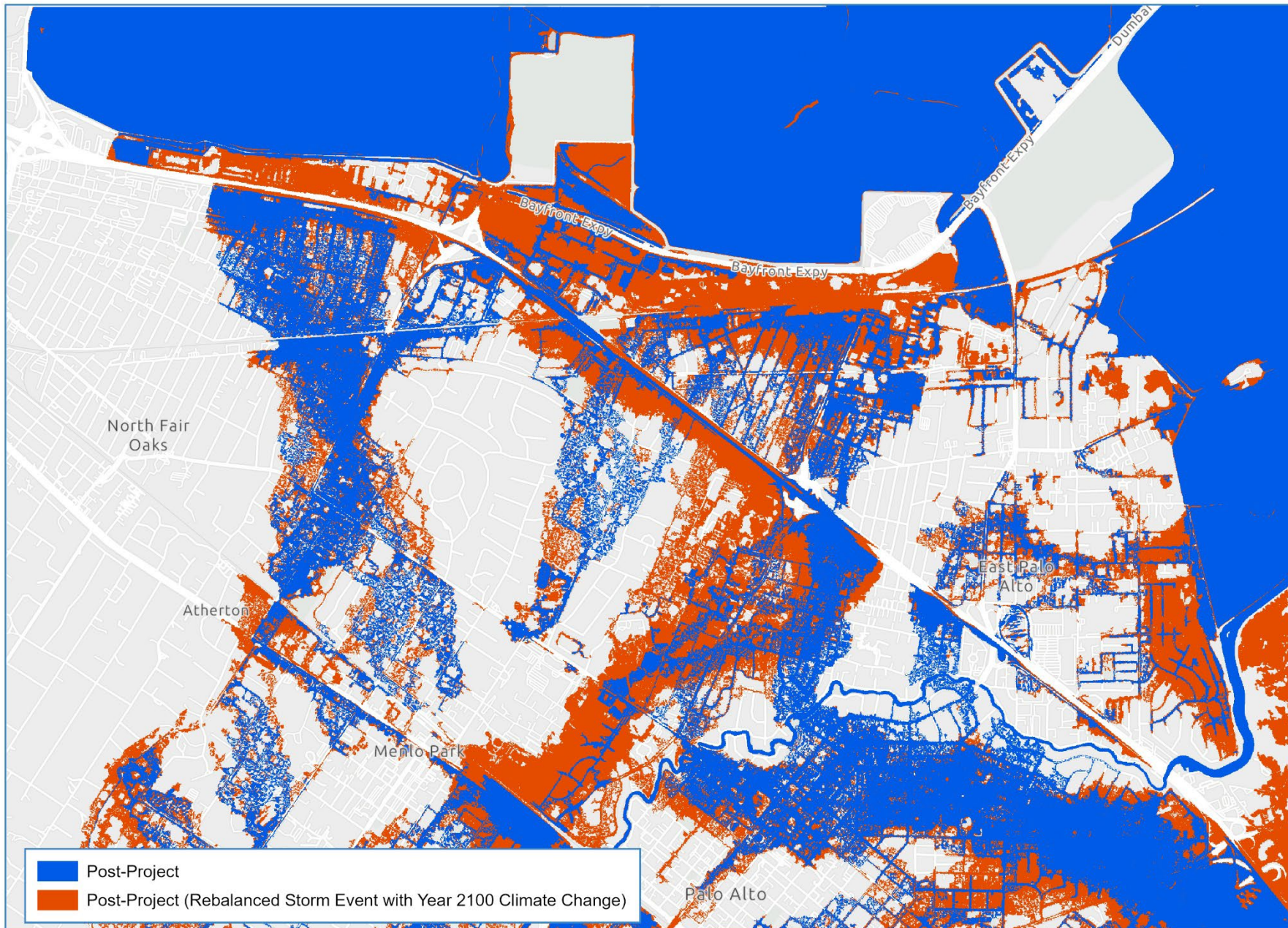
Compound Flooding with Climate Change *Integrated Catchment Model (ICM)*

- 3.5 feet of Sea Level Rise
- Rebalanced 72-hour storm pattern from Christmas 1955
 - SSP3-7.0 climate scenario
 - 3-hour rainfall plus 49.8%
 - 6-hour rainfall plus 44.6%
 - 24-hour rainfall plus 38.5%
- Does not consider future benefits from San Francisquito Creek projects.



Interior Drainage with Climate Change *Integrated Catchment Model (ICM)*

- 3.5 feet of Sea Level Rise
- Rebalanced 72-hour storm pattern from Christmas 1955
 - SSP3-7.0 climate scenario
 - 3-hour rainfall plus 49.8%
 - 6-hour rainfall plus 44.6%
 - 24-hour rainfall plus 38.5%
- Does not consider future benefits from San Francisquito Creek projects.



Impact of SAFER Bay on Interior Drainage

- Once completed, SAFER Bay removes the shoreline (coastal) flood hazard from the interior area.
- East Palo Alto SAFER Bay does not cause adverse impacts to the interior drainage system or change residual interior flooding.
- Menlo SAFER Bay does not cause adverse impacts to the interior drainage system or change residual interior flooding.
- Terminal pump stations may require changes to pump trim or horsepower increases but those are not caused by the levee project.
- The coastal levee does not resolve existing interior drainage issues associated with San Francisquito Creek overflows or existing storm drain system limitations. Nor does it exacerbate those problems.
- Menlo SAFER Bay includes drainage provisions to prevent vector control problems within what will become isolated brackish ponds, for example between the new levee alignment and the PG&E substation. These provisions are included in the post-Project ICM.
- With or without the completion of SAFER Bay, East Palo Alto and Menlo Park will need to be evaluated interior drainage through the lens of level of service and that evaluation could be affected by future climate change, particularly an increase in precipitation, which is not for the SAFER Bay project to address.
- Precipitation increases are likely to be more impactful on interior drainage than sea level rise.

Interior Drainage Study

- ECRB Comment: The ECRB requested that the interior drainage study is provided to the ECRB.
- This has been provided to ECRB