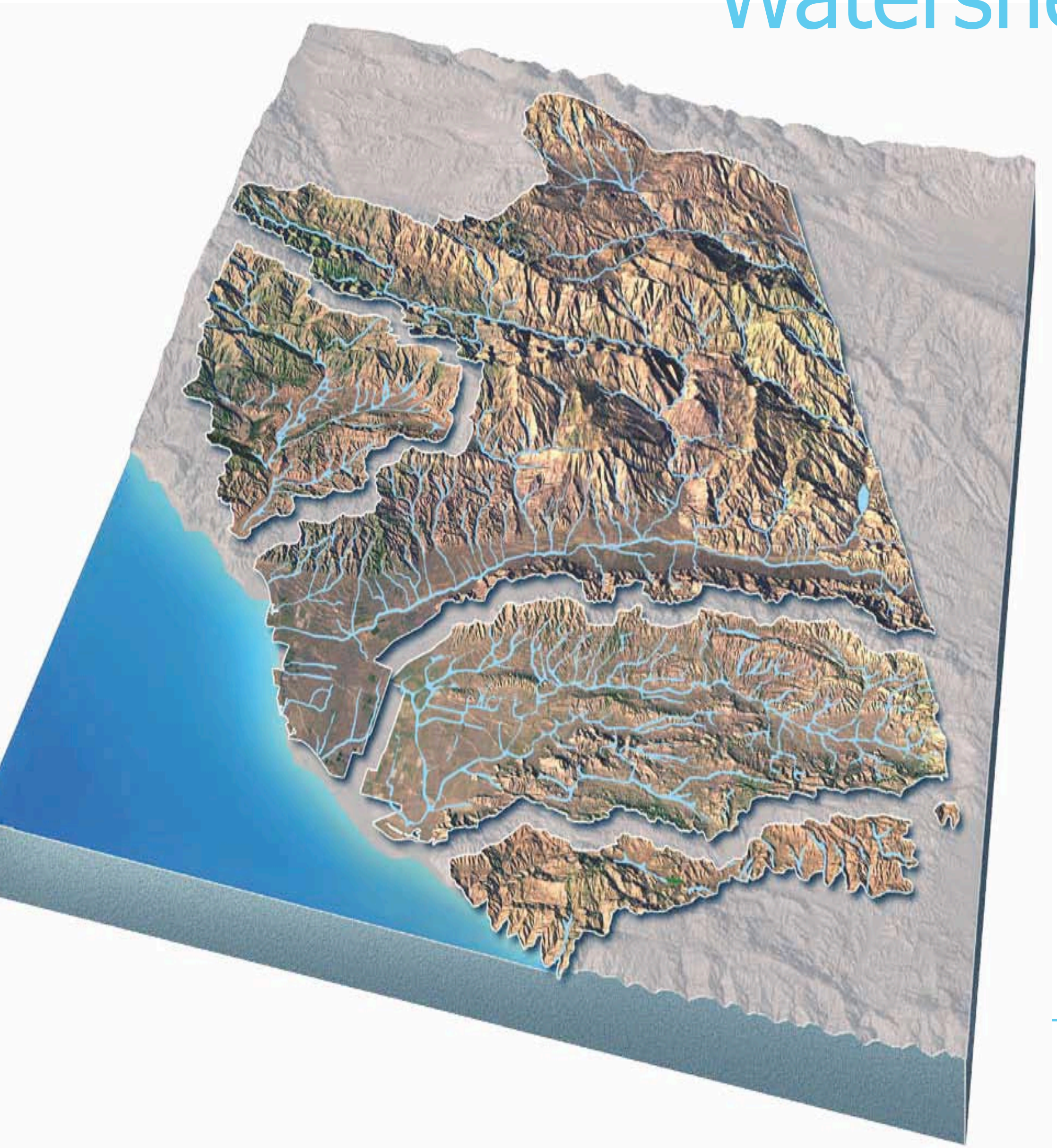
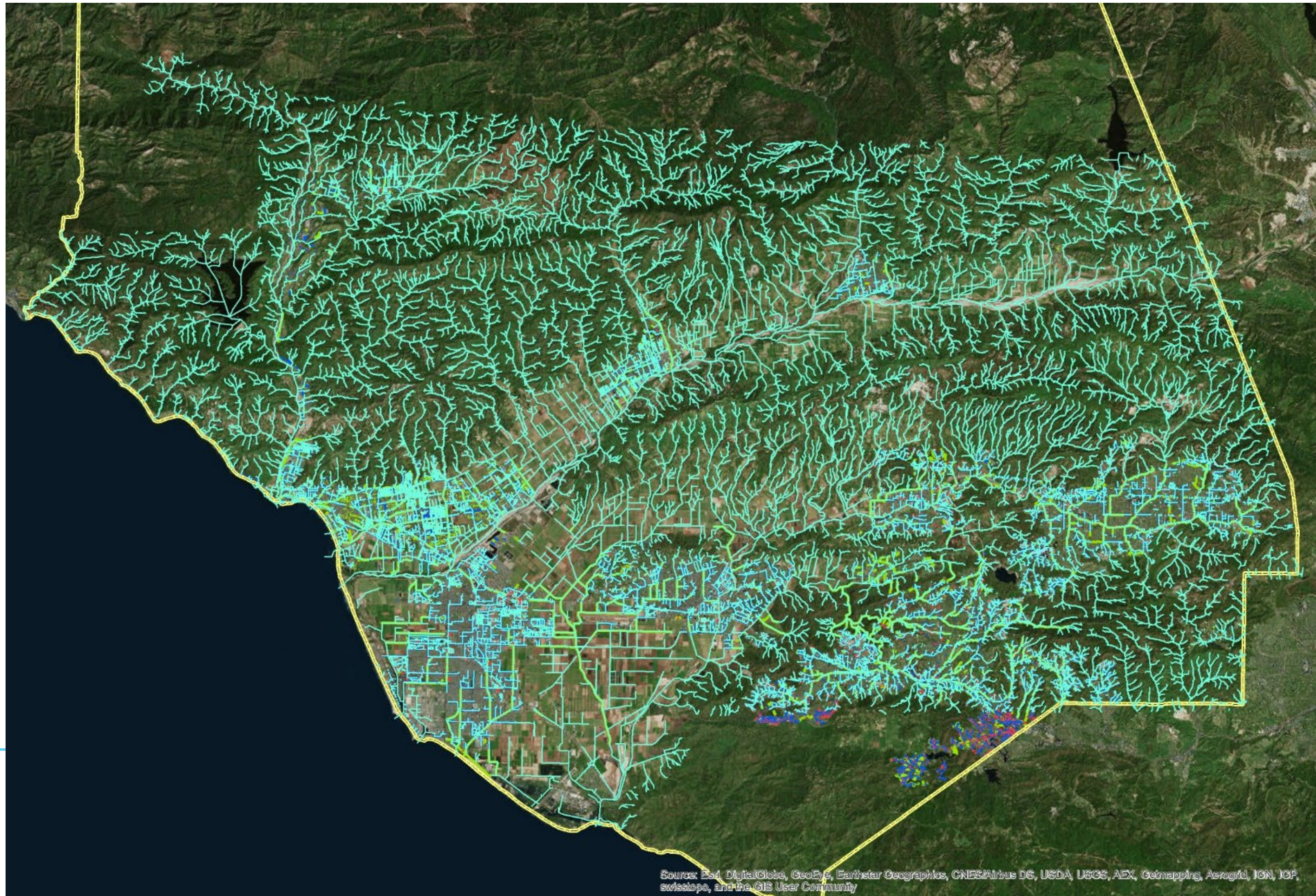
PUBLIC VENTURA COUNTY WORKS

Infrastructure Planning Design Approach Related to Climate Change and Sea Level Rise

July 26, 2022

Watersheds

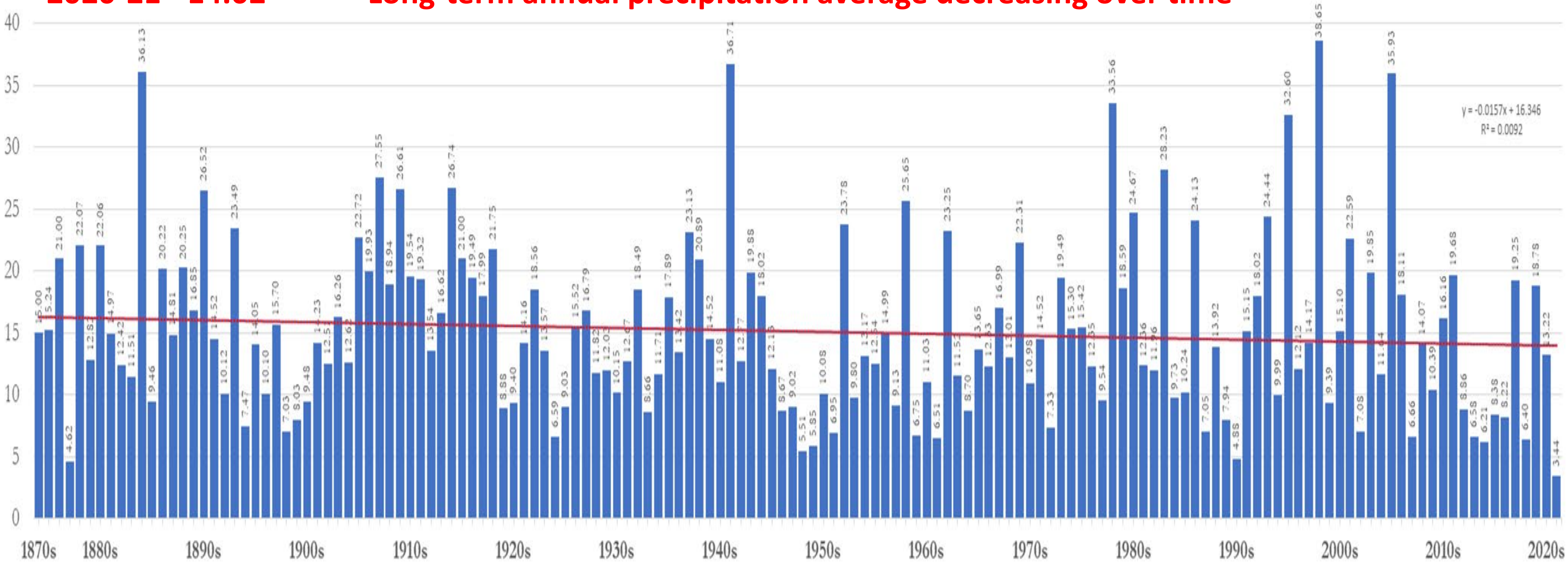



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Ventura County Climate - Precipitation

Ventura City Hall
1873-74 - 16.33”
2020-21 - 14.02”

Long-term annual precipitation average decreasing over time

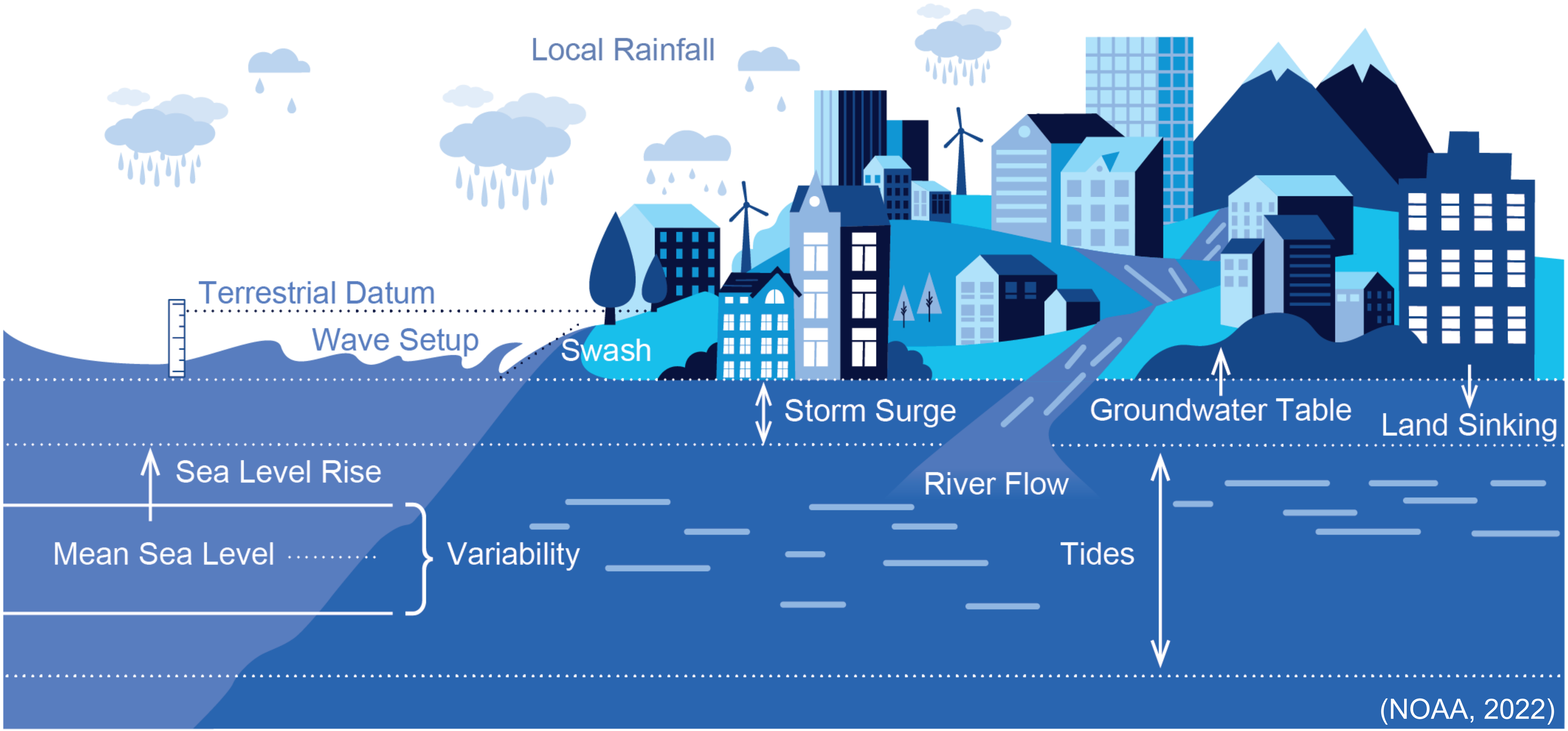


Ventura County Climate – Precipitation Intensity

- Climate studies for Southern California are predicting the design storm rainfall intensity could be increased by 5-10%

- Example of impact on Watershed Protection's hydrology model:
  - Sexton Canyon (rain gage #167) with 100-yr 1-hr intensity of 1.81 in/hr
  - The 90% confidence interval ranges from 1.66 to 2.01 in/hr
  - Thus, a 10% increase in intensity is 1.99 in/hr, or close to upper limit of confidence interval

Physical Factors Directly Contributing to Coastal Flood Exposure



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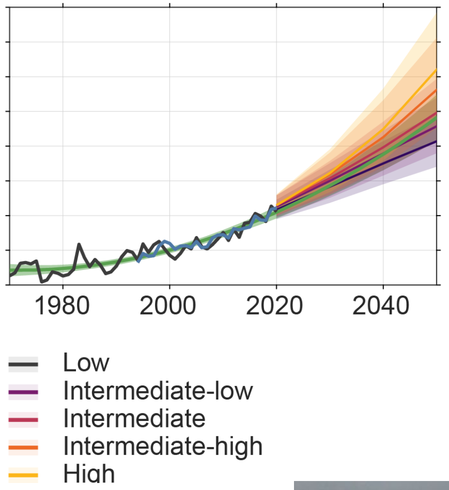
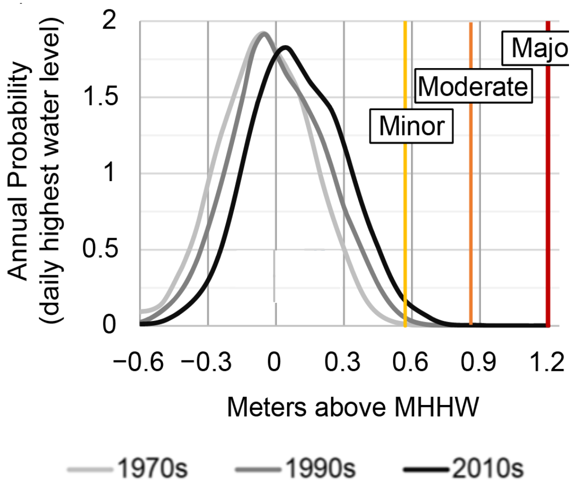
Coastal Threats Due to Climate Change

- Sea Level Rise
- High Tide Flooding
- Shoreline Retreat





Sea Level Rise Predictions by 2100 from 2010's

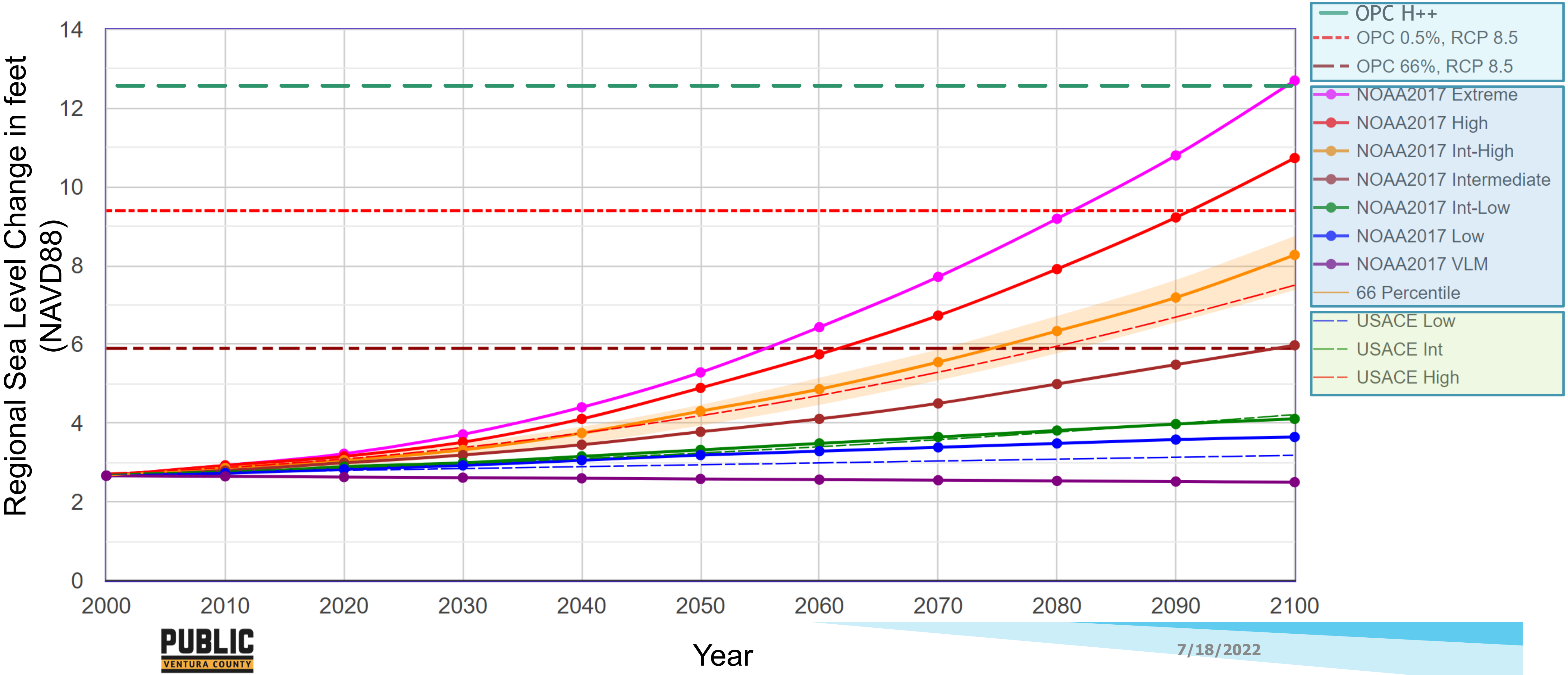
National Oceanic and Atmospheric Administration (NOAA, 2017)		Ocean Protection Council (OPC, 2018)		United States Army Corp of Engineers (USACE, 2013)	
Scenario	SLR (ft)	Scenario	SLR (ft)	Scenario	SLR (ft)
Extreme	10.0	H++ Extreme Risk Aversion	10.0	N/A	
High	8.1	High Emissions, Medium-High Risk Aversion	6.8	High	4.8
Intermediate-High	5.6	Low Emissions, Medium-High Risk Aversion	5.3	N/A	
Intermediate	3.3	High Emissions Low Risk Aversion	3.3	Intermediate	1.5
Low	1.0	Low Emissions Low Risk Aversion	2.3	Low	0.5

Probabilities of SLR

- Uncertainties of SLR
  - High vs. Low emissions
  - Climate change science (likely vs. H++ scenarios)
- SLR is selected based on Risk Tolerance

		Probabilistic Projections (in feet) (based on Kopp et al. 2014)					H++ scenario (Sweet et al. 2017) *Single scenario
		MEDIAN	LIKELY RANGE		1-IN-20 CHANCE	1-IN-200 CHANCE	
		50% probability sea-level rise meets or exceeds…	66% probability sea-level rise is between…		5% probability sea-level rise meets or exceeds…	0.5% probability sea-level rise meets or exceeds…	
				Low Risk Aversion		Medium - High Risk Aversion	Extreme Risk Aversion
High emissions	2030	0.3	0.2 -	0.4	0.5	0.7	1.0
	2040	0.5	0.3 -	0.7	0.8	1.1	1.6
	2050	0.7	0.4 -	1.0	1.2	1.8	2.5
Low emissions	2060	0.7	0.4 -	1.0	1.4	2.2	
High emissions	2060	0.9	0.6 -	1.3	1.6	2.5	3.6
Low emissions	2070	0.9	0.5 -	1.3	1.7	2.8	
High emissions	2070	1.1	0.7 -	1.7	2.1	3.3	4.9
Low emissions	2080	1.0	0.5 -	1.5	2.0	3.6	
High emissions	2080	1.4	0.9 -	2.1	2.7	4.3	6.3
Low emissions	2090	1.1	0.6 -	1.8	2.4	4.4	
High emissions	2090	1.7	1.1 -	2.6	3.3	5.3	7.9
Low emissions	2100	1.2	0.6 -	2.0	2.9	5.3	
High emissions	2100	2.1	1.2 -	3.1	4.1	6.6	9.8
Low emissions	2110*	1.3	0.7 -	2.1	3.0	5.9	
High emissions	2110*	2.2	1.4 -	3.2	4.2	6.9	11.5
Low emissions	2120	1.4	0.7 -	2.4	3.5	7.0	
High emissions	2120	2.5	1.7 -	3.7	4.9	8.2	13.7
Low emissions	2130	1.5	0.8 -	2.6	3.9	8.0	
High emissions	2130	2.9	1.8 -	4.2	5.6	9.5	16.0
Low emissions	2140	1.6	0.8 -	2.9	4.4	9.1	
High emissions	2140	3.1	2.0 -	4.8	6.4	11.0	18.6
Low emissions	2150	1.8	0.7 -	3.2	5.0	10.5	
High emissions	2150	3.5	2.2 -	5.3	7.2	12.6	21.4

Sea Level Rise Predictions by 2100



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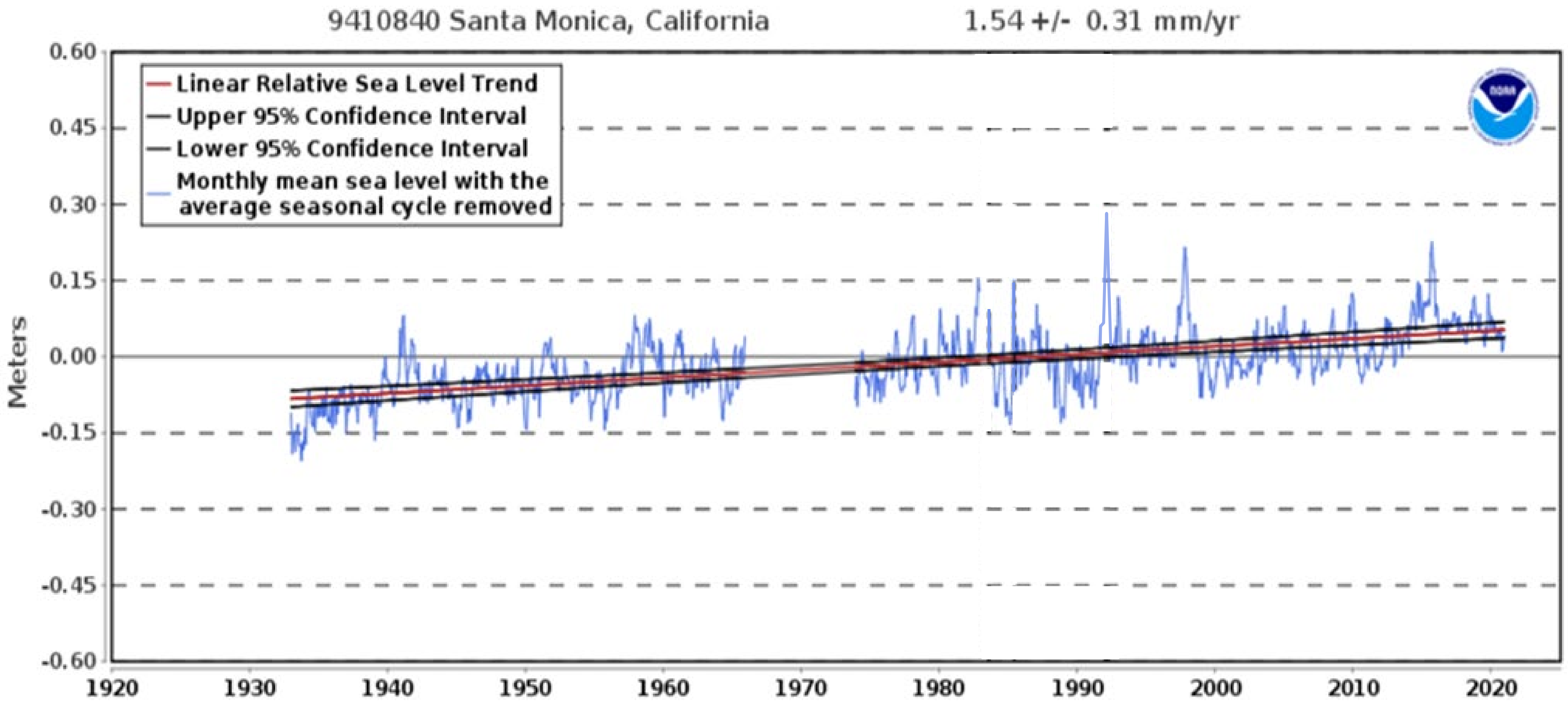
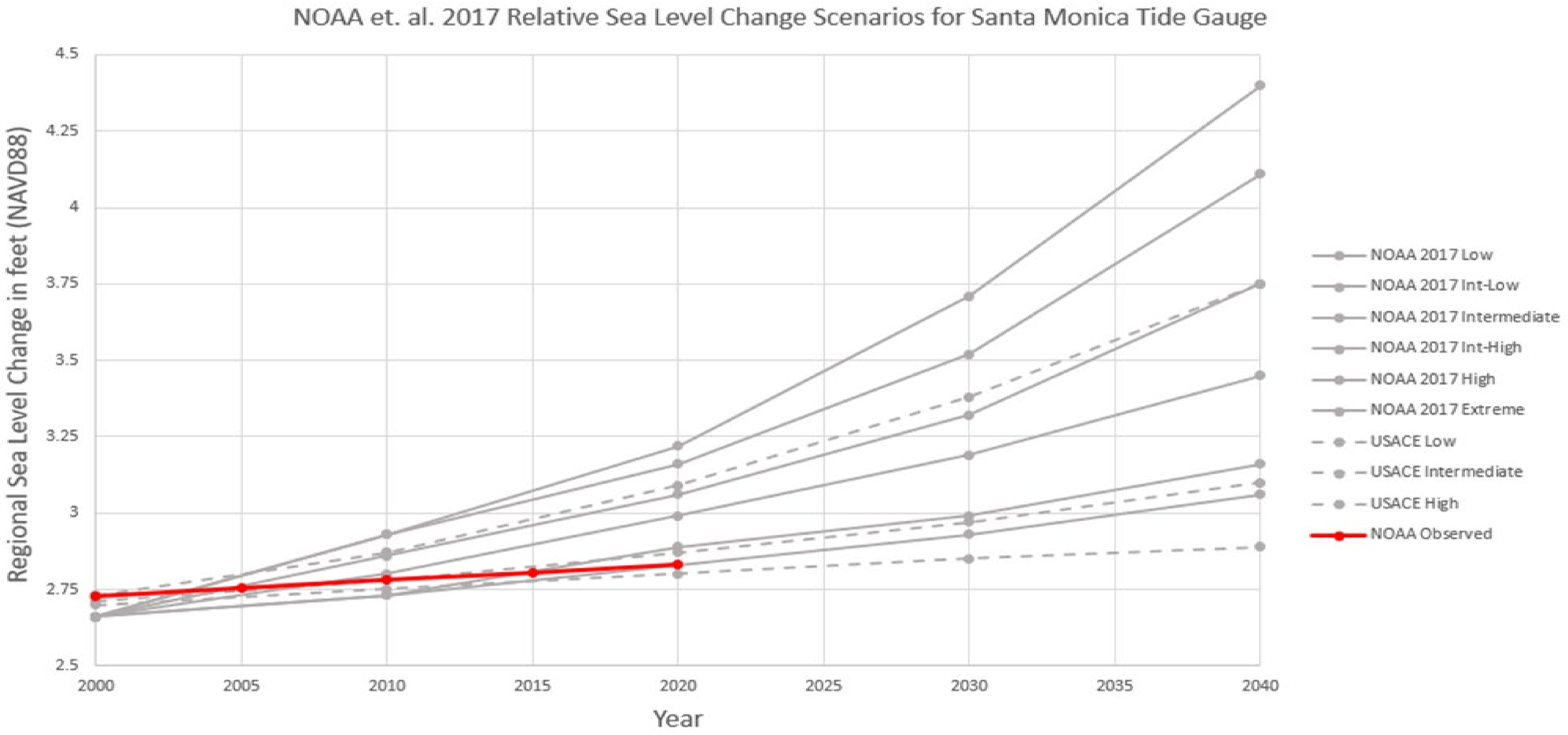
Historic Sea Level Rise - Observed



Historic Sea Level Rise – Observed on 20 yrs of modeled prediction



Sea Level Rise Predictions by 2050 (NOAA, 2022)

National Oceanic and Atmospheric Administration (NOAA,2022)	
Scenario	SLR (ft)
High	1.3
Intermediate-High	1.0
Intermediate	0.8
Intermediate-Low	0.7
Low	0.5

<u>Key Take-Aways:</u>

- Narrower range of projected SLR compared to 2017 – no ‘Extreme’ scenario
- High Tide Flood (HTF) events will increase in frequency and elevation
- SLR scenario predicted range increase is 1.4 to 6.4 feet at year 2100

High Tide Flooding (NOAA, 2022)

U.S. Region	1990			2020			2050		
	Minor Flood	Moderate Flood	Major Flood	Minor Flood	Moderate Flood	Major Flood	Minor Flood	Moderate Flood	Major Flood
National	1	0.2	0.03	3	0.3	0.04	>10	4	0.2
*Hawaii/Pac Is	0.06	<0.02	<0.02	0.2	<0.02	<0.02	9	0.1	<0.02
NE Atlantic	2	0.3	0.06	4	0.6	0.09	>10	6	0.4
SE Atlantic	0.9	0.1	0.03	2	0.2	0.04	>10	4	0.2
E Gulf	0.7	0.2	0.06	2	0.3	0.08	>10	3	0.3
W Gulf	1	0.3	0.1	4	0.7	0.2	>10	>10	1
SW Pacific	0.8	0.02	<0.02	1	0.04	<0.02	>10	0.7	<0.02
NW Pacific	3	0.3	<0.02	4	0.4	<0.02	>10	1	0.03
**Alaska	0.7	<0.02	<0.02	0.2	<0.02	<0.02	0.7	0.03	<0.02
US Carib	0.02	<0.02	<0.02	0.04	<0.02	<0.02	6	0.04	<0.02

*The Pacific Island locations use the same scenario assigned to the Hawaiian Islands (see Table 2.2); **Alaska locations, which as a whole could not be regionalized due to large differences in VLM, use the lower-bounding scenario per CONUS, which is the Intermediate-Low scenario (see Table 2.1). The lower-bounding scenario for Alaska is used to reflect the significant deviations below the Intermediate scenario (Figure A1.2b).

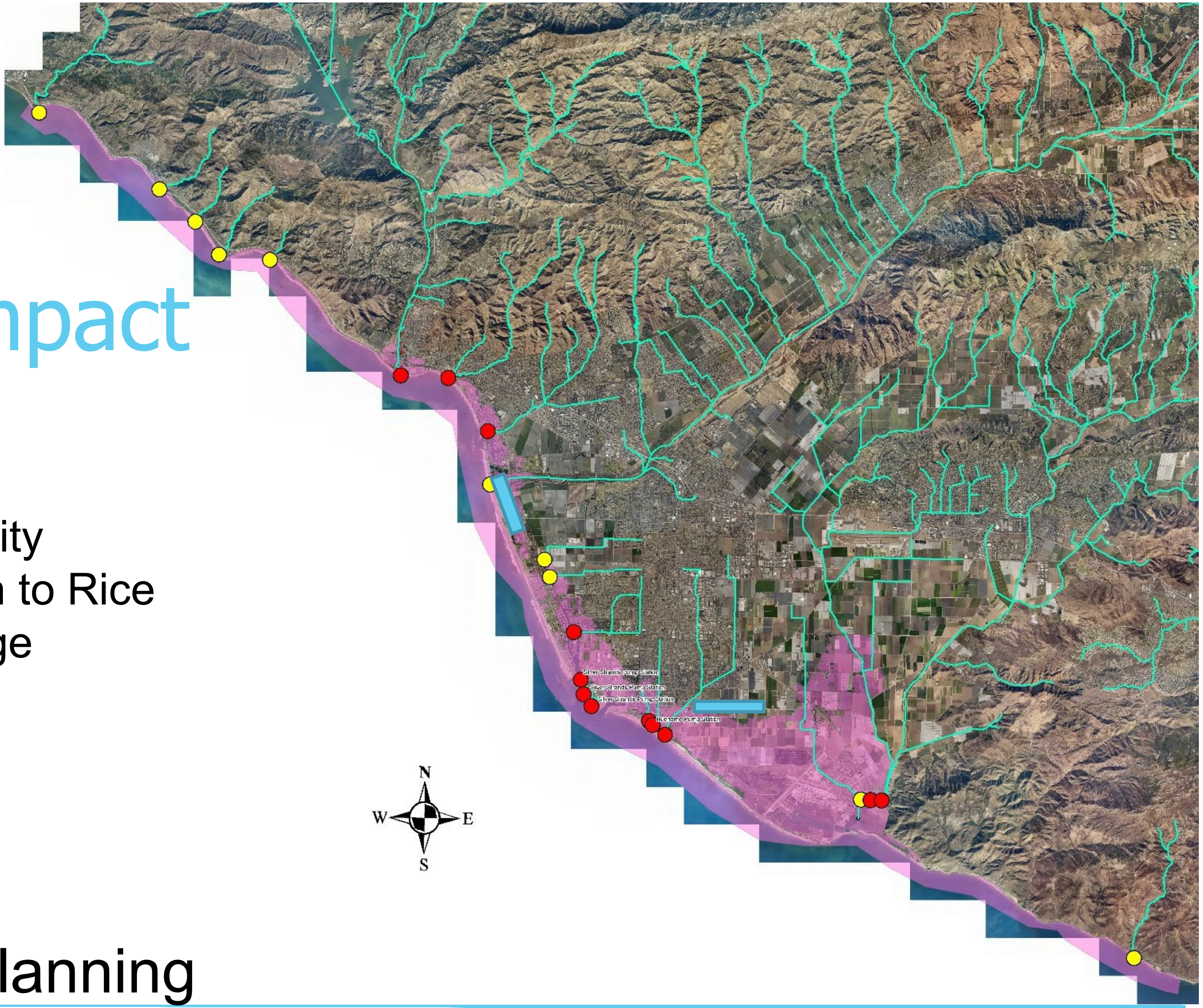
Minor Flood = 1.9' + MHHW
Moderate Flood = 2.8' + MHHW

Year 2020
Minor Flood ~1 every year
Moderate Flood ~1 every 25 years

Year 2050
Minor Flood ~10 every year
Moderate Flood ~1 every year

US Region	EWL Grid No.	NOAA ID	Location	Latitude	Longitude	Tide Range (m)	Flood Index u (m, MHHW)	u Trend (mm/yr)	Epoch of u	Minor Flood (m, MHHW)	Moderate Flood (m)	Major Flood (m)
SW	43500	9410170	San Diego, CA	32.71	−117.17	1.745	0.490	2.2	1983–2001	0.570	0.852	1.240
	43500	9410230	La Jolla, CA	32.87	−117.26	1.624	0.468	2.1	1983–2001	0.565	0.849	1.235
	43858	9410660	Los Angeles, CA	33.72	−118.27	1.674	0.472	1.0	1983–2001	0.567	0.850	1.237
	44217	9410840	Santa Monica, CA	34.01	−118.50	1.654	0.489	1.8	1983–2001	0.566	0.850	1.236
	44216	9411340	Santa Barbara, CA	34.41	−119.69	1.645	0.485	0.6	1983–2001	0.566	0.849	1.236
	44574	9412110	Port San Luis, CA	35.18	−120.76	1.623	0.449	1.0	1983–2001	0.565	0.849	1.235
	44932	9413450	Monterey, CA	36.61	−121.89	1.627	0.431	1.6	1983–2001	0.565	0.849	1.235

Watershed / Roads and Transportation Subject to Coastal Impact



- = VCPWA-WP Jurisdiction Only
- = VCPWA-WP Jurisdiction and Facility
- = VCPWA-RT Hueneme Rd: Edison to Rice
- = VCPWA-RT Harbor Blvd and Bridge

Next Step: Infrastructure Planning

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Infrastructure Planning

1. Identify Facility
2. Collect Data
3. Understand Level of Service
4. Establish failure consequence
5. Determine critical sea level elevation(s)
6. Use “best available” climate science to estimate timing and action thresholds
7. Develop adaptation strategies that can be deployed if action thresholds are reached
8. Estimate adaptation costs
9. Summarize findings

PWA Approach to Infrastructure Project Design

- Present to year 2050

  <u>Existing Infrastructure</u>

  - Analyze model and data specifically for NOAA's 2022 'Intermediate' prediction on existing level of service of coastal infrastructure (capital plans/cost projections)
  - Where impacts are expected decades into the future, infrastructure modification plans will be updated as a result of updated models and data

  <u>New/Replacement/Upgraded Infrastructure</u>

  - Designs will be based on NOAA's 2022 'Intermediate' models, with adaptive management contingency plans for 'high' model predictions

- Years 2050-2100

  Routinely analyze model and data refinements to determine climate change and sea level impacts and build resilient infrastructure

Recommendation

- Approve the Public Works Agency's infrastructure planning design approach as it relates to climate change and sea level rise

- Provide additional or alternative guidance

Questions

Impacts of Climate Change on Ventura County Watershed Hydrology

- WP Rain Gauge Records
  - Many rainfall gauge stations show declining trend – more drought years
  - This is particularly true in the past 15 years since the wetter than normal 2005 winter storm season
  - Initial statistics of stream gauge data (with the last 15-year data records included) points to a <u>possible</u> decrease in design discharges