Appendix B: Letter from Coastal Commission

STATE OF CALIFORNIA—NATURAL RESOURCES AGENCY EDMUND G. BROWN JR., GOVERNOR

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June 12, 2018

Tina Wehrmeister
Planning Director
City of Pacifica
1800 Francisco Blvd.
Pacifica, CA 94044

Subject: City of Pacifica Draft Adaptation Plan

Dear Ms. Wehrmeister:

Commission staff would like to express appreciation for the ongoing coordination and collaboration between our respective staffs as we move forward with the development of a Local Coastal Program Update (LCP update) to address potential future impacts related to sea level rise within the City of Pacifica. As a part of this process, Commission staff has participated as active members of the Technical Working Group, participated in the public workshops, and reviewed and commented on the Vulnerability Assessment and the Draft Adaptation Plan. Most recently, our coordinated efforts have focused on the Draft Adaptation Plan that will provide actionable information related to potential adaptation options for the City and eventually dictate the approach the LCP update will take to planning for sea level rise.

Commission staff previously provided comments on the draft of the City's Adaptation Plan (the Plan) via telephone conference on May 22, 2018, expressing concern that managed retreat and landward redevelopment was not more thoroughly explored as an option for long-term adaptive planning for areas that contain private development (along with some public infrastructure) in Pacifica's Coastal Zone. Commission staff strongly recommends that such an exploration of managed retreat be included in the Plan, as it is an important strategy to consider to assure that the Plan is an effective tool for use in developing an LCP Update that proactively protects coastal access, recreation, habitats, development, and other resources. Critically, analyzing a broad set of adaptation options also reflects the recommendations of both the Commission's adopted Sea Level Rise Policy Guidance document and the draft Residential Adaptation Policy Guidance document, as well as a variety of statewide guidance including the State of California's Climate Adaptation Strategy/Safeguarding California (2009, 2014, and 2018) and the Ocean Protection Council's State of California Sea-Level Rise Guidance (2018). Moreover, it is included in the City's own work program under which this adaptation report is being completed, as funded through grant by the CCC. Specifically, the grant agreement states that "the city will evaluate new accommodation, protection, and retreat strategies for each subarea listed above and compare how these address vulnerability and risk."

The overarching goal of long-term adaptation planning, as compared to the LCP policies and permitting decisions that are implemented in the short-term, is to discuss the range of planning options available to the City to address known vulnerabilities. This process is relevant for both immediate and future threats, and to identify the priority short-term strategies to implement while continuing to analyze and develop long-term options. Since decisions made today will have impacts on future resilience (for example, development that is constructed today is likely to be present in 75-100 years), it is critical to consider long-term options. Retreat is an important option to consider in the long-term, particularly for a city like Pacifica, which has dealt with significant threats to blufftop development that has necessitated the removal of this development, and where it is unclear that other options will be able to ensure long-term protection of beaches and coastal habitats, as required by the California Coastal Act. While managed retreat may not be a feasible or preferred strategy over the short- or medium-term, the scale of long-term vulnerabilities identified in the City's vulnerability assessment suggests that it is an important strategy to start to evaluate so that the City and its citizens and visitors can begin to understand the types of strategies that may be necessary to protect coastal resources, the trade-offs associated with different strategies, and the options for implementing various strategies throughout the City and over various planning horizons. Importantly, the Coastal Commission is not suggesting that managed retreat is a strategy that must be implemented in the short-term (or even in the long-term necessarily), but rather that it be evaluated so as to understand the conditions under which it might be necessary or preferred.

Furthermore, avoiding any contemplation of retreat as an adaptation strategy could open up legal challenges to the City's work related to full disclosure of potential coastal flooding and erosion hazards. By not identifying that future retreat may be necessary to respond to higher amounts of sea level rise and/or threats from increased erosion and/or flooding, the City may be opening itself up to legal risks. Given the uncertainty regarding future sea level rise and the possibility for increased erosion and flooding hazards the City should begin to put property owners on notice now, that different adaptation options, up to and including retreat and relocation, may be necessary to limit flood risk or erosion threat. The inclusion of a discussion of managed retreat and relocation as an option for adaptive planning puts property owners on notice of the potential array of adaptive planning approaches that may be necessary in the future.

Again, we greatly appreciate the ability to be a part this important planning effort and look forward to continued coordination and discussion of this important topic.

Sincerely,

Jeannine Manna
North Central District Manager

cc: Patrick Foster (CCC District Planner)
Stephanie Rexing (CCC District Supervisor)
Kelsey Ducklow (CCC LCP Grant Program Coordinator)
Bonny O'Connor (Pacifica Planner)

Appendix C: Sub-area Sea Level Rise Adaptation Overview Sheets

Appendix C: Sub-area Sea-Level Rise Adaptation Overview Sheets – EXAMPLE SHEET WITH DESCRIPTIONS

FIGURE

Sub-area Plan View Figure

TABLE

Descriptions of Sub-area Adaptation Alternatives analyzed for the Adaptation Plan

FIGURE

Sub-area beach width results from shore evolution modeling of each Adaptation Alternative

Based on revised hazard exposures that include revised coastal erosion projections

FIGURE

Economic cost-benefit results of each Sub-area Adaptation Alternative analyzed for the Adaptation Plan

TABLE

Sub-area asset vulnerabilities to coastal erosion, flooding and tidal inundation for 2100 from Vulnerability Assessment

Based on OCOF flooding and inundation hazard zones and Pacific Institute erosion hazard zones

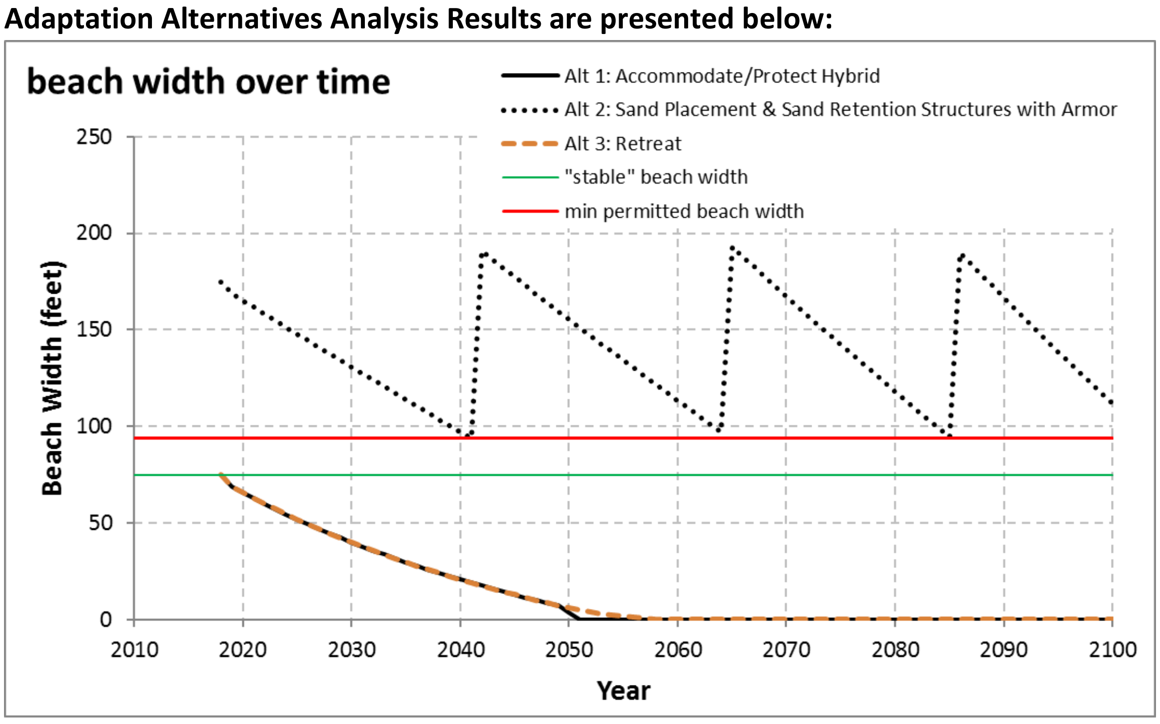
SUMMARY

Priority Recommendations for adaptation actions in each Sub-area based on City and public preferences and results of Adaptation Alternatives cost-benefit analysis

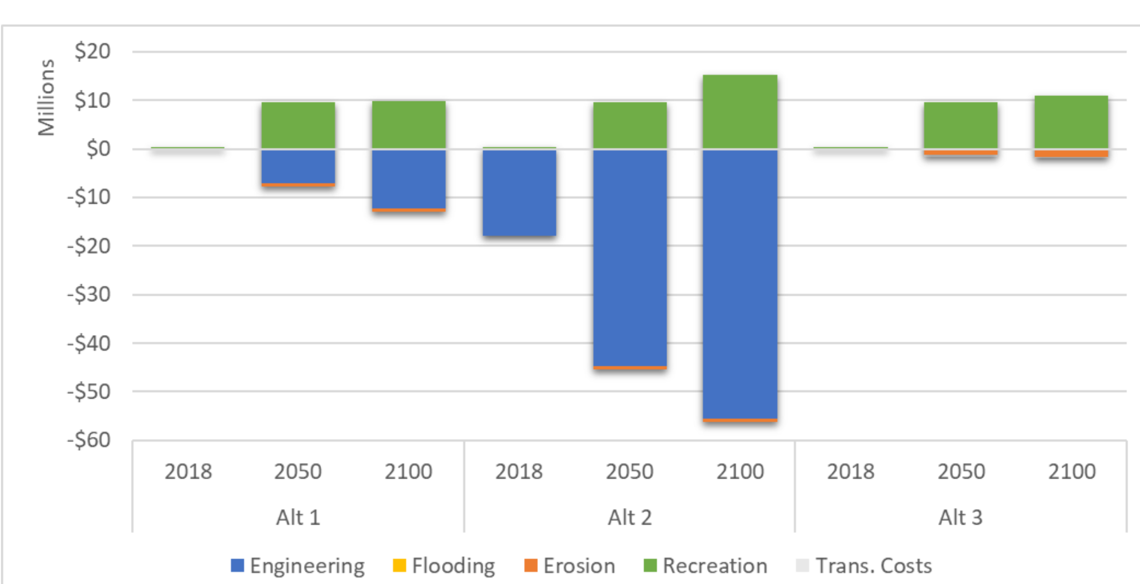
Appendix C: Fairmont West Sub-area Sea-Level Rise Adaptation Overview Sheet

Adaptation Alternative	Adaptation Measures	Description
1 Accommodate / Protect Hybrid	Transfer of development rights, Armor	**Now:** Allow erosion to proceed, option to transfer development rights. Maintain Dollaradio and armoring. **Future**: Assumes existing armor is maintained at Dollaradio. Backshore is allowed to erode until need to armor to protect road and utilities.
2 Protect	Armor, Beach nourishment, Sand retention structures, Transfer of development rights	**Now:** Place 100ft wide beach nourishment. Maintain Dollaradio and armoring. **Future:** Place sand: 100ft beach nourishment every time beach width falls below minimum threshold, increasing frequency as SLR accelerates. Build sand retention structures, timing to be determined with shore response modeling (part of overall artificial headlands strategy for north Pacifica).
3 Retreat	Managed retreat of infrastructure, transfer of development rights	**Now:** Allow bluff erosion to proceed, maintaining beach area. Assume Dollaradio armoring is maintained. Implement TDR (optional) and hazard avoidance measures in undeveloped parcels. **Future:** relocate road with consideration to maintain access to private property, relocate wastewater main away from erosion hazard. Timing TBD via shore response modeling. Maintain revetment for Dollaradio.

Adaptation Alternatives Analysis Results are presented below:



Beach width modeling results, which inform adaptation strategy implementation and provide outputs for recreational and ecological benefits.



Economic Costs and Benefits for each adaptation strategy
Costs include: Engineering costs of adaptation, cost of damaged infrastructure/property to erosion or flooding, cost of asset removal (where applicable) and property transaction costs (shown as a range of 0-50% of property values affected).
Benefits shown consist of Recreational value. Additional benefits for Alternatives 1 and 2 can be considered to equal avoided cost of damages under Alternative 3.

Sub-area Asset Exposure Table Fairmont West				Existing Conditions (% of Sub-area)	2100 Exposure Count (Percent of sub-area total) *Exposure Range for inundation and flooding is for Low to Medium-High SLR*		
Category	**Asset**	**Units**	**Total in Sub-area (% of Pacifica)**	**Storm Flooding**	**Coastal Erosion**	**Regular Tidal Inundation**	**Storm Flooding**
Coastal Structures	Armor Structures	feet	264.56 (1.6%)	188.238 (71.2%)	264.56 (100%)	-	188.24-188.24 (71.2% - 71.2%)
Coastal Structures	Levee	feet	0 (0.0%)	-	-	-	-
Communication	Comcast Underground Conduit	feet	0 (0.0%)	-	-	-	-
Communication	Towers Private	count	0 (0.0%)	-	-	-	-
Community	Affordable Rentals	count	0 (0.0%)	-	-	-	-
Community	Communities At Risk	count	0 (0.0%)	-	-	-	-
Community	Healthcare Facility	count	0 (0.0%)	-	-	-	-
Community	Landmarks	count	1 (100%)	-	1 (100%)	-	-
Community	Mobile Home Parks	count	0 (0.0%)	-	-	-	-
Community	Schools	acres	0 (0.0%)	-	-	-	-
Community	Senior Centers	count	0 (0.0%)	-	-	-	-
Ecosystem	Beaches	acres	5.496 (9.4%)	5.397 (98.2%)	5.317 (96.7%)	2.50-3.79 (45.5% - 68.9%)	5.49-5.48 (99.8% - 99.8%)
Ecosystem	CA Red Leg Frog Habitat	acres	0 (0.0%)	-	-	-	-
Ecosystem	Steelhead Habitat	feet	0 (0.0%)	-	-	-	-
Ecosystem	Streams	feet	0 (0.0%)	-	-	-	-
Ecosystem	Surfgrass	feet	0 (0.0%)	-	-	-	-
Ecosystem	Wetlands	acres	1.323 (0.6%)	0.039 (3.0%)	1.182 (89.4%)	-	0.10-0.10 (7.6% - 7.3%)
Emergency Response	Fire	acres	0 (0.0%)	-	-	-	-
Emergency Response	Police	acres	0 (0.0%)	-	-	-	-
Hazardous Waste	Cleanup Sites	count	0 (0.0%)	-	-	-	-
Hazardous Waste	Solid Waste Facility	count	0 (0.0%)	-	-	-	-
Hazardous Waste	Underground Storage Tanks	count	0 (0.0%)	-	-	-	-
Land Use	Auto Services	acres	0 (0.0%)	-	-	-	-
Land Use	Beach	acres	0 (0.0%)	-	-	-	-
Land Use	Commercial	acres	0 (0.0%)	-	-	-	-
Land Use	Hotels	acres	0 (0.0%)	-	-	-	-
Land Use	Industrial	acres	0 (0.0%)	-	-	-	-
Land Use	Mixed Use	acres	0 (0.0%)	-	-	-	-
Land Use	Mobile Homes	acres	0 (0.0%)	-	-	-	-
Land Use	Multi-Family	acres	9.034 (4.9%)	-	-	-	-
Land Use	Office	acres	0 (0.0%)	-	-	-	-
Land Use	Other Open Space	acres	15.963 (2.2%)	5.736 (35.9%)	-	3.98-4.85 (24.9% - 30.4%)	5.85-5.84 (36.7% - 36.6%)
Land Use	Other Public or Community Uses	acres	0 (0.0%)	-	-	-	-
Land Use	Parks & Accessible Open Space	acres	4.892 (0.2%)	-	-	-	-
Land Use	ROW	acres	0 (0.0%)	-	-	-	-
Land Use	Schools	acres	0 (0.0%)	-	-	-	-
Land Use	Single Family Residential	acres	27.82 (1.6%)	0.107 (0.4%)	3.955 (14.2%)	-	0.09-0.13 (0.3% - 0.5%)
Land Use	Vacant/Undeveloped	acres	24.934 (2.3%)	4.345 (17.4%)	21.751 (87.2%)	1.49-2.13 (6.0% - 8.5%)	4.44-4.64 (17.8% - 18.6%)
Lands	Pacifica City Limits	acres	113.895 (1.4%)	10.7 (9.4%)	50.568 (44.4%)	5.93-7.47 (5.2% - 6.6%)	10.90-11.13 (9.6% - 9.8%)
Lands	Parcels	count	457 (3.5%)	9 (2.0%)	157 (34.4%)	6.00-6.00 (1.3% - 1.3%)	11.00-11.00 (2.4% - 2.4%)
Lands	Parks Conservation	acres	24.878 (0.7%)	8.652 (34.8%)	17.809 (71.6%)	5.24-6.50 (21.1% - 26.1%)	8.84-8.88 (35.5% - 35.7%)
Recreation	Access Lateral	feet	0 (0.0%)	-	-	-	-
Recreation	Access Vertical	feet	0 (0.0%)	-	-	-	-
Recreation	Fishing Pier	count	0 (0.0%)	-	-	-	-
Recreation	Parks	acres	5.863 (0.2%)	-	-	-	-
Recreation	Trails	feet	109.477 (0.1%)	-	109.477 (100%)	-	-
Stormwater	Pipes	feet	9480.924 (3.2%)	-	2121.483 (22.4%)	-	-
Stormwater	Pump Stations	count	0 (0.0%)	-	-	-	-
Stormwater	Stormwater Outfalls	count	2 (1.8%)	-	2 (100%)	-	-
Transportation	Bridge Local	count	0 (0.0%)	-	-	-	-
Transportation	Bridge State	count	0 (0.0%)	-	-	-	-
Transportation	Highway	feet	6010.539 (0.0%)	-	89.653 (1.5%)	-	-
Transportation	Streets City	feet	10525.866 (1.9%)	-	3018.684 (28.7%)	-	-
Wastewater	Pipeline	feet	8460.077 (1.5%)	-	1689.686 (20.0%)	-	-
Wastewater	Pump Stations	count	0 (0.0%)	-	-	-	-
Water	NCCWD Pipelines	feet	11292.19 (1.6%)	-	1902.183 (16.8%)	-	-

Summary of recommended near-term adaptation priorities:

Armoring

2030-2040 – private armoring structures are maintained/upgraded by property owners

2040-2050 – construct armoring to protect public road and sewer line if the beach is not nourished and erosion continues.

Beach nourishment

2050-2060 (bluff toe within 260 feet of infrastructure) – place large (200-300 foot) beach nourishment to buffer against backshore erosion and provide recreation and ecology benefits. By constructing sand retention structures along north Pacifica, the efficacy of beach nourishments can be increased.

Transfer of Development Credits

2020+ initiate transfer of development credits at option of property owner, ongoing until all credits are exhausted.

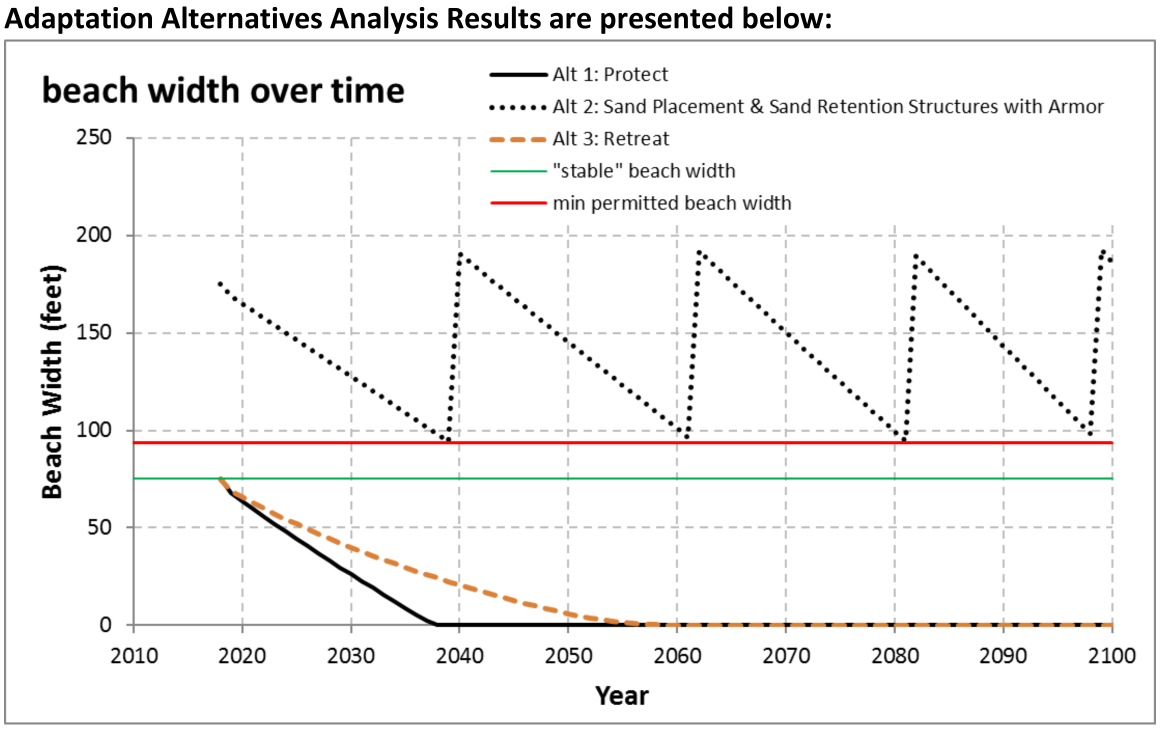
Managed Retreat/Realignment

2060-2070 – realign Palmetto Ave and sewer pipeline if coastal armoring or beach nourishment is not feasible. Palmetto serves as the primary access route for the Fairmont West neighborhood so a detailed transportation study will be required if managed realignment of Palmetto is considered.

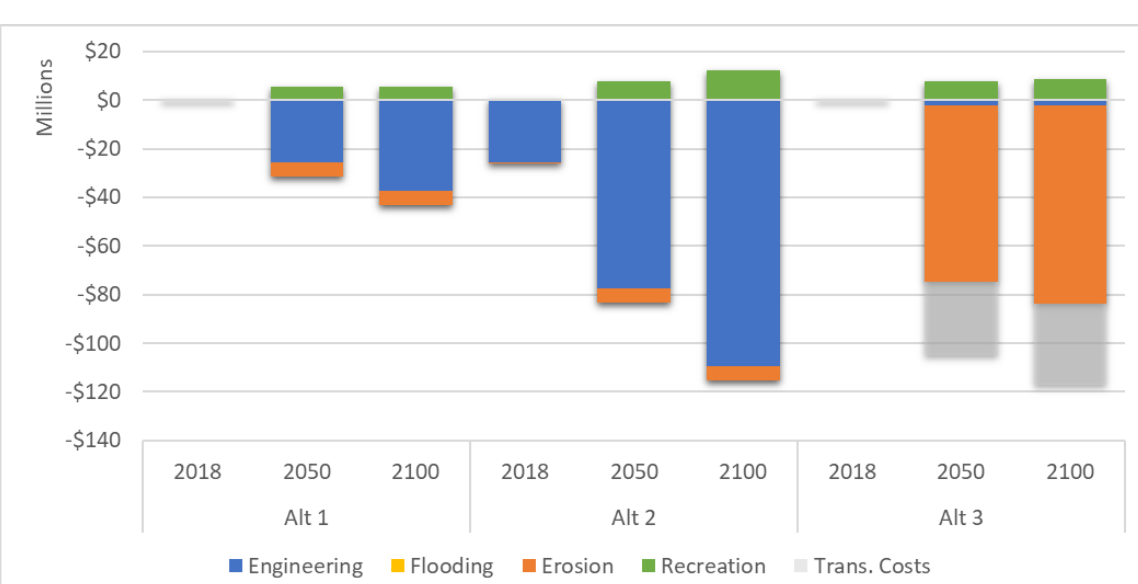
Appendix C: West Edgemar & Pacific Manor Sub-area Sea-Level Rise Adaptation Overview Sheet

Adaptation Alternative	Adaptation Measures	Description
1 Protect	Armor	**Now:** Armor bluffs between Manor Dr and Bill Drake Way and along SF RV Resort. **Future:** Maintain armor as needed to remain effective.
3 Protect	Armor, Beach nourishment, Sand retention structures	**Now:** Place 100ft wide beach nourishment. Maintain armoring and build armor between Manor Dr and Bill Drake Way and SF RV Resort. Build sand retention structures (part of overall artificial headlands strategy for north Pacifica). **Future:** Place sand: 100ft beach nourishment every time beach width falls below minimum threshold, increasing frequency as SLR accelerates.
3 Retreat	Managed removal/ relocation of assets	**Now:** Option to private property owners to remove or abandon existing armoring structures protecting property once it is damaged or no longer effective and to allow erosion. **Future:** Purchase property when buildings at risk, Remove or relocate public structures and infrastructure when at risk as erosion progresses.

Adaptation Alternatives Analysis Results are presented below:



Beach width modeling results, which inform adaptation strategy implementation and provide outputs for recreational and ecological benefits.



Economic Costs and Benefits for each adaptation strategy

Costs include: Engineering costs of adaptation, cost of damaged infrastructure/property to erosion or flooding, cost of asset removal (where applicable) and property transaction costs (shown as a range of 0-50% of property values affected).

Benefits shown consist of Recreational value. Additional benefits for Alternatives 1 and 2 can be considered to equal avoided cost of damages under Alternative 3.

Sub-area Asset Exposure Table West Edgemar, Pacific Manor				Existing Conditions (% of Sub-area)	2100 Exposure Count (Percent of sub-area total) *Exposure Range for inundation and flooding is for Low to Medium-High SLR*		
Category	**Asset**	**Units**	**Total in Sub-area (% of Pacifica)**	**Storm Flooding**	**Coastal Erosion**	**Regular Tidal Inundation**	**Storm Flooding**
Coastal Structures	Armor Structures	feet	3857.539 (23.8%)	2411.07 (62.5%)	3857.539 (100%)	54.57-507.51 (1.4% - 13.2%)	2197.83-2325.47 (57.0% - 60.3%)
Coastal Structures	Levee	feet	0 (0.0%)	-	-	-	-
Communication	Comcast Underground Conduit	feet	0 (0.0%)	-	-	-	-
Communication	Towers Private	count	0 (0.0%)	-	-	-	-
Community	Affordable Rentals	count	0 (0.0%)	-	-	-	-
Community	Communities At Risk	count	0 (0.0%)	-	-	-	-
Community	Healthcare Facility	count	1 (50.0%)	-	-	-	-
Community	Landmarks	count	0 (0.0%)	-	-	-	-
Community	Mobile Home Parks	count	0 (0.0%)	-	-	-	-
Community	Schools	acres	0 (0.0%)	-	-	-	-
Community	Senior Centers	count	0 (0.0%)	-	-	-	-
Ecosystem	Beaches	acres	5.384 (9.2%)	5.26 (97.7%)	5.384 (100%)	2.36-3.68 (43.8% - 68.3%)	5.37-5.38 (99.7% - 99.9%)
Ecosystem	CA Red Leg Frog Habitat	acres	0 (0.0%)	-	-	-	-
Ecosystem	Steelhead Habitat	feet	0 (0.0%)	-	-	-	-
Ecosystem	Streams	feet	0 (0.0%)	-	-	-	-
Ecosystem	Surfgrass	feet	0 (0.0%)	-	-	-	-
Ecosystem	Wetlands	acres	0.145 (0.1%)	0.02 (14.5%)	0.145 (100%)	-	0.02-0.02 (12.2% - 16.3%)
Emergency Response	Fire	acres	0 (0.0%)	-	-	-	-
Emergency Response	Police	acres	0 (0.0%)	-	-	-	-
Hazardous Waste	Cleanup Sites	count	1 (12.5%)	-	-	-	-
Hazardous Waste	Solid Waste Facility	count	0 (0.0%)	-	-	-	-
Hazardous Waste	Underground Storage Tanks	count	1 (20.0%)	-	-	-	-
Land Use	Auto Services	acres	0.887 (18.5%)	-	0.183 (20.6%)	-	-
Land Use	Beach	acres	7.163 (15.7%)	6.766 (94.5%)	-	5.50-6.10 (76.8% - 85.1%)	6.79-6.88 (94.8% - 96.0%)
Land Use	Commercial	acres	17.535 (19.7%)	3.056 (17.4%)	-	2.30-2.49 (13.1% - 14.2%)	2.93-2.91 (16.7% - 16.6%)
Land Use	Hotels	acres	0 (0.0%)	-	-	-	-
Land Use	Industrial	acres	0 (0.0%)	-	-	-	-
Land Use	Mixed Use	acres	0 (0.0%)	-	-	-	-
Land Use	Mobile Homes	acres	0 (0.0%)	-	-	-	-
Land Use	Multi-Family	acres	26.418 (14.3%)	2.851 (10.8%)	-	0.87-1.23 (3.3% - 4.7%)	2.84-2.99 (10.7% - 11.3%)
Land Use	Office	acres	0.221 (5.1%)	-	-	-	-
Land Use	Other Open Space	acres	0 (0.0%)	-	-	-	-
Land Use	Other Public or Community Uses	acres	0.998 (1.3%)	-	0.715 (71.6%)	-	-
Land Use	Parks & Accessible Open Space	acres	0 (0.0%)	-	-	-	-
Land Use	ROW	acres	0 (0.0%)	-	-	-	-
Land Use	Schools	acres	0 (0.0%)	-	-	-	-
Land Use	Single Family Residential	acres	6.289 (0.4%)	0.021 (0.3%)	2.48 (39.4%)	-	0.01-0.03 (0.2% - 0.5%)
Land Use	Vacant/Undeveloped	acres	5.176 (0.5%)	0.499 (9.6%)	5.02 (97.0%)	0.00-0.04 (0.0% - 0.7%)	0.57-0.69 (11.0% - 13.3%)
Lands	Pacifica City Limits	acres	94.131 (1.2%)	15.69 (16.7%)	61.146 (65.0%)	10.08-11.76 (10.7% - 12.5%)	15.63-15.99 (16.6% - 17.0%)
Lands	Parks Conservation	acres	10.571 (0.3%)	7.27 (68.8%)	10.153 (96.0%)	5.50-6.14 (52.0% - 58.0%)	7.31-7.52 (69.2% - 71.2%)
Lands	Parcels	count	140 (1.1%)	36 (25.7%)	96 (68.6%)	9.00-10.00 (6.4% - 7.1%)	35.00-37.00 (25.0% - 26.4%)
Recreation	Access Lateral	feet	998.07 (9.0%)	736.73 (73.8%)	998.07 (100%)	115.24-144.55 (11.5% - 14.5%)	655.24-710.25 (65.7% - 71.2%)
Recreation	Access Vertical	feet	418 (16.5%)	12.47 (3.0%)	418 (100%)	-	13.99-27.78 (3.3% - 6.6%)
Recreation	Fishing Pier	count	0 (0.0%)	-	-	-	-
Recreation	Parks	acres	0 (0.0%)	-	-	-	-
Recreation	Trails	feet	4834.075 (2.6%)	-	4834.075 (100%)	-	-
Stormwater	Pipes	feet	9354.452 (3.2%)	218.73 (2.3%)	2959.798 (31.6%)	161.49-181.97 (1.7% - 1.9%)	230.14-233.51 (2.5% - 2.5%)
Stormwater	Pump Stations	count	0 (0.0%)	-	-	-	-
Stormwater	Stormwater Outfalls	count	4 (3.7%)	3 (75.0%)	3 (75.0%)	2.00-2.00 (50.0% - 50.0%)	3.00-3.00 (75.0% - 75.0%)
Transportation	Bridge Local	count	0 (0.0%)	-	-	-	-
Transportation	Bridge State	count	2 (22.2%)	-	-	-	-
Transportation	Highway	feet	6953.771 (0.0%)	-	1250.61 (18.0%)	-	-
Transportation	Streets City	feet	11703.863 (2.1%)	-	5339.903 (45.6%)	-	-
Wastewater	Pipeline	feet	14226.711 (2.6%)	-	7265.406 (51.1%)	-	-
Wastewater	Pump Stations	count	0 (0.0%)	-	-	-	-
Water	NCCWD Pipelines	feet	13558.454 (1.9%)	-	7941.885 (58.6%)	-	-

Summary of recommended near-term adaptation priorities:

Armoring

2020-2030 (immediately) – maintain and expand armoring structures to protect public infrastructure. The City is currently proceeding with new armoring along bluffs between Bill Drake Way and Manor Dr. to protect Esplanade Ave. and public utilities.

2030-2040 (~1 ft SLR) – property owners may maintain and expand armor on private property

Beach nourishment

2020-2050 (immediately) – nourish beach to reduce armoring maintenance requirements and provide recreation and ecology benefits. By constructing sand retention structures along north Pacifica, the efficacy of beach nourishments can be increased.

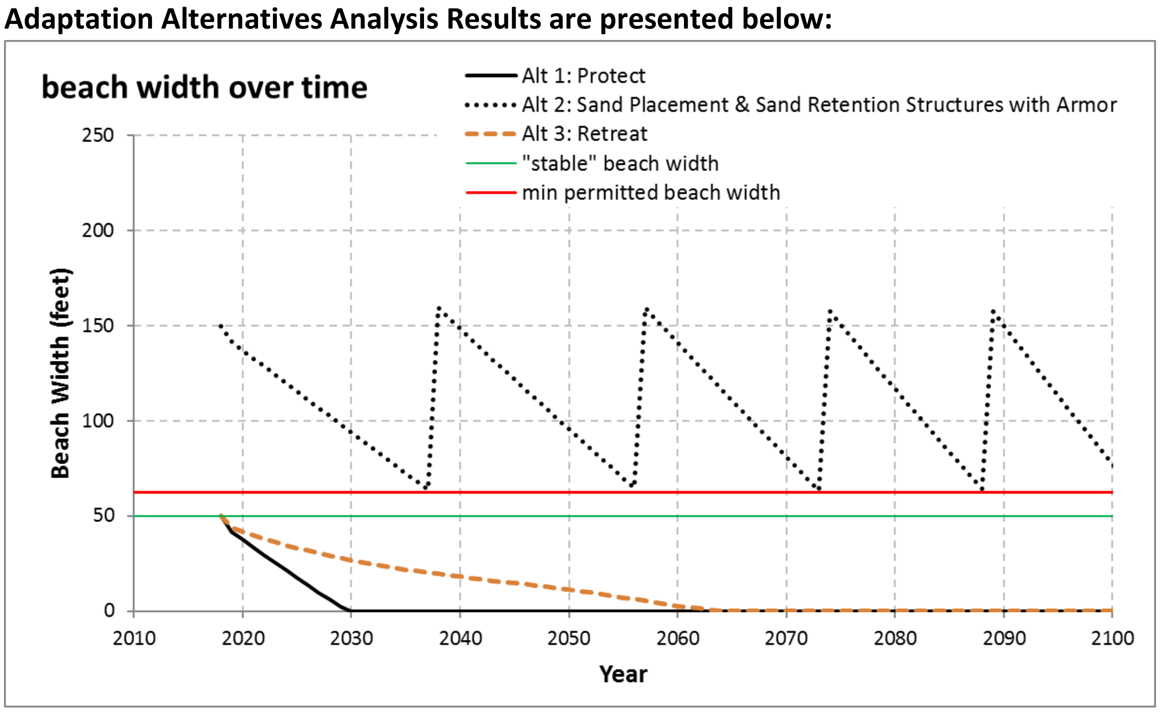
Managed Retreat/Realignment

Timing is dependent on presence and condition of coastal armoring structures, location of built assets relative to the bluff edge, and willingness of property owners to engage in managed retreat, and availability of public funding for relocation of public infrastructure.

Appendix C: Northwest Sharp Park Sub-area Sea-Level Rise Adaptation Overview Sheet

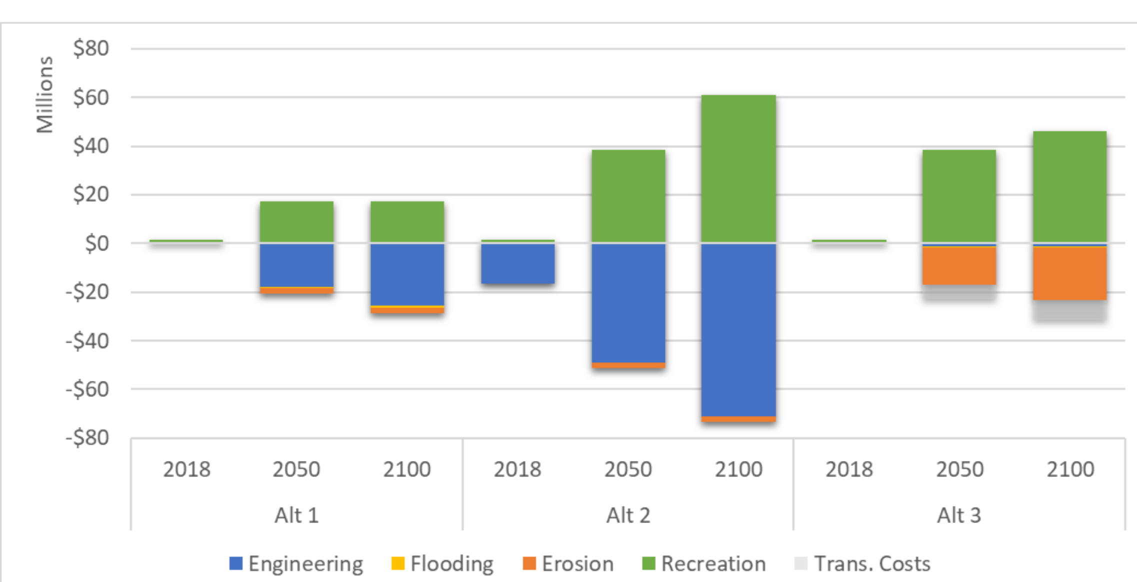
Adaptation Alternative	Adaptation Measures	Description
1 Protect	Armor	**Now:** Maintain existing armor, build new armoring elsewhere. **Future:** Maintain armor as needed to remain effective.
3 Protect	Armor, Beach nourishment, Sand retention structures	**Now:** Maintain existing armor, build new armor elsewhere. Nourish beach by 100 feet. Build sand retention structures (part of overall artificial headlands strategy for north Pacifica). **Future:** Maintain armoring and sand retention structures. Place sand: 100ft beach nourishment every time beach width falls below minimum threshold, increasing frequency as SLR accelerates.
3 Retreat	Managed removal/ relocation of assets	**Now:** Option to private property owners to remove or abandon existing armoring structures protecting property once it is damaged or no longer effective and to allow erosion. **Future:** Purchase property when buildings at risk, Remove or relocate public structures and infrastructure when at risk as erosion progresses.

Adaptation Alternatives Analysis Results are presented below:



Beach width modeling results, which inform adaptation strategy implementation and provide outputs for recreational and ecological benefits.

Sub-area Asset Exposure Table Northwest Sharp Park				Existing Conditions (% of Sub-area)	2100 Exposure Count (Percent of sub-area total) *Exposure Range for inundation and flooding is for Low to Medium-High SLR*		
Category	**Assets**	**Units**	**Total in Sub-area (% of Pacifica)**	**Storm Flooding**	**Coastal Erosion**	**Regular Tidal Inundation**	**Storm Flooding**
Coastal Structures	Armor Structures	feet	3601.654 (22.2%)	2238.838 (62.2%)	3601.654 (100%)	-	2067.92-2273.42 (57.4% - 63.1%)
Coastal Structures	Levee	feet	0 (0.0%)	-	-	-	-
Communication	Comcast Underground Conduit	feet	3007.378 (2.0%)	-	1895.112 (63.0%)	-	-
Communication	Towers Private	count	0 (0.0%)	-	-	-	-
Community	Affordable Rentals	count	0 (0.0%)	-	-	-	-
Community	Communities At Risk	count	0 (0.0%)	-	-	-	-
Community	Healthcare Facility	count	0 (0.0%)	-	-	-	-
Community	Landmarks	count	0 (0.0%)	-	-	-	-
Community	Mobile Home Parks	count	1 (100%)	-	1 (100%)	-	-
Community	Schools	acres	10.653 (4.5%)	-	-	-	-
Community	Senior Centers	count	0 (0.0%)	-	-	-	-
Ecosystem	Beaches	acres	3.318 (5.7%)	3.304 (99.6%)	3.317 (100%)	1.56-2.40 (47.1% - 72.2%)	3.32-3.32 (99.9% - 100%)
Ecosystem	CA Red Leg Frog Habitat	acres	0 (0.0%)	-	-	-	-
Ecosystem	Steelhead Habitat	feet	0 (0.0%)	-	-	-	-
Ecosystem	Streams	feet	0 (0.0%)	-	-	-	-
Ecosystem	Surfgrass	feet	y	-	-	-	-
Ecosystem	Wetlands	acres	0 (0.0%)	-	-	-	-
Emergency Response	Fire	acres	0 (0.0%)	-	-	-	-
Emergency Response	Police	acres	0 (0.0%)	-	-	-	-
Hazardous Waste	Cleanup Sites	count	0 (0.0%)	-	-	-	-
Hazardous Waste	Solid Waste Facility	count	0 (0.0%)	-	-	-	-
Hazardous Waste	Underground Storage Tanks	count	0 (0.0%)	-	-	-	-
Land Use	Auto Services	acres	0.114 (2.4%)	-	0.106 (93.2%)	-	-
Land Use	Beach	acres	1.887 (4.1%)	1.789 (94.8%)	-	1.29-1.55 (68.3% - 82.3%)	1.84-1.87 (97.4% - 99.0%)
Land Use	Commercial	acres	2.672 (3.0%)	0.326 (12.2%)	-	0.09-0.16 (3.3% - 6.1%)	0.27-0.29 (10.2% - 10.9%)
Land Use	Hotels	acres	0 (0.0%)	-	-	-	-
Land Use	Industrial	acres	11.9 (64.9%)	1.269 (10.7%)	-	0.30-0.59 (2.5% - 5.0%)	1.19-1.27 (10.0% - 10.6%)
Land Use	Mixed Use	acres	0.3 (8.5%)	-	-	-	-
Land Use	Mobile Homes	acres	8.842 (100%)	1.699 (19.2%)	-	1.00-1.28 (11.3% - 14.5%)	1.71-1.81 (19.3% - 20.4%)
Land Use	Multi-Family	acres	0 (0.0%)	-	-	-	-
Land Use	Office	acres	0.132 (3.0%)	-	-	-	-
Land Use	Other Open Space	acres	0 (0.0%)	-	-	-	-
Land Use	Other Public or Community Uses	acres	0 (0.0%)	-	-	-	-
Land Use	Parks & Accessible Open Space	acres	0 (0.0%)	-	-	-	-
Land Use	ROW	acres	0 (0.0%)	-	-	-	-
Land Use	Schools	acres	10.653 (4.5%)	-	-	-	-
Land Use	Single Family Residential	acres	9.933 (0.6%)	0.746 (7.5%)	6.561 (66.1%)	0.03-0.14 (0.3% - 1.4%)	0.72-0.86 (7.3% - 8.6%)
Land Use	Vacant/Undeveloped	acres	1.259 (0.1%)	0.441 (35.0%)	1.259 (100%)	0.18-0.24 (13.9% - 19.3%)	0.38-0.41 (30.4% - 32.3%)
Lands	Pacifica City Limits	acres	63.824 (0.8%)	7.507 (11.8%)	29.2 (45.8%)	4.10-5.21 (6.4% - 8.2%)	7.36-7.73 (11.5% - 12.1%)
Lands	Parcels	count	155 (1.2%)	81 (52.3%)	125 (80.6%)	70.00-72.00 (45.2% - 46.5%)	82.00-82.00 (52.9% - 52.9%)
Lands	Parks Conservation	acres	0 (0.0%)	-	-	-	-
Recreation	Access Lateral	feet	737.758 (6.6%)	737.758 (100%)	737.758 (100%)	-	737.76-737.76 (100% - 100%)
Recreation	Access Vertical	feet	148.553 (5.9%)	26.725 (18.0%)	148.553 (100%)	-	-
Recreation	Fishing Pier	count	0 (0.0%)	-	-	-	-
Recreation	Parks	acres	0 (0.0%)	-	-	-	-
Recreation	Trails	feet	2965.264 (1.6%)	-	1318.32 (44.5%)	-	-
Stormwater	Pipes	feet	6931.722 (2.4%)	168.348 (2.4%)	1262.228 (18.2%)	2.67-22.36 (0.0% - 0.3%)	161.55-188.22 (2.3% - 2.7%)
Stormwater	Pump Stations	count	0 (0.0%)	-	-	-	-
Stormwater	Stormwater Outfalls	count	2 (1.8%)	1 (50.0%)	2 (100%)	-	1.00-1.00 (50.0% - 50.0%)
Transportation	Bridge Local	count	0 (0.0%)	-	-	-	-
Transportation	Bridge State	count	0 (0.0%)	-	-	-	-
Transportation	Highway	feet	4072.648 (0.0%)	-	125.933 (3.1%)	-	-
Transportation	Streets City	feet	9857.95 (1.8%)	-	5329.645 (54.1%)	-	-
Wastewater	Pipeline	feet	8265.525 (1.5%)	-	3327.011 (40.3%)	-	-
Wastewater	Pump Stations	count	0 (0.0%)	-	-	-	-
Water	NCCWD Pipelines	feet	8894.445 (1.3%)	-	3789.539 (42.6%)	-	-



Economic Costs and Benefits for each adaptation strategy

Costs include: Engineering costs of adaptation, cost of damaged infrastructure/property to erosion or flooding, cost of asset removal (where applicable) and property transaction costs (shown as a range of 0-50% of property values affected).

Benefits shown consist of Recreational value. Additional benefits for Alternatives 1 and 2 can be considered to equal avoided cost of damages under Alternative 3.

Summary of recommended near-term adaptation priorities:

Armoring

2020-2030 (immediately) – maintain and expand armoring structures to protect public infrastructure. The City is currently planning new armoring along bluffs between Bill Drake and Manor Dr to protect Esplanade Ave and public utilities.

2030-2040 (~1 ft SLR) – property owners may maintain and expand armor on private property, armor upgrades to limit wave overtopping will also be needed without beach nourishment.

Beach nourishment

2020-2050 (immediately) – nourish beach to reduce armoring maintenance requirements and provide recreation and ecology benefits. By constructing sand retention structures along north Pacifica, the efficacy of beach nourishments can be increased.

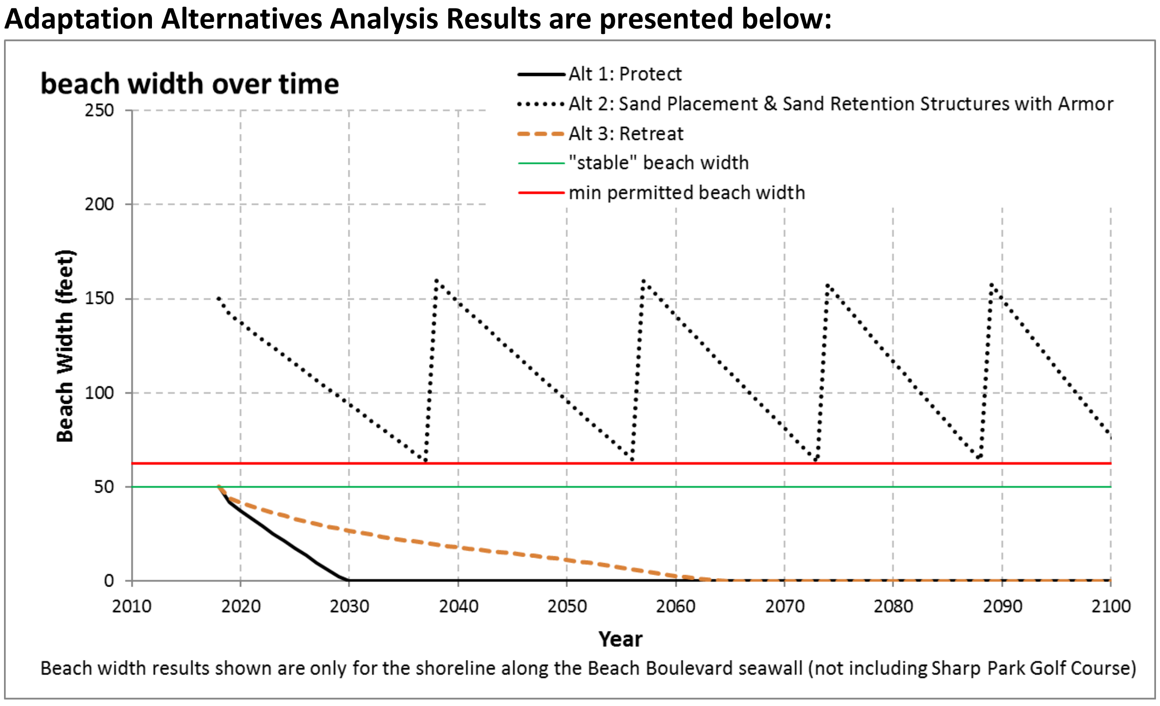
Managed Retreat/Realignment

2030-2050 (1-2 ft SLR) Timing is dependent on location of built assets relative to the bluff edge. Private structures are at the threshold for significant damage from wave run-up and overtopping of the armored bluff face.

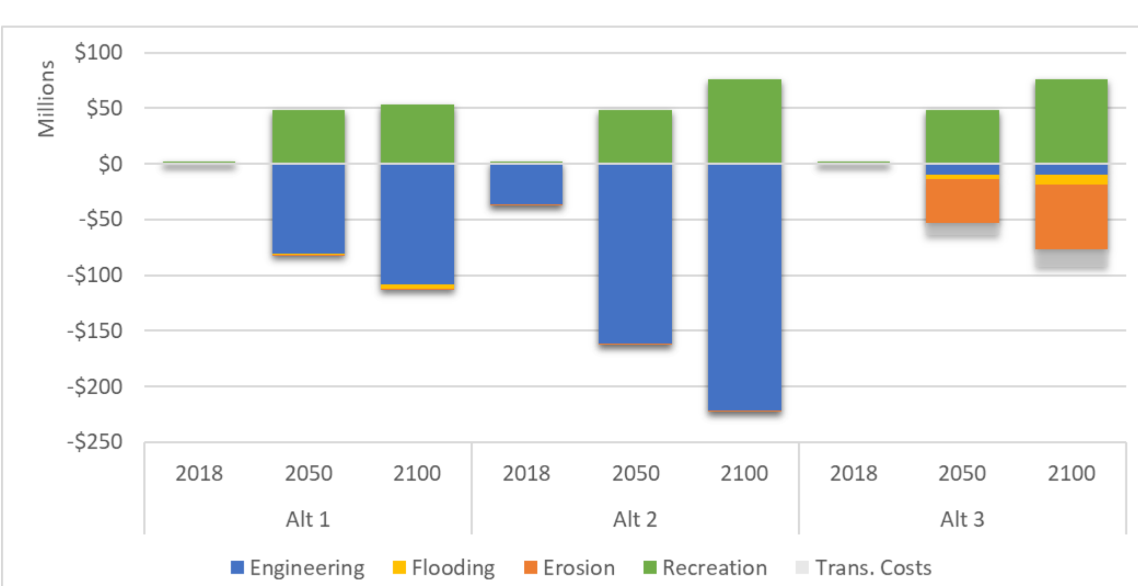
Appendix C: Sharp Park, West Fairway Park and Mori Point Sub-area Sea-Level Rise Adaptation Overview Sheet

Adaptation Alternative	Adaptation Measures	Description
1 Protect	Armor, levees	**Now:** Maintain existing armor, extend seawall to close Clarendon gap to SPGC levee. Assumes SF will armor and maintain SPGC levee. Build stormwater detention basins with setback levees and stormwater pump stations at Clarendon/Lakeside Ave and end of Fairway Drive. **Future:** Maintain armoring structures.
2 Protect	Armor, Beach nourishment, Sand retention structures, Levees	**Now:** Maintain existing armor, extend seawall to close Clarendon gap to SPGC levee. Nourish beach by 100 feet. Build stormwater detention basins with setback levees and stormwater pump stations at Clarendon/Lakeside Ave and end of Fairway Drive to prevent flooding from Laguna Salada during rain events. Build sand retention structures (part of overall artificial headlands strategy for north Pacifica). **Future:** Maintain armoring and sand retention structures. Place sand: repeat 100-foot beach nourishment every time beach width falls below minimum threshold, increasing frequency as SLR accelerates.
3 Retreat	Managed removal/ relocation of assets	**Now:** Option to private property owners to remove or abandon existing armoring structures protecting property once it is damaged or no longer effective and to allow erosion. **Future:** Purchase property when buildings at risk, Remove or relocate public structures and infrastructure when at risk as erosion progresses.

Adaptation Alternatives Analysis Results are presented below:



Beach width modeling results, which inform adaptation strategy implementation and provide outputs for recreational and ecological benefits.



Economic Costs and Benefits for each adaptation strategy

Costs include: Engineering costs of adaptation, cost of damaged infrastructure/property to erosion or flooding, cost of asset removal (where applicable) and property transaction costs (shown as a range of 0-50% of property values affected).

Benefits shown consist of Recreational value. Additional benefits for Alternatives 1 and 2 can be considered to equal avoided cost of damages under Alternative 3.

Sub-area Asset Exposure Table Sharp Park, West Fairway Park, and Mori Point				Existing Conditions (% of Sub-area)	2100 Exposure Count (Percent of sub-area total) *Exposure Range for inundation and flooding is for Low to Medium-High SLR*		
Category	**Asset**	**Units**	**Total in Sub-area (% of Pacifica)**	**Storm Flooding**	**Coastal Erosion**	**Regular Tidal Inundation**	**Storm Flooding**
Coastal Structures	Armor Structures	feet	5745.243 (35.4%)	5303.68 (92.3%)	5705.658 (99.3%)	-	5459.00-5459.00 (95.0% - 95.0%)
Coastal Structures	Levee	feet	3149.267 (100%)	1707.391 (54.2%)	3149.267 (100%)	-	2028.50-2115.12 (64.4% - 67.2%)
Communication	Comcast Underground Conduit	feet	12976.887 (8.8%)	1848.454 (14.2%)	3920.002 (30.2%)	-	5545.68-5694.46 (42.7% - 43.9%)
Communication	Towers Private	count	5 (19.2%)	-	-	-	-
Community	Affordable Rentals	count	1 (20.0%)	-	-	-	-
Community	Communities At Risk	acres	0 (0.0%)	-	-	-	-
Community	Healthcare Facility	count	0 (0.0%)	-	-	-	-
Community	Landmarks	count	4 (44.4%)	-	-	-	-
Community	Mobile Home Parks	count	0 (0.0%)	-	-	-	-
Community	Schools	acres	0.093 (0.0%)	-	-	-	-
Community	Senior Centers	count	0 (0.0%)	-	-	-	-
Ecosystem	Beaches	acres	20.531 (35.2%)	20.353 (99.1%)	20.378 (99.3%)	4.88-7.61 (23.8% - 37.1%)	20.51-20.51 (99.9% - 99.9%)
Ecosystem	CA Red Leg Frog Habitat	acres	0 (0.0%)	-	-	-	-
Ecosystem	Steelhead Habitat	feet	0 (0.0%)	-	-	-	-
Ecosystem	Streams	feet	1700.067 (1.5%)	-	-	-	-
Ecosystem	Surfgrass	feet	329.821 (2.0%)	329.821 (100%)	2.406 (0.7%)	329.82-329.82 (100% - 100%)	329.82-329.82 (100% - 100%)
Ecosystem	Wetlands	acres	31.712 (14.8%)	30.459 (96.0%)	14.349 (45.2%)	20.10-28.76 (63.4% - 90.7%)	30.68-30.70 (96.7% - 96.8%)
Emergency Response	Fire	acres	0 (0.0%)	-	-	-	-
Emergency Response	Police	acres	0 (0.0%)	-	-	-	-
Hazardous Waste	Cleanup Sites	count	1 (12.5%)	-	-	-	-
Hazardous Waste	Solid Waste Facility	count	0 (0.0%)	-	-	-	-
Hazardous Waste	Underground Storage Tanks	count	1 (20.0%)	-	-	-	-
Land Use	Auto Services	acres	0.586 (12.2%)	-	-	-	-
Land Use	Beach	acres	2.245 (4.9%)	2.236 (99.6%)	-	0.28-0.61 (12.6% - 27.1%)	2.24-2.24 (100% - 100%)
Land Use	Commercial	acres	2.204 (2.5%)	0.234 (10.6%)	-	-	0.30-0.35 (13.5% - 15.9%)
Land Use	Hotels	acres	0 (0.0%)	-	-	-	-
Land Use	Industrial	acres	0.296 (1.6%)	-	-	-	-
Land Use	Mixed Use	acres	1.672 (47.5%)	0.221 (13.2%)	-	-	0.76-0.76 (45.3% - 45.3%)
Land Use	Mobile Homes	acres	0 (0.0%)	-	-	-	-
Land Use	Multi-Family	acres	17.381 (9.4%)	3.457 (19.9%)	-	-	8.62-9.05 (49.6% - 52.1%)
Land Use	Office	acres	0.934 (21.5%)	-	-	-	-
Land Use	Other Open Space	acres	0.088 (0.0%)	0.088 (100%)	-	-	0.09-0.09 (100% - 100%)
Land Use	Other Public or Community Uses	acres	7.332 (9.6%)	0.011 (0.1%)	3.728 (50.8%)	-	4.20-4.31 (57.2% - 58.7%)
Land Use	Parks & Accessible Open Space	acres	266.781 (9.6%)	114.524 (42.9%)	92.665 (34.7%)	43.15-71.84 (16.2% - 26.9%)	120.73-128.38 (45.3% - 48.1%)
Land Use	ROW	acres	0.64 (7.7%)	0.007 (1.1%)	0.64 (100%)	-	0.64-0.64 (100% - 100%)
Land Use	Schools	acres	0 (0.0%)	-	-	-	-
Land Use	Single Family Residential	acres	43.819 (2.5%)	1.174 (2.7%)	5.211 (11.9%)	-	5.51-6.79 (12.6% - 15.5%)
Land Use	Vacant/Undeveloped	acres	3.24 (0.3%)	0.234 (7.2%)	1.44 (44.5%)	-	0.87-1.03 (26.9% - 31.9%)
Lands	Pacifica City Limits	acres	410.471 (5.1%)	129.269 (31.5%)	120.09 (29.3%)	42.74-72.72 (10.4% - 17.7%)	157.40-168.37 (38.3% - 41.0%)
Lands	Parks Conservation	acres	269.053 (7.4%)	116.787 (43.4%)	94.91 (35.3%)	43.43-72.45 (16.1% - 26.9%)	123.00-130.65 (45.7% - 48.6%)
Lands	Parcels	count	683 (5.2%)	111 (16.3%)	207 (30.3%)	9.00-15.00 (1.3% - 2.2%)	241.00-263.00 (35.3% - 38.5%)
Recreation	Access Lateral	feet	4967.416 (44.6%)	4799.061 (96.6%)	4967.416 (100%)	-	4965.54-4967.42 (100% - 100%)
Recreation	Access Vertical	feet	739.208 (29.2%)	393.876 (53.3%)	739.208 (100%)	-	617.47-617.53 (83.5% - 83.5%)
Recreation	Fishing Pier	count	12 (1200.0%)	1 (8.3%)	1 (8.3%)	-	1.00-1.00 (8.3% - 8.3%)
Recreation	Parks	acres	131.383 (4.5%)	83.299 (63.4%)	48.591 (37.0%)	26.18-52.28 (19.9% - 39.8%)	86.11-93.54 (65.5% - 71.2%)
Recreation	Trails	feet	25646.832 (13.8%)	3041.175 (11.9%)	10838.471 (42.3%)	-	4493.83-5049.88 (17.5% - 19.7%)
Stormwater	Pipes	feet	23201.914 (7.9%)	5461.811 (23.5%)	4652.522 (20.1%)	473.54-1851.89 (2.0% - 8.0%)	7576.66-8060.68 (32.7% - 34.7%)
Stormwater	Pump Stations	count	3 (33.3%)	1 (33.3%)	3 (100%)	-	3.00-3.00 (100% - 100%)
Stormwater	Stormwater Outfalls	count	12 (11.0%)	9 (75.0%)	8 (66.7%)	3.00-6.00 (25.0% - 50.0%)	10.00-10.00 (83.3% - 83.3%)
Transportation	Bridge Local	count	0 (0.0%)	-	-	-	-
Transportation	Bridge State	count	4 (44.4%)	-	-	-	-
Transportation	Highway	feet	9263.799 (0.0%)	-	-	-	59.19-69.87 (0.6% - 0.8%)
Transportation	Streets City	feet	36633.25 (6.5%)	5342.075 (14.6%)	7491.986 (20.5%)	31.69-439.18 (0.1% - 1.2%)	11250.25-12410.01 (30.7% - 33.9%)
Wastewater	Pipeline	feet	44760.047 (8.1%)	10253.233 (22.9%)	12827.066 (28.7%)	-	17534.30-19141.75 (39.2% - 42.8%)
Wastewater	Pump Stations	count	2 (33.3%)	1 (50.0%)	1 (50.0%)	-	2.00-2.00 (100% - 100%)
Water	NCCWD Pipelines	feet	35373.134 (5.1%)	4364.073 (12.3%)	8235.167 (23.3%)	-	10918.07-12148.84 (30.9% - 34.3%)

Summary of recommended near-term adaptation priorities:

Armoring

2020-2030 (immediately) – Maintain and expand armoring structures to protect public infrastructure.
2030-2040 (~1 ft SLR) – Armor upgrades to limit wave overtopping will be needed without beach nourishment.
2050 (~2 feet SLR) – Wave overtopping may become unmanageable with 2-3 feet of SLR and further actions such as elevating structures may be needed.

Beach nourishment

2020-2050 (immediately) – nourish beach to reduce armoring maintenance requirements and provide recreation and ecology benefits. an Francisco should nourish the beach in front of the SPGC berm as needed to maintain the current beach width. By constructing sand retention structures along north Pacifica, the efficacy of beach nourishments can be increased.

Flood Protection

2020-2030 – construct Clarendon Ave stormwater basin, pump station, and interior SPGC levee to protect homes and businesses from existing fluvial storm flood hazard zone.
2060-2070 – construct West Fairway Park stormwater basin, pump station, and interior SPGC levee to protect western homes from future coastal/fluvial flood hazard zone.

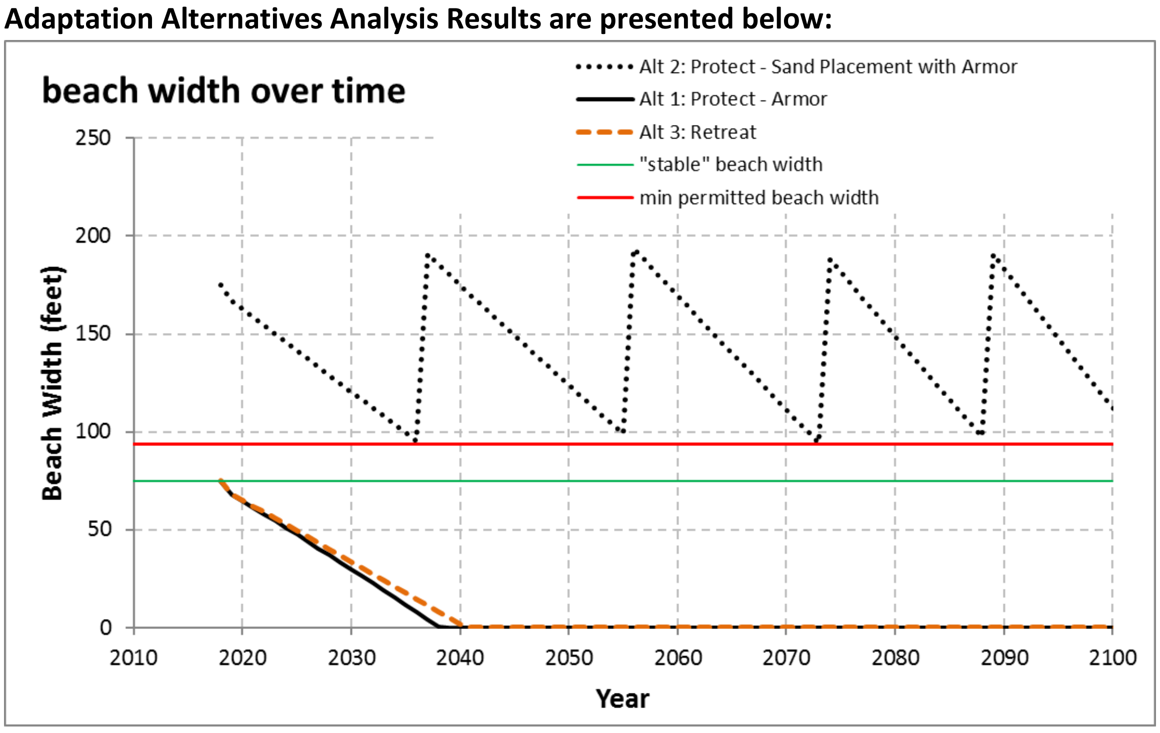
Managed Retreat/Realignment

Timing is dependent on presence and condition of coastal armoring structures, location of built assets relative to the bluff edge and or flood hazard zone, willingness of property owners to engage in managed retreat, and availability of public funding for relocation of public infrastructure.

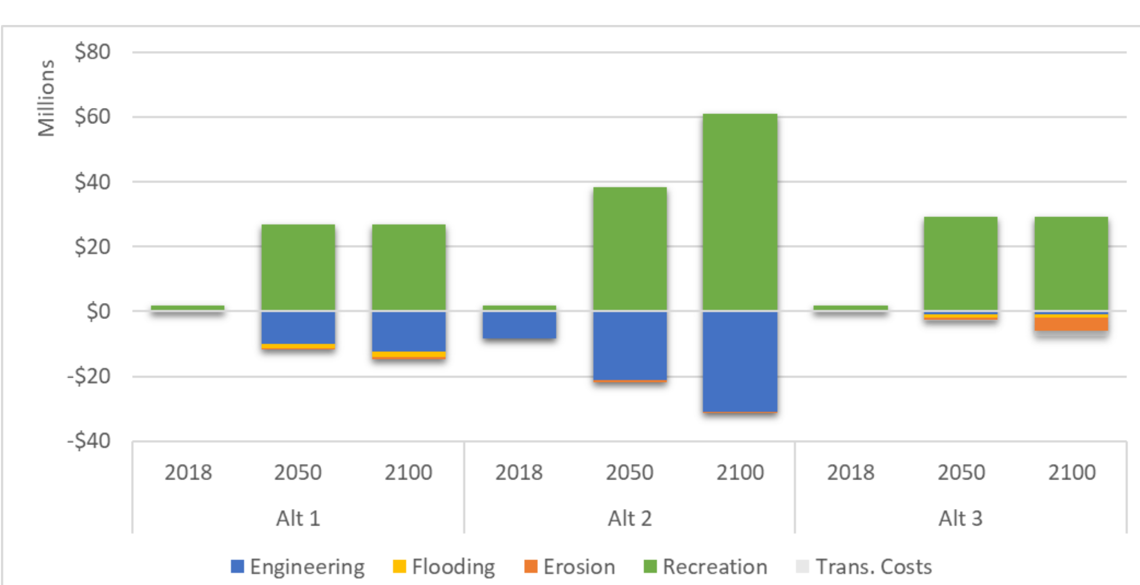
Appendix C: Rockaway Beach, Quarry and Headlands Sub-area Sea-Level Rise Adaptation Overview Sheet

Adaptation Alternative	Adaptation Measures	Description
1 Protect / Accommodate Hybrid	Armor, managed removal of assets, Development setbacks	**Now:** Maintain existing armoring structures, allow erosion in south cove (City owned). Development setbacks for quarry property. **Future:** Erosion continues in south cove until Hwy 1 threatened, assume Caltrans armors embankment or takes an alternative adaptation strategy. Relocate south cove public facilities as needed. Upgrade armoring as needed to maintain efficacy
2 Protect / Accommodate Hybrid	Armor, Beach nourishment, Development setbacks	**Now:** Place sand: 100ft beach initially and every time beach width falls below minimum threshold. Development setbacks for quarry property. **Future:** Nourish 100ft beach every time beach width falls below minimum threshold to delay need to armor Hwy 1 and reduce maintenance needs for existing armor, increasing nourishment frequency as SLR accelerates.
3 Retreat / Accommodate Hybrid	Managed removal/ relocation of assets, Development setbacks	**Now:** Option to private property owners to remove or abandon existing armoring structures protecting property once it is damaged or no longer effective and to allow erosion. **Future:** Purchase property when buildings at risk, Remove or relocate public structures and infrastructure when at risk as erosion progresses.

Adaptation Alternatives Analysis Results are presented below:



Beach width modeling results, which inform adaptation strategy implementation and provide outputs for recreational and ecological benefits.



Economic Costs and Benefits for each adaptation strategy
Costs include: Engineering costs of adaptation, cost of damaged infrastructure/property to erosion or flooding, cost of asset removal (where applicable) and property transaction costs (shown as a range of 0-50% of property values affected).
Benefits shown consist of Recreational value. Additional benefits for Alternatives 1 and 2 can be considered to equal avoided cost of damages under Alternative 3.

Sub-area Asset Exposure Table Rockaway Beach, Quarry, and Headlands				Existing Conditions (% of Sub-area)	2100 Exposure Count (Percent of sub-area total) *Exposure Range for inundation and flooding is for Low to Medium-High SLR*		
Category	**Asset**	**Units**	**Total in Sub-area (% of Pacifica)**	**Storm Flooding**	**Coastal Erosion**	**Regular Tidal Inundation**	**Storm Flooding**
Coastal Structures	Armor Structures	feet	1490.051 (9.2%)	1441.935 (96.8%)	1490.051 (100%)	261.33-469.41 (17.5% - 31.5%)	1490.05-1490.05 (100% - 100%)
Coastal Structures	Levee	feet	0 (0.0%)	-	-	-	-
Communication	Comcast Underground Conduit	feet	3097.362 (2.1%)	423.371 (13.7%)	2402.337 (77.6%)	-	1258.58-1429.77 (40.6% - 46.2%)
Communication	Towers Private	count	0 (0.0%)	-	-	-	-
Community	Affordable Rentals	count	0 (0.0%)	-	-	-	-
Community	Communities At Risk	count	0 (0.0%)	-	-	-	-
Community	Healthcare Facility	count	0 (0.0%)	-	-	-	-
Community	Landmarks	count	0 (0.0%)	-	-	-	-
Community	Mobile Home Parks	count	0 (0.0%)	-	-	-	-
Community	Schools	acres	0 (0.0%)	-	-	-	-
Community	Senior Centers	count	0 (0.0%)	-	-	-	-
Ecosystem	Beaches	acres	3.72 (6.4%)	3.035 (81.6%)	3.72 (100%)	1.89-2.90 (50.8% - 77.9%)	3.70-3.71 (99.5% - 99.7%)
Ecosystem	CA Red Leg Frog Habitat	acres	0 (0.0%)	-	-	-	-
Ecosystem	Steelhead Habitat	feet	0 (0.0%)	-	-	-	-
Ecosystem	Streams	feet	4365.341 (3.8%)	484.352 (11.1%)	1571.187 (36.0%)	104.46-149.04 (2.4% - 3.4%)	635.30-667.64 (14.6% - 15.3%)
Ecosystem	Surfgrass	feet	2230.281 (13.8%)	2230.281 (100%)	1065.95 (47.8%)	2230.28-2230.28 (100% - 100%)	2230.28-2230.28 (100% - 100%)
Ecosystem	Wetlands	acres	3.292 (1.5%)	0.072 (2.2%)	0.568 (17.2%)	0.02-0.04 (0.5% - 1.3%)	0.10-0.12 (3.0% - 3.6%)
Emergency Response	Fire	acres	0 (0.0%)	-	-	-	-
Emergency Response	Police	acres	0 (0.0%)	-	-	-	-
Hazardous Waste	Cleanup Sites	count	1 (12.5%)	-	-	-	-
Hazardous Waste	Solid Waste Facility	count	0 (0.0%)	-	-	-	-
Hazardous Waste	Underground Storage Tanks	count	1 (20.0%)	-	-	-	-
Land Use	Auto Services	acres	0 (0.0%)	-	-	-	-
Land Use	Beach	acres	10.993 (24.1%)	9.367 (85.2%)	-	8.38-9.24 (76.3% - 84.1%)	10.29-10.27 (93.6% - 93.4%)
Land Use	Commercial	acres	2.069 (2.3%)	0.628 (30.4%)	-	0.19-0.22 (9.3% - 10.8%)	0.63-0.72 (30.5% - 34.8%)
Land Use	Hotels	acres	4.384 (67.2%)	1.924 (43.9%)	-	-	3.18-3.18 (72.6% - 72.6%)
Land Use	Industrial	acres	0 (0.0%)	-	-	-	-
Land Use	Mixed Use	acres	0.721 (20.5%)	0.079 (10.9%)	-	-	0.31-0.34 (43.1% - 46.8%)
Land Use	Mobile Homes	acres	0 (0.0%)	-	-	-	-
Land Use	Multi-Family	acres	0.197 (0.1%)	-	-	-	-
Land Use	Office	acres	0.53 (12.2%)	-	-	-	-
Land Use	Other Open Space	acres	10.346 (1.4%)	1.055 (10.2%)	-	-	1.14-1.26 (11.0% - 12.2%)
Land Use	Other Public or Community Uses	acres	1.35 (1.8%)	-	1.35 (100%)	-	0.03-0.01 (1.9% - 1.1%)
Land Use	Parks & Accessible Open Space	acres	0.465 (0.0%)	0.465 (100%)	0.465 (100%)	0.12-0.17 (26.7% - 37.6%)	0.46-0.46 (100% - 100%)
Land Use	ROW	acres	0 (0.0%)	-	-	-	-
Land Use	Schools	acres	0 (0.0%)	-	-	-	-
Land Use	Single Family Residential	acres	0.286 (0.0%)	0.213 (74.4%)	0.27 (94.3%)	-	0.29-0.29 (100% - 100%)
Land Use	Vacant/Undeveloped	acres	113.419 (10.3%)	7.996 (7.0%)	50.496 (44.5%)	4.00-4.59 (3.5% - 4.0%)	8.27-8.86 (7.3% - 7.8%)
Lands	Pacifica City Limits	acres	191.834 (2.4%)	23.09 (12.0%)	79.9 (41.7%)	12.69-14.34 (6.6% - 7.5%)	26.51-27.79 (13.8% - 14.5%)
Lands	Parcels	count	56 (0.4%)	23 (41.1%)	36 (64.3%)	9.00-10.00 (16.1% - 17.9%)	24.00-34.00 (42.9% - 60.7%)
Lands	Parks Conservation	acres	56.995 (1.6%)	12.625 (22.2%)	32.703 (57.4%)	8.43-9.77 (14.8% - 17.1%)	13.78-13.95 (24.2% - 24.5%)
Recreation	Access Lateral	feet	697.125 (6.3%)	353.412 (50.7%)	697.125 (100%)	24.40-539.05 (3.5% - 77.3%)	697.13-697.13 (100% - 100%)
Recreation	Access Vertical	feet	180.778 (7.1%)	64.368 (35.6%)	180.778 (100%)	-	95.43-88.69 (52.8% - 49.1%)
Recreation	Fishing Pier	count	0 (0.0%)	-	-	-	-
Recreation	Parks	acres	5.848 (0.2%)	3.27 (55.9%)	5.113 (87.4%)	2.86-3.46 (48.9% - 59.2%)	4.21-4.17 (71.9% - 71.3%)
Recreation	Trails	feet	7556.328 (4.1%)	890.873 (11.8%)	4373.516 (57.9%)	-	1039.21-1154.56 (13.8% - 15.3%)
Stormwater	Pipes	feet	1886.323 (0.6%)	440.692 (23.4%)	898.762 (47.6%)	17.63-19.20 (0.9% - 1.0%)	565.80-589.00 (30.0% - 31.2%)
Stormwater	Pump Stations	count	0 (0.0%)	-	-	-	-
Stormwater	Stormwater Outfalls	count	9 (8.3%)	3 (33.3%)	5 (55.6%)	1.00-3.00 (11.1% - 33.3%)	3.00-3.00 (33.3% - 33.3%)
Transportation	Bridge Local	count	0 (0.0%)	-	-	-	-
Transportation	Bridge State	count	0 (0.0%)	-	-	-	-
Transportation	Highway	feet	6820.728 (0.0%)	-	913.9 (13.4%)	-	-
Transportation	Streets City	feet	4143.432 (0.7%)	800.581 (19.3%)	2738.07 (66.1%)	-	1563.67-1895.06 (37.7% - 45.7%)
Wastewater	Pipeline	feet	13089.767 (2.4%)	1643.448 (12.6%)	5757.214 (44.0%)	-	2486.49-3516.82 (19.0% - 26.9%)
Wastewater	Pump Stations	count	2 (33.3%)	1 (50.0%)	1 (50.0%)	-	1.00-1.00 (50.0% - 50.0%)
Water	NCCWD Pipelines	feet	5567.154 (0.8%)	645.537 (11.6%)	2976.446 (53.5%)	-	1549.16-2486.16 (27.8% - 44.7%)

Summary of recommended near-term adaptation priorities:

Armoring

2020 to 2030 (immediately) – upgrade existing public armoring structures along north cove

2050 to 2060 (or when backshore is within 100 feet of Hwy 1 embankment) – install revetment for Highway 1 embankment

Beach nourishment

2020-2030 (immediately) – plan and implement beach nourishment of entire cove. Rockaway is a favorable location with best potential for testing nourishment as an adaptation strategy. By nourishing the beach, maintenance needs for backshore armoring are reduced.

Transfer of Development Credits

2020+ TDRs could also be implemented for private property at the Quarry and Headlands.

Development Setbacks

2020-2030 – Establish set-back requirements for new development in the Quarry and Headlands areas.

Managed Retreat/Realignment

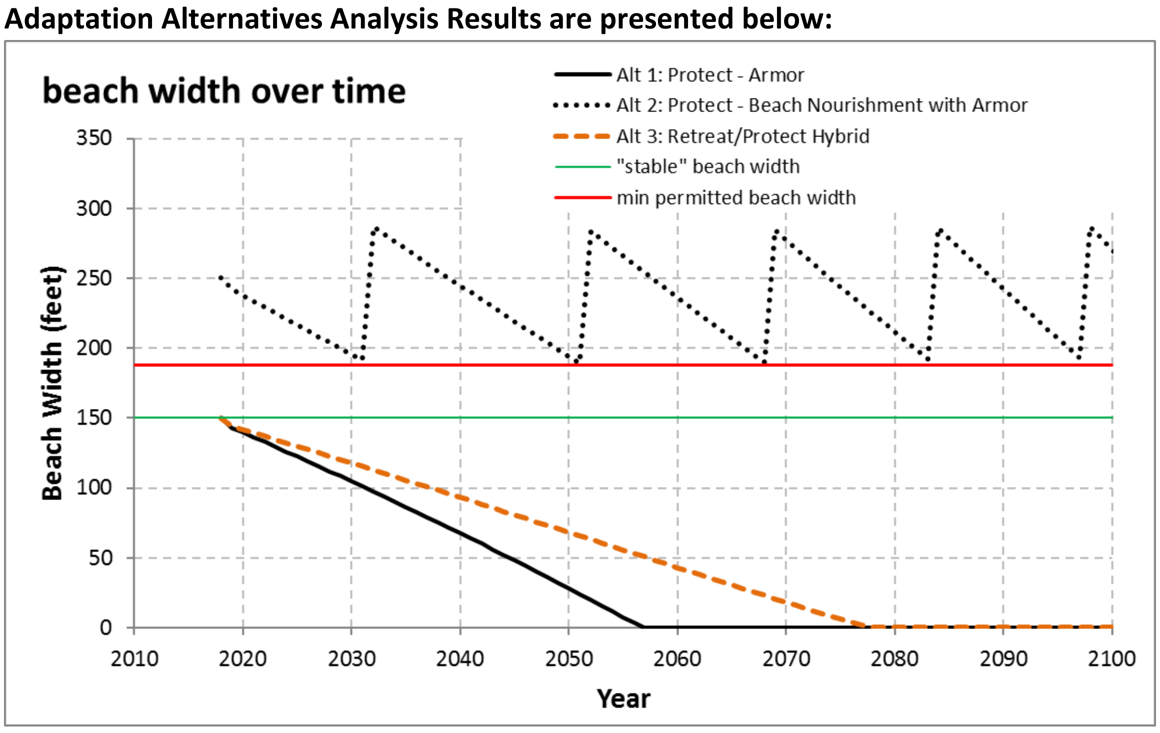
2060-2100 – Remove/relocate public parking and restrooms when impacted by erosion.

Timing of other asset removal/relocation is dependent on presence and condition of coastal armoring structures, location of built assets relative to the bluff edge and or flood hazard zone, willingness of private property owners, and availability for public funding for relocation of public infrastructure.

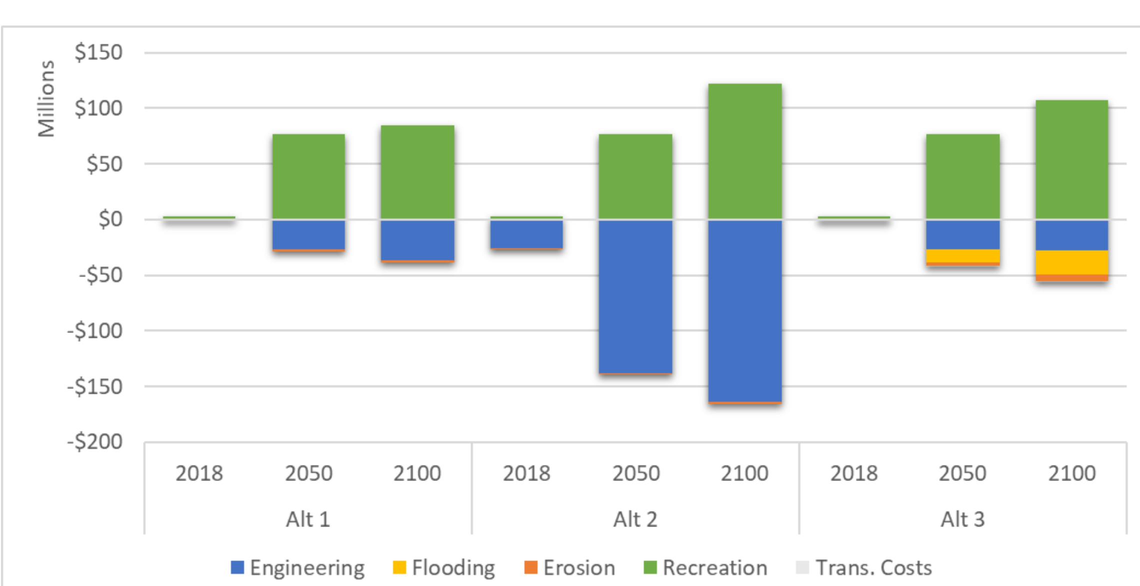
Appendix C: Pacifica State Beach Sub-area Sea-Level Rise Adaptation Overview Sheet

Adaptation Alternative	Adaptation Measures	Description
1 Protect	Armor, Flood protection	**Now:** Maintain existing armoring structures, option to owners to build new armor on private lands south parking and pump stations. Allow erosion of northern dunes. **Future:** Floodproof pump stations. Raise and armor Highway 1 to counteract erosion and wave overtopping exposure for West Linda Mar, coordinate with Caltrans adaptation planning.
2 Protect	Armor, Beach nourishment	**Now:** Maintain existing armoring structures, option to owners to build new armor on private lands south parking and pump stations. Allow erosion of northern dunes. **Future:** Nourish 100' beach and dunes when beach width falls below the minimum beach width. Assumes Caltrans Raises and armors Hwy 1 as needed. Floodproof pump stations as needed.
3 Retreat / Protect Hybrid	Managed retreat, Armor	**Now:** Allow erosion at publicly owned areas (optional for privately owned commercial facility in this sub-area). **Future**: Remove parking and relocate pump stations and realign sewer mains and . Raise and armor Highway 1 (part of West Linda Mar hybrid strategy) to counteract erosion and wave overtopping exposure, coordinate Caltrans adaptation planning.

Adaptation Alternatives Analysis Results are presented below:



Beach width modeling results, which inform adaptation strategy implementation and provide outputs for recreational and ecological benefits.



Economic Costs and Benefits for each alternative adaptation strategy (West Linda Mar sub-area included) Costs include: Engineering costs of adaptation, cost of damaged infrastructure/property to erosion or flooding, cost of asset removal (where applicable) and property transaction costs (shown as a range of 0-50% of property values affected).

Benefits shown consist of Recreational value. Additional benefits for Alternatives 1 and 2 can be considered to equal avoided cost of damages under Alternative 3.

Sub-area Asset Exposure Table Pacifica State Beach				Existing Conditions (% of Sub-area)	2100 Exposure Count (Percent of sub-area total) *Exposure Range for inundation and flooding is for Low to Medium-High SLR*		
Category	**Asset**	**Units**	**Total in Sub-area (% of Pacifica)**	**Storm Flooding**	**Coastal Erosion**	**Regular Tidal Inundation**	**Storm Flooding**
Coastal Structures	Armor Structures	feet	676.819 (4.2%)	676.819 (100%)	676.819 (100%)	12.05-85.11 (1.8% - 12.6%)	676.82-676.82 (100% - 100%)
Coastal Structures	Levee	feet	0 (0.0%)	-	-	-	-
Communication	Comcast Underground Conduit	feet	0 (0.0%)	-	-	-	-
Communication	Towers Private	count	0 (0.0%)	-	-	-	-
Community	Affordable Rentals	count	0 (0.0%)	-	-	-	-
Community	Communities At Risk	count	0 (0.0%)	-	-	-	-
Community	Healthcare Facility	count	0 (0.0%)	-	-	-	-
Community	Landmarks	count	0 (0.0%)	-	-	-	-
Community	Mobile Home Parks	count	0 (0.0%)	-	-	-	-
Community	Schools	acres	0 (0.0%)	-	-	-	-
Community	Senior Centers	count	0 (0.0%)	-	-	-	-
Ecosystem	Beaches	acres	16.582 (28.4%)	16.565 (99.9%)	15.79 (95.2%)	4.35-7.43 (26.2% - 44.8%)	16.34-16.58 (98.6% - 100%)
Ecosystem	CA Red Leg Frog Habitat	acres	0 (0.0%)	-	-	-	-
Ecosystem	Steelhead Habitat	feet	471.474 (1.8%)	217.775 (46.2%)	178.251 (37.8%)	193.83-471.47 (41.1% - 100%)	471.47-471.47 (100% - 100%)
Ecosystem	Streams	feet	55.514 (0.0%)	55.514 (100%)	55.514 (100%)	29.52-55.51 (53.2% - 100%)	55.51-55.51 (100% - 100%)
Ecosystem	Surfgrass	feet	0 (0.0%)	-	-	-	-
Ecosystem	Wetlands	acres	0.346 (0.2%)	0.133 (38.5%)	0.106 (30.6%)	0.10-0.33 (28.6% - 93.9%)	0.33-0.35 (95.6% - 99.6%)
Emergency Response	Fire	acres	0 (0.0%)	-	-	-	-
Emergency Response	Police	acres	0 (0.0%)	-	-	-	-
Hazardous Waste	Cleanup Sites	count	0 (0.0%)	-	-	-	-
Hazardous Waste	Solid Waste Facility	count	0 (0.0%)	-	-	-	-
Hazardous Waste	Underground Storage Tanks	count	0 (0.0%)	-	-	-	-
Land Use	Auto Services	acres	0 (0.0%)	-	-	-	-
Land Use	Beach	acres	23.219 (51.0%)	21.563 (92.9%)	-	3.80-7.42 (16.4% - 32.0%)	18.93-21.71 (81.5% - 93.5%)
Land Use	Commercial	acres	0.676 (0.8%)	0.676 (100%)	-	0.00-0.14 (0.2% - 20.9%)	0.68-0.68 (100% - 100%)
Land Use	Hotels	acres	0 (0.0%)	-	-	-	-
Land Use	Industrial	acres	0 (0.0%)	-	-	-	-
Land Use	Mixed Use	acres	0 (0.0%)	-	-	-	-
Land Use	Mobile Homes	acres	0 (0.0%)	-	-	-	-
Land Use	Multi-Family	acres	0 (0.0%)	-	-	-	-
Land Use	Office	acres	0 (0.0%)	-	-	-	-
Land Use	Other Open Space	acres	0 (0.0%)	-	-	-	-
Land Use	Other Public or Community Uses	acres	3.172 (4.1%)	3.172 (100%)	2.866 (90.4%)	0.06-0.28 (1.7% - 8.9%)	3.17-3.17 (100% - 100%)
Land Use	Parks & Accessible Open Space	acres	0 (0.0%)	-	-	-	-
Land Use	ROW	acres	0 (0.0%)	-	-	-	-
Land Use	Schools	acres	0 (0.0%)	-	-	-	-
Land Use	Single Family Residential	acres	0 (0.0%)	-	-	-	-
Land Use	Vacant/Undeveloped	acres	0 (0.0%)	-	-	-	-
Lands	Pacifica City Limits	acres	38.93 (0.5%)	28.973 (74.4%)	27.653 (71.0%)	3.51-9.31 (9.0% - 23.9%)	26.79-30.75 (68.8% - 79.0%)
Lands	Parcels	count	18 (0.1%)	18 (100%)	18 (100%)	14.00-16.00 (77.8% - 88.9%)	18.00-18.00 (100% - 100%)
Lands	Parks Conservation	acres	23.219 (0.6%)	21.563 (92.9%)	21.139 (91.0%)	3.80-7.42 (16.4% - 32.0%)	18.93-21.72 (81.5% - 93.5%)
Recreation	Access Lateral	feet	3427.209 (30.8%)	3427.209 (100%)	3427.209 (100%)	113.71-1229.88 (3.3% - 35.9%)	3427.21-3427.21 (100% - 100%)
Recreation	Access Vertical	feet	827.978 (32.7%)	820.757 (99.1%)	794.732 (96.0%)	5.30-62.78 (0.6% - 7.6%)	686.51-827.98 (82.9% - 100%)
Recreation	Fishing Pier	count	0 (0.0%)	-	-	-	-
Recreation	Parks	acres	16.91 (0.6%)	15.254 (90.2%)	16.245 (96.1%)	0.40-2.27 (2.4% - 13.5%)	12.62-15.41 (74.7% - 91.1%)
Recreation	Trails	feet	4054.032 (2.2%)	2067.633 (51.0%)	2162.422 (53.3%)	-	1648.99-2355.41 (40.7% - 58.1%)
Stormwater	Pipes	feet	1723.793 (0.6%)	1723.793 (100%)	1518.014 (88.1%)	334.67-586.96 (19.4% - 34.1%)	1723.79-1723.79 (100% - 100%)
Stormwater	Pump Stations	count	6 (66.7%)	6 (100%)	6 (100%)	-	6.00-6.00 (100% - 100%)
Stormwater	Stormwater Outfalls	count	2 (1.8%)	2 (100%)	2 (100%)	2.00-2.00 (100% - 100%)	2.00-2.00 (100% - 100%)
Transportation	Bridge Local	count	1 (25.0%)	-	-	-	1.00-1.00 (100% - 100%)
Transportation	Bridge State	count	0 (0.0%)	-	-	-	-
Transportation	Highway	feet	4412.671 (0.0%)	1905.395 (43.2%)	748.381 (17.0%)	-	1780.09-2195.19 (40.3% - 49.7%)
Transportation	Streets City	feet	667.241 (0.1%)	326.01 (48.9%)	-	-	451.88-667.24 (67.7% - 100%)
Wastewater	Pipeline	feet	6404.812 (1.2%)	4904.812 (76.6%)	4158.117 (64.9%)	113.61-906.63 (1.8% - 14.2%)	3709.19-4910.86 (57.9% - 76.7%)
Wastewater	Pump Stations	count	1 (16.7%)	1 (100%)	1 (100%)	-	1.00-1.00 (100% - 100%)
Water	NCCWD Pipelines	feet	1348.493 (0.2%)	614.794 (45.6%)	370.374 (27.5%)	4.99-199.00 (0.4% - 14.8%)	816.75-1213.67 (60.6% - 90.0%)

Summary of recommended near-term adaptation priorities:

Armoring

2050-2060 (~2 ft SLR or 100 foot offset from shoreline to assets)– build/upgrade armoring along parking lot and construct new armor at south parking lot/Linda Mar pump station.

2050 – City to engage with Caltrans to protect Highway 1, to be constructed by 2100.

Beach nourishment

2050-2060 (~2 ft SLR or 100 foot offset from dune toe to Highway 1) – nourish beach and restore dunes as needed to maintain 100-foot buffer seaward of the sewer force main and/or Highway 1. Repeat nourishments as needed.

Flood protection

2020-2030 (immediately) – floodproof Anza pump station (stormwater) to mitigate existing coastal storm flooding vulnerabilities to wave run-up.

2050-2060 (~2 feet SLR) – floodproof Linda Mar pump stations (sewer and stormwater) to mitigate future coastal storm flooding vulnerabilities to wave run-up. Beach nourishment could be effective in delaying the need to floodproof Linda Mar pump stations.

Managed Retreat/Realignment

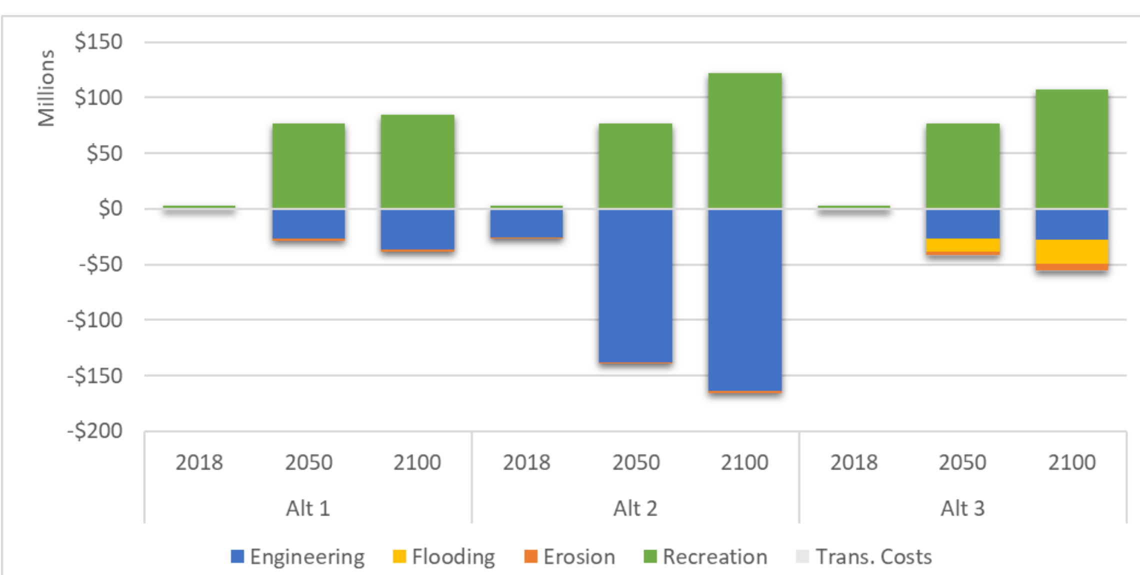
Timing is dependent on presence and condition of coastal armoring structures, location of built assets relative to the bluff edge and or flood hazard zone, willingness of property owners, and availability of public funding for relocation of public infrastructure.

Appendix C: West Linda Mar Sub-area Sea-Level Rise Adaptation Overview Sheet

Adaptation Alternative	Adaptation Measures	Description
1 Protect	Armor/Flood Protect	**Future:** Assumes Caltrans will raise Highway 1 (with armor) to protect the highway from wave overtopping (which will also provide protection to the neighborhood). Build levee/floodwall along San Pedro Creek to limit river flooding exposure and coastal exposure with future SLR. Add wells and pumps to manage rising groundwater with SLR in lowest areas of neighborhood.
2 Accommodate	Elevate structures, Groundwater management	**Now:** Follow requirements of City's Flood Damage Prevention Ordinance. **Future:** install wells and pumps to manage rising groundwater with SLR. (~120 structures affected by 2100 groundwater, ~300 structures affected by 2100 coastal storm (100-yr))

Adaptation Alternatives Analysis Results are presented below:

Beach width was not calculated for this sub-area



Economic Costs and Benefits for each adaptation strategy (Pacifica State Beach sub-area is included)
Costs include: Engineering costs of adaptation, cost of damaged infrastructure/property to erosion or flooding, cost of asset removal (where applicable) and property transaction costs (shown as a range of 0-50% of property values affected).
Benefits for Alternatives 1 and 2 can be considered to equal avoided cost of damages under Alternative 3.

Sub-area Asset Exposure Table West Linda Mar				Existing Conditions (% of Sub-area)	2100 Exposure Count (Percent of sub-area total) *Exposure Range for inundation and flooding is for Low to Medium-High SLR*		
Category	**Asset**	**Units**	**Total in Sub-area (% of Pacifica)**	**Storm Flooding**	**Coastal Erosion**	**Regular Tidal Inundation**	**Storm Flooding**
Coastal Structures	Armor Structures	feet	0 (0.0%)	-	-	-	-
Coastal Structures	Levee	feet	0 (0.0%)	-	-	-	-
Communication	Comcast Underground Conduit	feet	24319.476 (16.5%)	696.486 (2.9%)	-	-	1344.86-3049.67 (5.5% - 12.5%)
Communication	Towers Private	count	0 (0.0%)	-	-	-	-
Community	Affordable Rentals	count	1 (20.0%)	-	-	-	-
Community	Communities At Risk	count	0 (0.0%)	-	-	-	-
Community	Healthcare Facility	count	1 (50.0%)	-	-	-	-
Community	Landmarks	count	2 (22.2%)	1 (50.0%)	-	-	1.00-1.00 (50.0% - 50.0%)
Community	Mobile Home Parks	count	0 (0.0%)	-	-	-	-
Community	Schools	acres	43.66 (18.6%)	-	-	-	-
Community	Senior Centers	count	1 (100%)	-	-	-	-
Ecosystem	Beaches	acres	0 (0.0%)	-	-	-	-
Ecosystem	CA Red Leg Frog Habitat	acres	181.271 (0.5%)	-	-	-	-
Ecosystem	Steelhead Habitat	feet	5492.985 (21.1%)	-	-	-	104.30-219.81 (1.9% - 4.0%)
Ecosystem	Streams	feet	7214 (6.3%)	-	-	3.94-44.85 (0.1% - 0.6%)	291.02-571.00 (4.0% - 7.9%)
Ecosystem	Surfgrass	feet	0 (0.0%)	-	-	-	-
Ecosystem	Wetlands	acres	7.614 (3.5%)	-	-	0.00-0.00 (0.0% - 0.0%)	0.02-0.15 (0.3% - 1.9%)
Emergency Response	Fire	acres	1.646 (83.6%)	-	-	-	-
Emergency Response	Police	acres	0 (0.0%)	-	-	-	-
Hazardous Waste	Cleanup Sites	count	2 (25.0%)	1 (50.0%)	-	-	2.00-2.00 (100% - 100%)
Hazardous Waste	Solid Waste Facility	count	0 (0.0%)	-	-	-	-
Hazardous Waste	Underground Storage Tanks	count	0 (0.0%)	-	-	-	-
Land Use	Auto Services	acres	0.42 (8.8%)	0.42 (100%)	-	-	0.42-0.42 (100% - 100%)
Land Use	Beach	acres	0 (0.0%)	-	-	-	-
Land Use	Commercial	acres	18.242 (20.5%)	8.587 (47.1%)	-	0.01-3.08 (0.0% - 16.9%)	8.86-12.29 (48.5% - 67.4%)
Land Use	Hotels	acres	1.891 (29.0%)	-	-	-	-
Land Use	Industrial	acres	0.983 (5.4%)	-	-	-	-
Land Use	Mixed Use	acres	0 (0.0%)	-	-	-	-
Land Use	Mobile Homes	acres	0 (0.0%)	-	-	-	-
Land Use	Multi-Family	acres	7.102 (3.8%)	-	-	-	-
Land Use	Office	acres	1.03 (23.7%)	-	-	-	-
Land Use	Other Open Space	acres	28.739 (3.9%)	0.001 (0.0%)	-	0.06-1.12 (0.2% - 3.9%)	2.61-3.79 (9.1% - 13.2%)
Land Use	Other Public or Community Uses	acres	15.133 (19.8%)	3.477 (23.0%)	0.283 (1.9%)	0.60-2.30 (4.0% - 15.2%)	3.51-4.72 (23.2% - 31.2%)
Land Use	Parks & Accessible Open Space	acres	21.858 (0.8%)	1.797 (8.2%)	-	0.53-1.43 (2.4% - 6.6%)	1.71-1.96 (7.8% - 8.9%)
Land Use	ROW	acres	0 (0.0%)	-	-	-	-
Land Use	Schools	acres	59.795 (25.2%)	-	-	-	-
Land Use	Single Family Residential	acres	289.447 (16.4%)	22.696 (7.8%)	0.24 (0.1%)	1.32-11.45 (0.5% - 4.0%)	26.72-43.62 (9.2% - 15.1%)
Land Use	Vacant/Undeveloped	acres	155.432 (14.1%)	-	-	-	-
Lands	Pacifica City Limits	acres	575.807 (7.1%)	50.619 (8.8%)	1.174 (0.2%)	4.58-28.14 (0.8% - 4.9%)	58.57-85.77 (10.2% - 14.9%)
Lands	Parcels	count	1953 (15.0%)	242 (12.4%)	4 (0.2%)	44.00-142.00 (2.3% - 7.3%)	268.00-386.00 (13.7% - 19.8%)
Lands	Parks Conservation	acres	31.942 (0.9%)	2.455 (7.7%)	0.246 (0.8%)	1.10-2.11 (3.5% - 6.6%)	2.37-2.61 (7.4% - 8.2%)
Recreation	Access Lateral	feet	0 (0.0%)	-	-	-	-
Recreation	Access Vertical	feet	0 (0.0%)	-	-	-	-
Recreation	Fishing Pier	count	0 (0.0%)	-	-	-	-
Recreation	Parks	acres	27.819 (1.0%)	-	-	-	-
Recreation	Trails	feet	10318.582 (5.6%)	-	-	-	-
Stormwater	EQ Basin	acres	0.401 (100%)	0.401 (100%)	-	0.00-0.40 (1.0% - 100%)	0.40-0.40 (100% - 100%)
Stormwater	Pipes	feet	33229.948 (11.4%)	6495.865 (19.5%)	329.144 (1.0%)	1181.51-4152.38 (3.6% - 12.5%)	7395.02-9702.32 (22.3% - 29.2%)
Stormwater	Pump Stations	count	0 (0.0%)	-	-	-	-
Stormwater	Stormwater Outfalls	count	9 (8.3%)	-	-	-	-
Transportation	Bridge Local	count	2 (50.0%)	-	-	-	-
Transportation	Bridge State	count	2 (22.2%)	-	-	-	-
Transportation	Highway	feet	7470.476 (0.0%)	1841.48 (24.7%)	681.753 (9.1%)	-	
Transportation	Streets City	feet	81165.088 (14.4%)	11074.088 (13.6%)	-	1540.09-6145.19 (1.9% - 7.6%)	11713.44-14641.42 (14.4% - 18.0%)
Wastewater	Pipeline	feet	83553.921 (15.1%)	10563.016 (12.6%)	-	1483.14-6265.44 (1.8% - 7.5%)	11610.32-14360.48 (13.9% - 17.2%)
Wastewater	Pump Stations	count	0 (0.0%)	-	-	-	-
Water	NCCWD Pipelines	feet	104890.026 (15.0%)	13683.684 (13.0%)	721.172 (0.7%)	2008.47-7938.78 (1.9% - 7.6%)	14454.34-18861.96 (13.8% - 18.0%)

Summary of recommended near-term adaptation priorities:

Armoring

2050 – City to engage with Caltrans to protect Highway 1, to be constructed by 2100.

Flood protection

2020-2030 (immediately) – construct floodwall along commercial property to manage flooding from San Pedro Creek under existing conditions with SLR allowance. Future flood studies that include climate-driven changes in precipitation should inform any floodwall design.

Groundwater Management

2030-2050 (~0-2 feet SLR) – begin groundwater monitoring to determine needs for dewatering wells in the lowest portions of the West Linda Mar neighborhood. Because the area already has wetlands close to backyards, the tidal inundation hazard zones used to estimate groundwater daylighting impacts may underestimate the risk. Even a small rain event could cause significant flooding in the neighborhood if groundwater levels are close to the ground surface.

Managed Retreat/Realignment

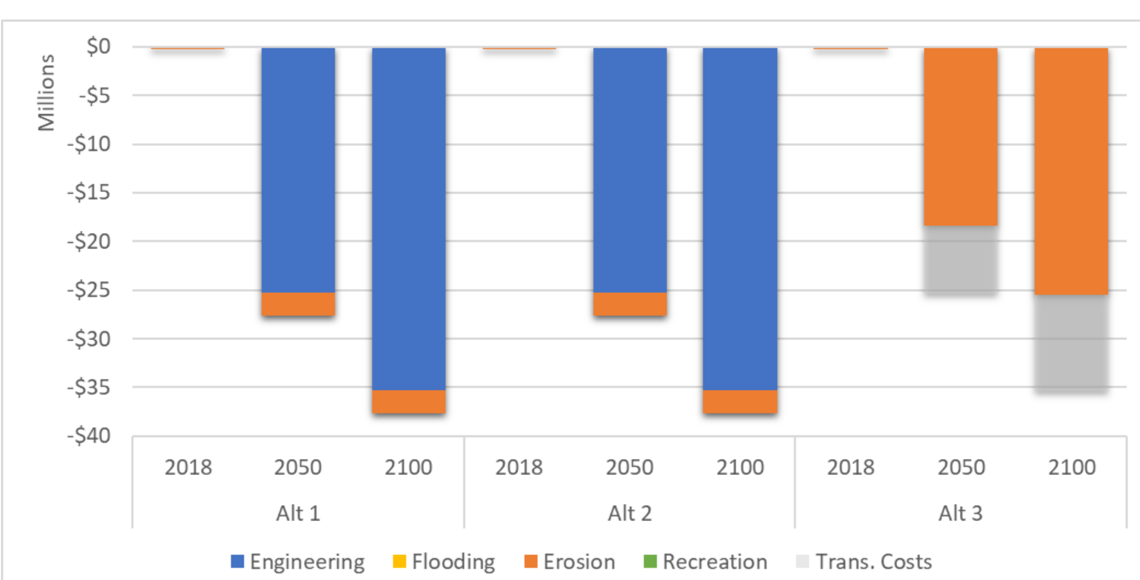
Timing is dependent on presence and condition of coastal armoring structures, location of built assets relative to the flood hazard zone, willingness of property owners, and availability of public funding for relocation of public infrastructure.

Appendix C: Pedro Point and Shelter Cove Sub-area Sea-Level Rise Adaptation Overview Sheet

Adaptation Alternative	Adaptation Measures	Description
1 Protect	Armor	**Now:** Assume existing private armoring structures are maintained and expanded by property owners along Shoreside Dr. Armoring of the headland is included in the form of a rock revetment but detailed slope stability and engineering analyses would be required to validate any design to limit erosion of the headland. **Future:** Maintain armored toe of headland. Shelter Cove not considered in this plan due to access issues.
2 Protect / Accommodate Hybrid	Armor, Beach nourishment, Elevate structures.	**Now:** Assume armor is maintained and expanded by property owners along Shoreside Dr. In conjunction with Pacifica SB nourishment, nourish 100' beach as part of Pacifica State Beach alternative. **Future:** Nourish 100' beach when beach width falls below the minimum beach width, increasing frequency as SLR accelerates. Raise buildings above coastal flooding elevation.
3 Retreat	Managed removal/ relocation of assets	**Now:** Option to private property owners to remove or abandon existing armoring structures protecting property once it is damaged or no longer effective and to allow erosion. **Future:** Purchase property when buildings at risk and remove structures and utilities, Remove or relocate public structures and infrastructure when at risk as erosion progresses.

Adaptation Alternatives Analysis Results are presented below:

Beach width results are presented in the Pacifica State Beach Subarea for the beach portion of Pedro Point and Shelter Cove sub-area.



Economic Costs and Benefits for each adaptation strategy
Costs include: Engineering costs of adaptation, cost of damaged infrastructure/property to erosion or flooding, cost of asset removal (where applicable) and property transaction costs (shown as a range of 0-50% of property values affected).
Benefits shown consist of Recreational value. Additional benefits for Alternatives 1 and 2 can be considered to equal avoided cost of damages under Alternative 3.

Sub-area Asset Exposure Table Pedro Point and Shelter Cove				Existing Conditions (% of Sub-area)	2100 Exposure Count (Percent of sub-area total) *Exposure Range for inundation and flooding is for Low to Medium-High SLR*		
Category	**Asset**	**Units**	**Total in Sub-area (% of Pacifica)**	**Storm Flooding**	**Coastal Erosion**	**Regular Tidal Inundation**	**Storm Flooding**
Coastal Structures	Armor Structures	feet	583 (3.6%)	583 (100%)	465.862 (79.9%)	293.44-481.65 (50.3% - 82.6%)	583.00-583.00 (100% - 100%)
Coastal Structures	Levee	feet	0 (0.0%)	-	-	-	-
Communication	Comcast Underground Conduit	feet	0 (0.0%)	-	-	-	-
Communication	Towers Private	count	1 (3.8%)	-	-	-	-
Community	Affordable Rentals	count	0 (0.0%)	-	-	-	-
Community	Communities At Risk	count	1 (100%)	1 (100%)	1 (100%)	1.00-1.00 (100% - 100%)	1.00-1.00 (100% - 100%)
Community	Healthcare Facility	count	0 (0.0%)	-	-	-	-
Community	Landmarks	count	0 (0.0%)	-	-	-	-
Community	Mobile Home Parks	count	0 (0.0%)	-	-	-	-
Community	Schools	acres	0 (0.0%)	-	-	-	-
Community	Senior Centers	count	0 (0.0%)	-	-	-	-
Ecosystem	Beaches	acres	1.364 (2.3%)	1.364 (100%)	0.723 (53.0%)	0.93-1.24 (67.9% - 90.7%)	1.36-1.36 (100% - 100%)
Ecosystem	CA Red Leg Frog Habitat	acres	131.996 (0.4%)	-	-	-	-
Ecosystem	Steelhead Habitat	feet	164.418 (0.6%)	16.955 (10.3%)	16.955 (10.3%)	68.74-151.58 (41.8% - 92.2%)	159.42-162.67 (97.0% - 98.9%)
Ecosystem	Streams	feet	578.161 (0.5%)	178.346 (30.8%)	151.421 (26.2%)	290.61-527.82 (50.3% - 91.3%)	562.56-571.35 (97.3% - 98.8%)
Ecosystem	Surfgrass	feet	3053.368 (19.0%)	2899.113 (94.9%)	2286.718 (74.9%)	1790.98-2370.48 (58.7% - 77.6%)	3018.00-3053.37 (98.8% - 100%)
Ecosystem	Wetlands	acres	5.568 (2.6%)	0.021 (0.4%)	1.934 (34.7%)	0.02-0.03 (0.3% - 0.6%)	0.78-1.23 (13.9% - 22.2%)
Emergency Respons	Fire	acres	0 (0.0%)	-	-	-	-
Emergency Respons	Police	acres	0 (0.0%)	-	-	-	-
Hazardous Waste	Cleanup Sites	count	0 (0.0%)	-	-	-	-
Hazardous Waste	Solid Waste Facility	count	0 (0.0%)	-	-	-	-
Hazardous Waste	Underground Storage Tanks	count	0 (0.0%)	-	-	-	-
Land Use	Auto Services	acres	0 (0.0%)	-	-	-	-
Land Use	Beach	acres	0.028 (0.1%)	0.028 (100%)	-	0.02-0.03 (75.3% - 99.5%)	0.03-0.03 (100% - 100%)
Land Use	Commercial	acres	6.228 (7.0%)	0.003 (0.1%)	-	0.04-0.12 (0.7% - 2.0%)	0.31-1.35 (5.0% - 21.6%)
Land Use	Hotels	acres	0 (0.0%)	-	-	-	-
Land Use	Industrial	acres	0.521 (2.8%)	-	-	-	-
Land Use	Mixed Use	acres	0.34 (9.7%)	-	-	-	-
Land Use	Mobile Homes	acres	0 (0.0%)	-	-	-	-
Land Use	Multi-Family	acres	0 (0.0%)	-	-	-	-
Land Use	Office	acres	0.114 (2.6%)	-	-	-	-
Land Use	Other Open Space	acres	138.996 (18.8%)	0.558 (0.4%)	-	0.04-0.15 (0.0% - 0.1%)	0.55-0.57 (0.4% - 0.4%)
Land Use	Other Public or Community Uses	acres	0 (0.0%)	-	-	-	-
Land Use	Parks & Accessible Open Space	acres	0 (0.0%)	-	-	-	-
Land Use	ROW	acres	0 (0.0%)	-	-	-	-
Land Use	Schools	acres	0 (0.0%)	-	-	-	-
Land Use	Single Family Residential	acres	55.984 (3.2%)	3.323 (5.9%)	25.415 (45.4%)	0.46-0.99 (0.8% - 1.8%)	3.79-4.40 (6.8% - 7.9%)
Land Use	Vacant/Undeveloped	acres	29.344 (2.7%)	0.397 (1.4%)	2.513 (8.6%)	0.05-0.21 (0.2% - 0.7%)	1.31-1.77 (4.5% - 6.0%)
Lands	Pacifica City Limits	acres	152.832 (1.9%)	9.41 (6.2%)	36.903 (24.1%)	5.49-6.80 (3.6% - 4.4%)	11.78-14.28 (7.7% - 9.3%)
Lands	Parcels	count	328 (2.5%)	13 (4.0%)	91 (27.7%)	11.00-13.00 (3.4% - 4.0%)	17.00-18.00 (5.2% - 5.5%)
Lands	Parks Conservation	acres	139.023 (3.8%)	0.586 (0.4%)	12.638 (9.1%)	0.06-0.17 (0.0% - 0.1%)	0.57-0.60 (0.4% - 0.4%)
Recreation	Access Lateral	feet	314.619 (2.8%)	314.619 (100%)	314.619 (100%)	129.41-314.62 (41.1% - 100%)	314.62-314.62 (100% - 100%)
Recreation	Access Vertical	feet	214.12 (8.5%)	186.572 (87.1%)	171.468 (80.1%)	35.11-159.72 (16.4% - 74.6%)	194.63-214.12 (90.9% - 100%)
Recreation	Fishing Pier	count	0 (0.0%)	-	-	-	-
Recreation	Parks	acres	0 (0.0%)	-	-	-	-
Recreation	Trails	feet	9023.361 (4.9%)	50.189 (0.6%)	37.207 (0.4%)	-	109.99-366.15 (1.2% - 4.1%)
Stormwater	Pipes	feet	3660.637 (1.3%)	-	-	-	-
Stormwater	Pump Stations	count	0 (0.0%)	-	-	-	-
Stormwater	Stormwater Outfalls	count	7 (6.4%)	-	-	-	-
Transportation	Bridge Local	count	0 (0.0%)	-	-	-	-
Transportation	Bridge State	count	0 (0.0%)	-	-	-	-
Transportation	Highway	feet	2532.49 (0.0%)	-	-	-	-
Transportation	Streets City	feet	18371.055 (3.3%)	-	7107.297 (38.7%)	-	116.18-167.25 (0.6% - 0.9%)
Wastewater	Pipeline	feet	16624.544 (3.0%)	-	2574.016 (15.5%)	14.00-293.82 (0.1% - 1.8%)	603.40-992.64 (3.6% - 6.0%)
Wastewater	Pump Stations	count	0 (0.0%)	-	-	-	-
Water	NCCWD Pipelines	feet	17062.759 (2.4%)	-	3313.556 (19.4%)	-	24.87-165.87 (0.1% - 1.0%)

Summary of recommended near-term adaptation priorities:

Armoring

2020-2030 – enable property owners to update coastal armor structures to more resilient designs

2050-2100 – private property is vulnerable to bluff erosion, but implementing bluff toe armoring would be complicated due to land ownership. Develop a hazard mitigation program: The program would be subject to available funding and voluntary action by property owners.

Flood protection

2030-2040 – amend zoning and policy documents to allow private property owners to raise homes and other structures above wave run-up hazard.

Transfer of Development Credits

2020+ TDRs could be implemented on undeveloped parcels to limit future vulnerability to bluff erosion.

Managed Retreat/Realignment

Timing dependent on presence and condition of coastal armoring structures, location of built assets relative to the bluff edge and or flood hazard zone, willingness of property owners, and availability of public funding for relocation of public infrastructure.

Appendix D: Shoreline Evolution Model

ESA Shoreline Evolution Model

In order to define erosion-specific adaptation strategies through time, ESA applied a shoreline evolution model that enables the following to be quantified:

- Schedule of Armoring construction and maintenance, given thresholds for stable beach widths per sub-area.
- Schedule of beach nourishments, given thresholds of stable beach width per sub-area.
- Outputs of beach width over time, enabling the quantification and valuation of recreational benefits and ecological function (not assigned a dollar value, but included in the discussion).

This model tracks the shoreline location, backshore location, and beach width. For beaches backed by dunes or structures, the backshore location represents the toe of the dune or structure. Backshore erosion results in a total loss of property. Using a 1-year time step, the shoreline movement and backshore erosion are calculated using relationships described in the following sections.

Beach Width

The beach width is the distance between the shoreline[1] and the backshore. A starting beach width was estimated for each reach by taking the average distance between the mean high water line[2] and the backshore location as observed in the 2009 - 2011 California Coastal Conservancy Coastal LiDAR Project Hydro-Flattened Bare Earth DEM (collected in Spring 2010 in this area). Subsequent beach widths are calculated based on the relative movement of the shoreline and backshore. If the shoreline erodes more quickly than the backshore, then the beach narrows, and vice versa.

Shoreline Movement

Three components contribute to shoreline movement in this quantified conceptual model: landward movement due to sea level rise (SLR), shoreline erosion caused by other coastal processes (e.g., waves, wind, changes in sediment supply), and seaward movement of the shore due to sand placement activities:

$$Shoreline\ Movement = SLR\ transgression + Ongoing\ erosion + Beach\ nourishment$$

Sea Level Rise Transgression

The impact of sea level rise on shoreline movement is incorporated by assuming that the shoreline will move inland based on the shape of the beach profile and the amount of sea level rise:

$$Sea\ Level\ Rise\ Transgression = \frac{increase\ in\ sea\ level}{shoreface\ slope}$$

[1] Assumed to be located at Mean High Water (MHW=5.29 ft NAVD88, from NOAA San Francisco tide gage).

[2] The MHW line was extracted from the 2009 - 2011 California Coastal Conservancy Coastal LiDAR Project Hydro-Flattened Bare Earth DEM.

The shoreface slope used in this equation depends on whether or not the backshore is eroding. A1 shows how the sea level rise erosion changes with beach width. When the backshore is not allowed to erode, or the beach is so wide that backshore erosion is not occurring (like when the beach is widened after beach nourishment), the shoreline erodes according to a standard Bruun slope, which is the slope between the depth of closure and the backshore toe location (shoreface height/active profile length).

However, if the backshore is allowed to erode, it will release sand into the system that will slow future erosion. In this case, a modified Bruun slope is used, which accounts for the eroding dune height. This slope is calculated as: (shoreface height + dune height)/(active profile length). Therefore, if the dune is very high, the slope increases and the sea level rise transgression is reduced. The taller the dune, the more the sea level rise transgression is reduced. In the beach nourishment scenarios, the shoreface slope is changed over time to reflect decreasing availability of beach-sized sediments. See the discussions about beach nourishment below for more detail.

The model assumes a linear transition between when a regular Bruun slope is used and when the modified Bruun slope is used (Figure A1Figure). When the beach is more than 2x wider than the stable beach slope, the Bruun slope is used. When the beach is narrower than the stable beach slope and the backshore is allowed to erode, the modified Bruun slope is used. In between these two beach widths, the erosion is linearly interpolated between the two methods.

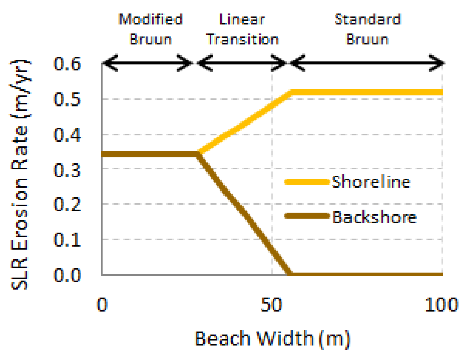


Figure A1: Example of empirical relationships between sea level rise-induced erosion rate and beach width. In this example the existing beach width is 28 meters. The sea level rise erosion rate for the standard Bruun slope is 0.52 m/yr, while the modified Bruun slope, which takes into account sediments released by the eroding dune, is 0.34 m/yr. In between the two conditions, a linear transition is assumed.

As the rate of sea level rise increases towards the end of the century, the contribution of sea level rise to shoreline movement will likely be greater than ongoing erosion in areas with a beach, while narrow beaches fronting bluffs or armoring structures may be lost entirely.

Background Erosion

All four reaches have a historic shoreline trend – either erosion or accretion. If no action is taken, and the beach and dunes are allowed to erode, this component of erosion will remain constant. However, if actions are taken that modify the beach's behavior (like beach nourishment or building a seawall), this component of erosion can increase or decrease. In this model, shoreline erosion is specified as a function of beach width. When the beach is nourished, the beach widens and the shoreline moves seaward. In this unusually wide beach configuration, the shoreline erosion rate is expected to increase (Dean 2002). If the beach narrows (either due to sea level rise or background erosion combined with holding the line), shoreline erosion decreases. An exponential empirical relationship was established between shoreline erosion rate and beach width for each reach that reflects this conceptual model.

$$E_{shoreline}(t) = \min(E_{shoreline,historic} * e^{a\left(\frac{BW(t)}{BW_{stable}} - 1\right)}, E_{shoreline,max})$$

Where:

$E_{shoreline}$ (t)	= Shoreline erosion at time t
$E_{shoreline, historic}$	= Historic shoreline erosion rate
$E_{shoreline,max}$	= Maximum shoreline erosion rate
BW (t)	= Beach width at time t
$BW_{ambient}$	= "Ambient" beach width
a	= calibration parameter for erosion rate responsive to beach width

Similar exponential relationships have been proposed for existing sand placement projects (Dean 2002). One assumption is that sand placements are self-similar. Previous studies have shown that an exponential relationship may overestimate the erosion rates (Dette et al. 1994). Because very little data exist related to response of shoreline erosion to sand placement, the decay parameter was selected based on wave exposure. Then, the value of (a) was increased in areas with higher wave exposure, like Manor, and decreased in reaches with lower wave exposure, like Pacifica State Beach. When a groin is implemented, the decay parameter is reduced by 50%, to account for the reduced potential sediment transport. In the beach nourishment scenarios, the decay parameter can be increased over time to reflect decreasing availability of beach-sized sediments (finer sediments are removed from the system more quickly). See the discussions about beach nourishment below for more detail.

An example of this relationship is plotted in Figure A2Figure. When the beach width is equal to the ambient beach width, the erosion rate is equal to the long-term historic erosion rate. The equation is capped with a maximum erosion rate to acknowledge that there is a limit to how quickly sand can be removed from the beach. A high value of the calibration parameter (a) leads to erosion rates being more responsive to beach width. A value of 0 would result in a constant erosion rate equal to the historic erosion rate, regardless of beach width.

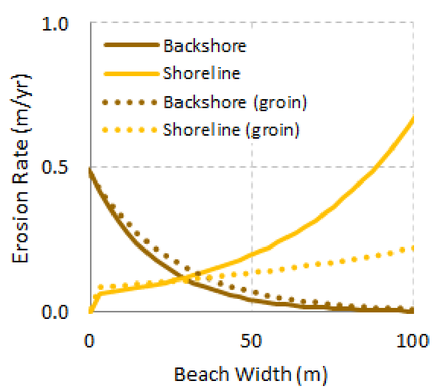


Figure A2: Example of empirical relationships between erosion rate and beach width. In this example, the existing beach width is 29 meters. The historic shoreline and backshore erosion rates are both 0.12 m/year. When a groin is added, the ambient beach width is assumed to widen by 25% to 36 meters; the shoreline erosion rates for beaches wider than the ambient beach with are reduced compared to no-groin conditions.

Beach Nourishment

This component of the equation applies during beach nourishment scenarios. Each time beach nourishment is implemented, it widens the beach by shifting the shoreline seaward. The amount the shoreline is shifted seaward depends on the volume of sand placed on the beach, the profile characteristics, and sand quality.

Backshore Erosion

The backshore location is tracked using a similar empirical relationship as the shoreline. The basic equation is similar except that the beach nourishment adjustment (which only changes the shoreline) is replaced with a placement loss distance (which only affects the backshore when armor is constructed).

$$Backshore\ Movement = SLR\ transgression + Ongoing\ erosion - Placement\ Loss$$

Sea Level Rise Transgression

As with the shoreline, the impact of sea level rise on backshore movement is incorporated by assuming that the backshore toe will move inland based on the shape of the beach profile and the amount of sea level rise:

$$Sea\ Level\ Rise\ Transgression = \frac{increase\ in\ sea\ level}{shoreface\ slope}\ or\ 0$$

The sea level rise component of backshore erosion is plotted on Figure A1 along with the shoreline erosion. If the backshore is allowed to erode and the beach is narrower than the stable beach width, a modified Bruun slope is used in this equation. This slope is calculated as:

$$Modified\ Bruun\ Slope = \frac{shoreface\ height + dune\ height}{active\ profile\ length}$$

If the scenario is to hold the line or the beach is wider than twice the stable beach width, the backshore does not erode. The backshore erosion is linear between 0 and the modified Bruun transgression when the beach is between the stable beach width and 2x the stable beach width.

Background Erosion

Bluff erosion is expected to have the opposite response to beach width: when the beach is wide, the backshore is expected to erode more slowly than if the beach is narrow, due to the additional protection from waves provided by the wide beach. When the beach becomes narrow, the backshore is expected to erode more quickly due to more frequent wave contact at the backshore toe. Once again, the erosion rate is capped by the maximum backshore erosion rate to acknowledge that the backshore (bluff/cliffs in particular) should have a maximum erosion rate which is a function of geology. This relationship is plotted, along with the similar relationship for shoreline erosion, in Figure A2.

$$E_{backshore}(t) = \min(E_{backshore,historic} * e^{-b\left(\frac{BW(t)}{BW_{stable}}-1\right)}, E_{backshore,max})$$

Where:

$E_{backshore}$ (t) = Backshore erosion at time t
$E_{backshore,\ historic}$ = Historic backshore erosion rate

$E_{backshore,max}$ = Maximum backshore erosion rate
BW (t) = Beach width at time t
$BW_{ambient}$ = “Ambient” beach width
b = calibration parameter for erosion rate responsive to beach width

In this case we calculate the decay parameter (b) using the ratio:

$$b = \frac{shoreface\ height + dune\ height}{shoreface\ height}$$

which is derived from a modified Bruun profile. This value could be modified in more detailed studies with additional information about how the backshore responds to narrower or wider beaches. Most reaches were relatively insensitive to this parameter.

It is important to note that this model does not address backshore erosion due to terrestrial processes (e.g., ground water levels, seismic forces, geology, land use, etc.) that are independent of coastal processes and outside the scope of this study.

Placement Loss

Placement loss refers to the space taken up by construction of a coastal protection structure like a revetment or seawall. These structures are usually placed at the back of the beach and cover part of the existing beach width, effectively shifting the backshore line seaward. For the current study, a placement loss of 7.6 meters (25 feet) is assumed for new armoring structures.

Appendix E: Methodology for Economic Analysis of Sea Level Rise Hazards for Pacifica Sea Level Rise LCP Update

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memorandum

date May 4, 2018

to Bonny O'Connor, AICP

cc Tina Wehrmeister

from Phil King, PhD; James Jackson, PE; Bob Battalio, PE

subject Methodology for Economic Analysis of Sea Level Rise Hazards for Pacifica Sea Level Rise LCP Update

Executive Summary

- The economic analysis for this project will provide the City of Pacifica with the best available data/analysis for public and private property at-risk due to coastal hazards.

- The economic analysis will evaluate the market value of land and the replacement costs of residential, commercial and public structures in order to provide an aggregate estimate of the value of property at risk due to coastal hazards—for planning purposes.

- The engineering consulting firm, ESA, will provide estimates of the cost of replacement or modification of key infrastructure such as roads and wastewater facilities as well as engineering cost estimates for each adaptation strategy.

- For each adaptation strategy, the economic benefit/cost analysis will compare the engineering costs of each adaptation strategy with the benefits (in terms of protecting private and public property) of each strategy.

- This memo provides more detail on methods and data sources.

Purpose of the Analysis

The economic analysis prepared for this project is designed to provide the City of Pacifica, its residents, and other stakeholders with the best available information on the aggregate economic value of property and activities at-risk due to hazards associated with sea-level rise. The economic analysis will use the best available data on property values and coastal recreation. The economic analysis will also estimate the economic activity and tax revenues associated with businesses in these hazard zones (e.g., hotels).

Although the economic analysis will include a benefit-cost analysis, it should be emphasized at the outset that this analysis is *not* designed to proscribe any specific policies, but rather to inform local decision-makers and stakeholders about the economic considerations associated with various sea-level rise scenarios and adaptation options available to the City.

It should be emphasized that the, economic analysis is only one indicator for adaptation scenarios. Any economic analysis is subject to numerous limitations, which are discussed in this memo. The memo will detail the methodology employed in the economic analysis, specifically: 1) The use of geospatial data; 2) The valuation of economic assets including land, buildings and other infrastructure (e.g. wastewater utilities including pump stations); 3) Non-market valuation including the valuation of coastal recreation (beach recreation, hiking, golfing) and other ecological functions goods and services (EFGS) in the hazard zone; 4) Economic Impact analysis; 5) How to apply the economic methods to adaptation.

Geospatial Data

The impacts of coastal erosion, flooding, and other coastal hazards all have spatial components (e.g. extent of flooding and erosion) that are best modeled in a geospatial framework (i.e., using maps). The engineering consulting firm associated with this project, ESA, will provide modeling of flooding, erosion and other coastal hazards with geospatial references. The modeling will include specific geospatial coordinates, which define the specific locations of expected future erosion and flooding from 1% or other storm event (also referred to as a 100-year storm or flood, though they may occur more frequently). The flooding data will also include depth of flooding either as a specific measure of the depth (i.e., in feet or meters) or as a category (e.g., high, medium, low). The hazard maps will be overlain on the map of assets (e.g. homes, streets, etc.) to identify assets that would be impacted by the hazard.

The economic analysis will begin with (San Mateo) County Assessor’s parcel data and City land use data, to identify property boundaries, location and size of the parcel along with other information obtained from the City of Pacifica such as zoning and current use. In the case of taxable property, the parcel data also provides the current assessed value of the land and “improvements” (structures).

The use of geospatial analysis also allows one to incorporate the length and width of beaches, coastal trails, parking, access points and other pertinent information about coastal recreation. One can also incorporate geospatial data on environmentally sensitive habitat (ESHA).

Valuing Land and Structures

Erosion Losses

This study will use 2018 market prices (per parcel, per acre) to value land. If land is lost due to erosion, the loss is assumed to be equal to the loss of the land at current market value. For small (mostly) residential parcels (< ¼ acre) this analysis will assume that the land value and structure value is lost as soon as any part of the parcel is eroded. For larger parcels (> ¼ acre) the loss of land will be pro-rated—the percentage loss in land will be equivalent to the percentage loss in value (i.e., if 50% of a $1,000,000 parcel is lost, $500,000 in market value is lost).

There are numerous ways to apply current market prices to estimate the value of lost property; however, the current assessed value of land often does not provide an accurate estimate, since California's Proposition 13 limits increases in assessed value to 2% per year from the last date of sale. For property that has not changed hands for many years, this 2% limit can result in undervaluing the current market price. For example, for residential housing, according to the Case-Shiller housing Index, housing prices in San Francisco in January 2018 are 4.91 times higher than in January 1988, 30 years ago.[1] However, even if housing prices were adjusted every year by 2%, the increase would only be equal to 1.81 times January 1988 prices[2] which is less than half of the market increase in value.

To adjust for the inherent bias in assessed data, this analysis will incorporate the best available housing price data to construct a housing priced index (HPI) for the City of Pacifica, which converts the original sale price into current market prices. The HPI will use the best available data on housing price changes, still to be determined.

Since there are fewer commercial properties in Pacifica than residential properties, this analysis will use available recent sales prices, and interviews with local commercial real estate experts to estimate the value of commercial property. Similarly, the analysis will examine the small number of government buildings and estimate the replacement cost. Public land will be valued using recent sales data from sales/purchases of public land, trusts, and conservation easements.

One limitation of using parcel data is that some parcels, mostly owned by local, State or Federal agencies are not subject to property tax. For these properties, we will rely on data provided by the City and County on recent acquisitions of land by government and non-government agencies. Since some of these transactions may be below market value, it's possible that the estimates provided for the estimates of the value of property owned by various governmental and non-governmental agencies may be too low—they should be considered to have a conservatively low estimated value. In addition, these un-assessed parcels typically do not have any information about the structures on them (if any) so it is difficult to estimate these structure damages.

Structures

All buildings will be valued at replacement cost using the best available data. Residential buildings/structures will be valued using a cost construction index based on the size of the structure (in square feet) and the prevailing

[1] Federal Reserve of St. Louis Database (2018).
[2] The value is adjusted by 2% a year for 30 years which is equivalent to $(1.02)^{30} = 1.81$.

type of construction.[3] Since there are a large number of residential structures, one must make some generalizations about size/materials and cost. For larger structures every effort will be made to estimate the replacement cost with reasonable accuracy.

Commercial property will also be valued by standard metrics (e.g., square footage of building, # rooms, etc.) using the best available data, in conjunction with local experts. Government and other buildings will also be estimated type of structure.

Roads and Other Infrastructure

Roads, wastewater infrastructure will be valued at replacement cost using estimates prepared by ESA. If modifications to existing infrastructure is warranted, then these costs will be incorporated into the analysis.

Flood Damages

Flood damages to structures will be estimated by applying the U.S. Army Corps of Engineers depth damage curves (USACE, 2003) which estimates damages as a percent of the total value of the structure. The Corps' method also allows one to estimate the average damage to the contents of the structure (e.g., furniture, appliances, etc.). These curves translate flood depth into a percentage loss as a function of the total value of the structure. The percentage loss also varies with the number of stories, type of construction, and other factors.

Non-Market Valuation

In addition to using market prices/values, economists use techniques referred to as non-market valuation to evaluate property and ecosystems that cannot be adequately valued by market prices. For coastal communities such as Pacifica, beaches (below the mean high tide line) are always considered public property and there is no market price. Consequently, economists value beaches, and other coastal ecosystems using non-market valuation techniques. While we recognize these values, estimating them is beyond the scope of work of this study. The appendix to this memo contains a more detailed description of non-market valuation.

Beach Recreation

This study will estimate the recreational value of Pacifica's beaches and coastal trails and golf course, using non-market valuation techniques. For beach recreation, this study will follow California Coastal Commission guidance and apply a day use value of $40 — that is a day at the beach is worth $40.[4] The study will use the best available attendance data. For Pacifica State (Linda Mar) Beach, this study will use the City of Pacifica's attendance estimates, which it has supplied to the California Coastal Commission. For other beaches, we will use the best available data including data from a recent San Mateo County Coastal Access Study (2015) as well as the Draft Coastal Regional Sediment Master Plan (CRSMP) prepared for the San Francisco littoral cell, which contains estimates of attendance at all of Pacifica's beaches.

[3] Specifically, this report will use data from RSMeans, Square Foot Costs, 2015.
[4] California Coastal Commission (2015).

Other Coastal Recreation

In addition to numerous beaches, the City of Pacifica also has a number of coastal trails, which are quite popular. As with beaches, these coastal trails are free and open to the public. The non-market value of hiking on trails has also been studied by economists. As with beaches, this study will apply a non-market value for coastal trails based on estimated attendance and day use value. Unfortunately, data on Pacifica's coastal trail usage is limited.

Pacifica also has a golf course in the coastal hazard zone. Coastal flooding has already impacted the golf course and future erosion may have larger impacts. The golf course is currently owned and operated by the City of San Francisco. Since everyone who uses the golf course must pay a fee, the City of San Francisco's Parks and Recreation department has records of golf course use and fees paid. Consequently, the value of the golf course can be approximated in terms of fees generated per year. However, the community of Pacifica may place a higher value on the course.

The challenge with estimating the potential impact of coastal erosion on the golf course is that erosion does not impact all of the holes. However, since golf is an 18- hole game, even the loss of one hole can seriously diminish the value of the golf course.

Summary of Methods/Data Sources

Table 1 below briefly summarizes the general methods and sources to be used in this study. In some cases (e.g., beach attendance at Pacifica State Beach) this study has identified a specific source; in other cases (e.g., commercial real estate data) a specific source has yet to be identified though a general methodology has been identified.

Table 1: Summary of Methods and Sources

Estimate	Valuation	Method	Source
Residential Land	Market	Update Parcel Data	Housing Price Data
Commercial Land	Market	Update Parcel Data	Commercial Land Data
Publicly Owned Land	Market	Update Parcel Data	Best Available Estimates
Land Trusts, Other Unassessed Land	Market	Update Parcel Data	Recent Sale Prices
Residential Buildings	Replacement Cost	Apply sq. ft. metric	RSMeans
Other Buildings	Replacement Cost	Apply sq. ft. metric	Best Available
Linda Mar Beach	Non-Market Valuation	Day Use Value *Attendance	City of Pacifica
Other Beaches	Non-Market Valuation	Day Use Value *Attendance	City of Pacifica
Trails	Non-Market Valuation	Day Use Value *Attendance	City of Pacifica
Golf Course	Market/Non-market	Day Use Value *Attendance	City of San Francisco
Roads	Replacement Unit Cost	Engineering Cost	ESA
Water/Sewer/Stormwater Infrastructure	Replacement Unit Cost	Engineering Cost	ESA
Adaptation Measures	Unit Costs	Engineering Cost	ESA

ESA has compiled a list of preliminary engineering unit costs for infrastructure replacement and adaptation measures, shown in Table 2 below. These costs were developed for prior studies in other areas with different shore geometries and wave exposures, and have not yet been tailored for Pacifica. ESA will work with the City to refine the engineering cost estimates as needed to reflect the geographic location and setting in Pacifica and ensure the costs are consistent with the City's recent experiences. The costs below were developed for projects including the Ocean Beach Master Plan (ESA PWA and SPUR, 2015), Southern Monterey Bay Climate Ready Study (Leo et al., 2017), San Francisco Coastal Regional Sediment Management Plan (ESA, 2016), and Economic Analysis of Nature-Based Adaptation to Climate Change in Ventura County (Environ and ESA PWA, 2013). Some costs have been adjusted based on input from Pacifica Department of Public Works.

Table 2: Engineering Unit Cost Estimates for Infrastructure Replacement and Adaptation Measures

Infrastructure Category	Cost	Unit	Asset
Water	$ 270 to 468	per LF	Main
Communications	$ 100	per LF	Comcast Conduit
Wastewater	$ 1,000,000	per mi	Wastewater Collection Main
Wastewater	$ 2,000,000	per mi	Wastewater Force Main
Transportation	$ 400	per LF	Roads (typical width)
Adaptation Measure	**Cost**	**Unit**	**Description**
Elevate Buildings	$ 150	per SF	In Flood Zone
Elevate Buildings	$ 250	per SF	In Wave Zone
Elevate Road	$ 800	per SF	Elevate on bridge/trestles
Rock Revetment	$ 40,000,000	per mi	i.e. Quarry stone
Seawall	$ 97,000,000	per mi	Reinforced Concrete
Breakwaters	$ 76,000,000	per mi	i.e. Quarry stone
Offshore Reef	$ 76,000,000	per mi	i.e. Quarry stone
Horizontal Levee	$ 2,000	per LF	Flat wide levee
Traditional Levee	$ 54	per CY	Clay Levee
Bulkhead/Floodwall	$ 5,000	per LF	Floodwall for Linda Mar/San Pedro Crk
Beach Nourishment	$ 22	per CY	Imported sand
Dune Restoration	$ 220,000	per acre	Vegetated sand dune with buried cobble
Pump Station (Sewer)	$ 11,000,000	per Pump	Sewer Pump Station

SF=square foot; mi=mile; LF=linear foot; CY=cubic yard

Economic Impacts

When making decisions about proposed coastal land uses, local decision-makers and stakeholders often are interested in the amount of spending and taxes generated for various activities. For example, beach tourists will spend money locally on food, gas, hotels (if staying overnight) and other items as a part of their beach activities. This spending generates economic activity and taxes for the City of Pacifica. This study will use the best available data on spending to estimate the local share of sales taxes and transient occupancy taxes generated by beach tourism.

In addition, a number of businesses (e.g., the Best Western hotel) are located within the coastal zone. This study will make every effort to estimate the share of Pacifica's taxes generated by businesses in the coastal zone. However, since this type of information is proprietary, the study will need to rely on the cooperation of local businesses.

The Future

The economic analysis in this study projects the impacts of sea-level out to 2100. However, our current understanding of the impacts of climate change is limited and evolving. In addition, our understanding of future economic conditions and market prices/replacement costs is similarly limited, particularly for longer time horizons.

The economic analysis for this study estimates all prices and replacement cost in (real) 2018 dollars. Effectively this assumption implies that the relative prices/costs of various decisions/options will remain the same over time—that is, the inflation rate for all goods and services will be the same. However, it is likely that some costs/prices will rise faster than others while new technologies or techniques may lower the relative prices of other goods and services.

As is standard in any economic benefit/cost analysis, future costs and benefits must be discounted — future benefits/costs are worth less than the same benefit/cost today. The choice of discount rate is critical in any benefit/cost analysis. Currently there is no consensus among economists as to what the proper discount rate should be.5 When considering capital investments (e.g., financing a seawall) one should consider the cost of capital — what it actually costs to borrow the necessary funds to finance a project. Currently, short and long term interest rates are historically low, and the cost of financing a project through State or local municipal bonds is in the 4% to 5% range. However, even a relatively low discount rate can imply that benefits and costs for future generations are valued far less than current benefits and many economists have argued that the social discount rate should be lower than the market cost of capital.6 Table 3 below shows the discounted value of a $100 benefit in future time horizons. When projecting out to 2100, even a relatively low discount rate, such as 3%, implies that a $100 benefit is worth less than one-tenth of today's valuation — $8.86. A 5% discount rate implies that by 2100 the benefit or cost is worth less than one-fiftieth of today's value ($1.86).

Table 3: Value of $100 over Time at Various Discount Rates

Discount Rate	0%	1%	3%	4%	5%
2030	$ 100.00	$ 88.74	$ 70.14	$ 62.46	$ 55.68
2060	$ 100.00	$ 65.84	$ 28.90	$ 19.26	$ 12.88
2100	$ 100.00	$ 44.22	$ 8.86	$ 4.01	$ 1.83

5 For example, see Arrow et. al., 2014 and Zuang et. al. (2007).
6 *Ibid.*

Adaptation

The economic analysis discussed above can be used to help inform adaptation decisions. Adaptation to sea level rise often involves compromise. For example, the decision to armor a portion of the coast involves a number of economic tradeoffs. First, the City of Pacifica, or private property owner or some other entity, must pay for the costs of armoring, including future maintenance or potential rebuilding. Second, armoring protects public and private property from coastal erosion and storms. Third, armoring may reduce beach width, reducing coastal recreation, and interfere with other coastal ecosystems processes.

For each adaptation strategy, the economic analysis will compare impacts of different adaptation strategies on: (1) land, structures and infrastructure, (2) recreation, (3) coastal ecosystems. Where possible, these changes will be estimated in dollar terms and comparisons can be made. However, as discussed above, our current knowledge, in terms of both the science and economics, of many ecological values is limited as is our ability to predict the future. Consequently, the benefit/cost analysis provided in this study should provide guidance to stakeholders and policy-makers, but is not designed to proscribe any particular policies.

Appendix: Non Market Valuation

This appendix will discuss how economists approach valuing various ecosystems, including beach ecosystems. The section begins with a discussion of non-market valuation, and continues with a discussion of various techniques currently in use to value these systems.

Ecologists and economists generally refer to services provided by beaches and other natural ecosystems with the term ecological functions goods and services (EFGS). Economists divide the total economic value (TEV) of these EFGS into a number of different components as shown in Figure 1 below. "Use Values" encompass EFGS that benefit humans either directly (Direct Use Value) or indirectly (Indirect Use Value). Direct use values involve uses that directly benefit human consumers, such as timber for a forest or beach visitation. Indirect use values occur when an ecosystem provides benefits that are more difficult to measure but still apparent, such as flood or storm control for a beach, or erosion control for a forest.

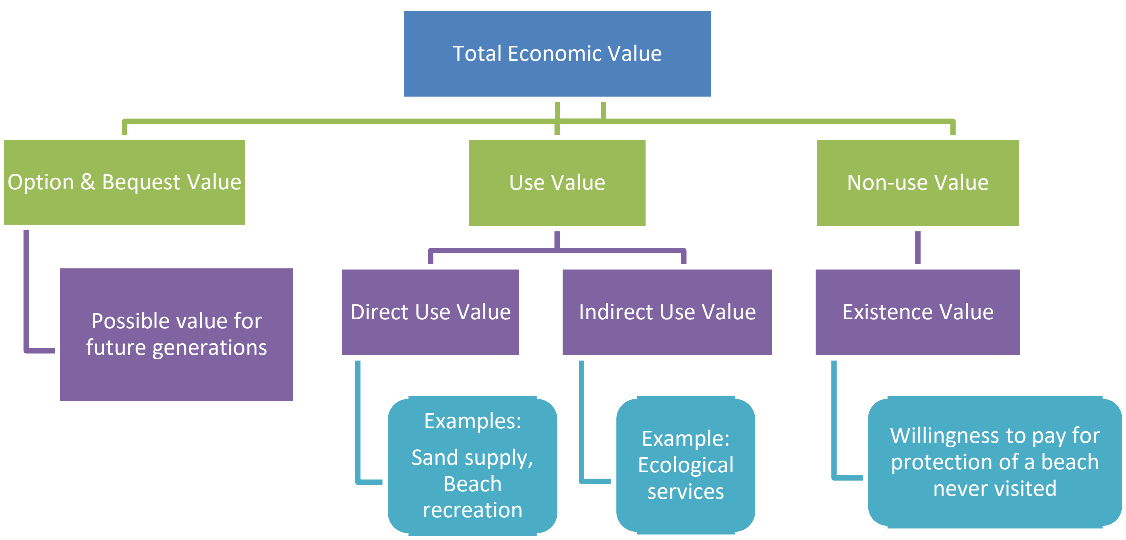

Figure 1: Schemata of Total Economic Value[7]

Direct Use Value

Visiting a beach to sunbathe, swim, surf or engage on other recreational activities is considered a direct use value. Since beaches below the mean high tide line in California allow open access, they are considered free (though parking may not be). Economists have developed techniques to estimate how much consumers would be willing to pay for a day at the beach (willingness to pay or WTP). A full discussion of these techniques is beyond the scope of this memo. Briefly, there are two widely accepted approaches to estimating WTP: revealed preference and stated preference.

[7] See Nelson (2012).

Revealed preference methods estimate the effort involved in a consumer decision to visit a particular beach or other natural ecosystem. The most common revealed preference technique is the travel cost model, which estimates the cost of travel to a particular site (not just gas or airfare but typically also the time it takes to get to the site). For example, one individual may be willing to pay $8000 to visit the Galapagos Islands, indicating a high WTP. For beaches with special amenities (e.g., a world class surf spot) WTP may be quite high. Economists also sometimes use "stated preference" models, which rely on surveys and ask visitors what they would be willing to pay to visit a beach or other ecosystem. Stated preference models (e.g., contingent valuation) have been criticized since visitors may misrepresent (or misunderstand) how much they would actually be willing to pay, and most estimates of beach WTP rely on revealed preference models.

Since individual's WTP for beaches and other natural ecosystems will vary from person to person, economists typically estimate a demand curve for these services and use a weighted measure (consumer surplus) of these values to derive a WTP for a beach day. For most policy applications, economists use a "day use value" to estimate the WTP for an average consumer. In May 2017, the California Coastal Commission adopted a day use value for California's beaches of $40/day8 for beach visitation in Solana Beach.

Indirect Use Value

The primary indirect use value for beaches, which will be estimated in this study, is the ability of beaches to help buffer storm damages and (inland) coastal erosion. ESA's storm analysis will model the geospatial extent (and depth) of coastal storms/erosion with varying beach widths according to agreed-upon scenarios and adaptation strategies. This analysis will estimate the differences in inland/upland private and public property loss/damage due to erosion and flooding. All things equal, a wider beach will act as a better buffer against storms/inland erosion than a narrower beach and the difference in damages can be estimated with reasonable accuracy.

Other Potential Use Values of Beach Ecosystems

Unfortunately, our knowledge of the other use values is still limited, both in terms of our knowledge of the ecology of beaches, as well as our economic valuation techniques. For now, most economic analyses of beaches, including this study, focus on recreation and storm damage prevention. Table A below, describes a number of ecosystem services provided by beaches.

[8] California Coastal Commission (2015).

Table A: Sandy Beach Ecosystem Services by Use Value Type[9]

Sandy Beach Ecosystem Services	Direct Use Value	Indirect Use Value
Sediment storage and transport;		X
Wave dissipation and associated buffering against extreme events (storms, tsunamis);		X
Dynamic response to sea-level rise (within limits);		X
Breakdown of organic materials and pollutants;		X
Water filtration and purification;		X
Nutrient mineralization and recycling;		X
Water storage in dune aquifers and seawater discharge through beaches—beaches with dunes only		X
Maintenance of biodiversity and genetic resources;	X	
Nursery areas for juvenile fishes;	X	
Nesting sites for turtles and shorebirds, and rookeries for pinnipeds;	X	
Prey resources for birds, fishes, and terrestrial wildlife;	X	
Scenic vistas and recreational opportunities;	X	
Bait and food organisms;	X	
Functional links between terrestrial and marine environments in the coastal zone.	X	

Option and Bequest Value and Other Non-Use Values

Finally, it should be noted that beaches and other natural habitats may have values beyond direct and indirect use values—that is, humans may wish to preserve an ecosystem for its existence value, e.g., we may be willing to devote resources to preserving a wilderness in Alaska even if we never go or never benefit directly and indirectly. In addition, humans may be concerned about future generations (bequest value) or the potential that these ecosystems have value we currently do not recognize (option value).

[9] See Defeo, McLachlan et al. (2009) and California Coastal Commission (2015).

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Appendix F: Sensitivity Analysis on Beach Attendance

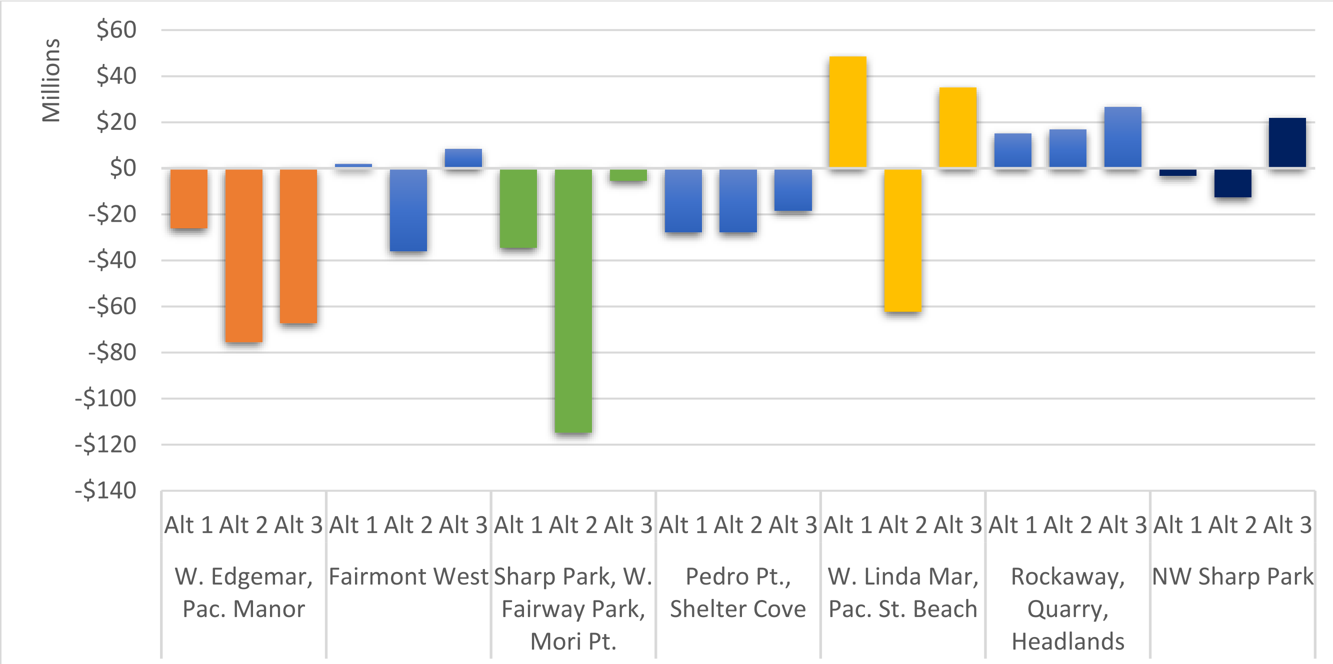
Appendix F: Sensitivity Analysis on Beach Use

The estimates of the recreational value of beaches in Pacifica are based on very limited data, except for Pacifica State Beach where the City has been conducting detailed counts. The estimates for other beaches are based on 2014 beach attendance data collected for the Draft Coastal Regional Sediment Master Plan (CRSMP). If attendance has increased significantly since then at any of the beaches, or if future growth in beach attendance is higher than the 0.6% per year assumed in this study, the results may shift. San Mateo County (2018) conducted a detailed analysis of beach use for a number of beaches in the County. Unfortunately, Pacifica's beaches were not included in this study. The San Mateo County study provided a high and low forecast or future beach recreation demand. The low estimate was based on population projections for the County, as are the projections in this study. However, the San Mateo County study also projected demand assuming that demand for beach recreation would grow faster than population growth (e.g., people go to the beach more often if the weather is warmer and sunnier). The sensitivity analysis here is analogous to the high projections for the San Mateo County study.

Economists often conduct sensitivity analyses to examine the impact of one particular assumption to the final result. If the final results change, then the result is sensitive to the assumption employed. A detailed sensitivity analysis of all variables is beyond the scope of this project; however the economic consultant did decide to examine a situation where beach attendance increased at 3% a year instead of 0.6%. Anecdotally, Pacifica has become a more popular beach destination in the past ten or so years than indicated by a 0.6% assumption.

Figure 1 below presents the net benefits for all sub-areas for the 2050 planning horizon given the assumptions employed in this study. The bar charts present the same information (in a slightly different format) as the main body of this report. Figure 2 presents the same information, but assuming that beach recreation changes to 3% a year. Although the net benefits increase for sub-areas with beaches, the relative ranking of each alternative, in terms of net benefits is unchanged, except for two sub-areas:

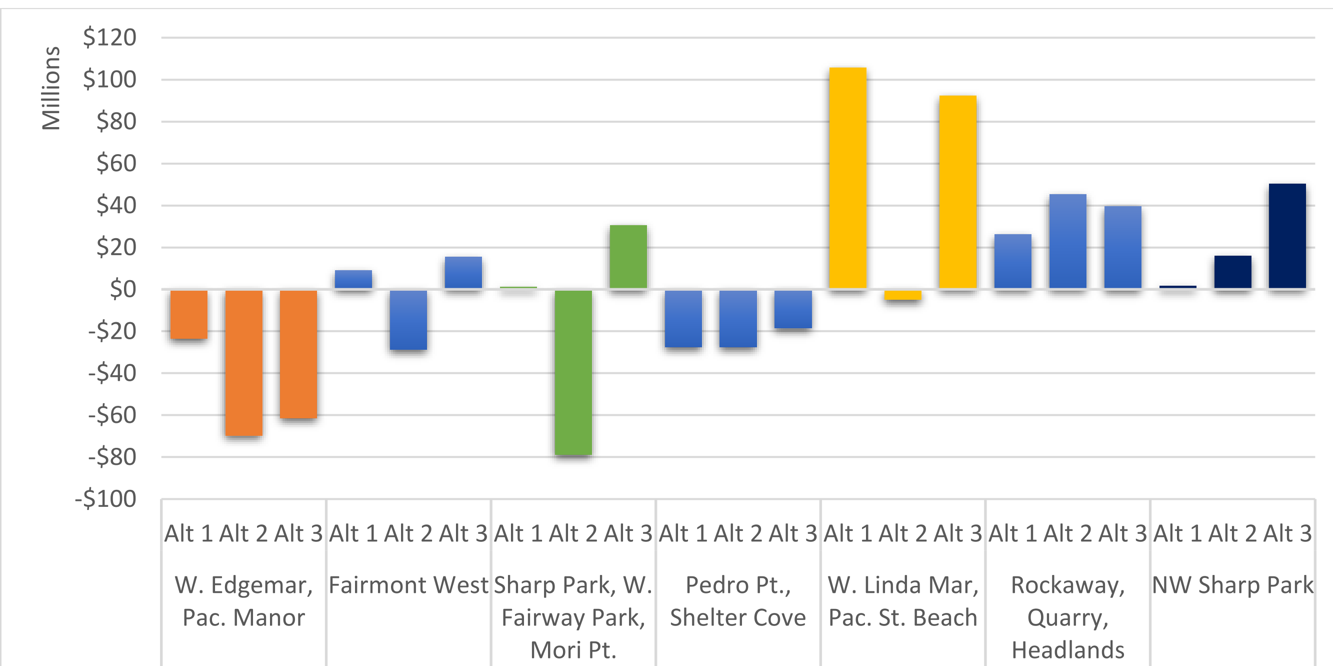
- For Rockaway Alternative 2, which involves beach nourishment, has the highest net benefits.
- For the Linda Mar/Pacifica State Beach sub-area, Alternative 2 moves to second place.



Pacifica LCP 170663

SOURCE: ESA,

Figure 1
Cost Benefit Analysis Results for 2050 with 0.6% growth in Beach Attendance



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SOURCE: ESA,

Figure 2
Cost Benefit Analysis Results for 2050 with 3% growth in Beach Attendance

Appendix G: Sharp Park Golf Course

Appendix G: Sharp Park Golf Course

Sharp Park golf course (SPGC) provides an 18-hole golf course along with other amenities associated with golfing. The course is owned and operated by the City of San Francisco's Department of Parks and Recreation. Evaluating Sharp Park Golf course's future from 2018-2100 is challenging for a number of reasons. In addition to the uncertainty surrounding future levels of sea level and the frequency/severity of coastal storms, the demand for golf in the future is uncertain. This study identified several challenges in estimating the economic value of Sharp Park Golf course:

- In the U.S., golf has been in decline for some time; according to Bloomberg[1] there were 30% fewer golfers in 2017, than in 2002.[2] *The Economist* magazine also noted a significant decline in golfing in 2015. On the other hand, many golf advocates have pointed to recent increases in junior golfing.[3] If the trend since 2002 continues, golf demand will fall and fewer courses will be needed in the future. The *San Jose Mercury News* recently noted that several Bay area golf courses have shut recently and the article noted that more closures were likely in the near future.[4]
- The Sharp Park golf course was designed by Alister MacKenzie, widely considered one of the greatest golf course architects. According to Golf Digest, MacKenzie designed three of the top ten golf courses in the world.[5]
- The Sharp Park golf course is located in/near the Laguna Salada wetland area and has significant ecological value including habitat for the red legged frog and San Francisco garter snake, both threatened/endangered species. Despite some mitigation, it's likely that the ecological value of the Laguna Salada wetland area has been significantly degraded as a result of its use as a golf course.
- Despite its beautiful location and historic architecture, the golf course receives relatively low ratings. This study examined ratings of Bay Area/Northern California golf sites from golfadvisor.com.[6] Out of a possible 5 star rating, 40.6% of the courses in their sample received 4-5 stars, 35.5% received 3-4 stars, and the remainder received less than 3 stars. Sharp Park golf course received 3 stars, indicating it's in the bottom one-third of all courses. A closer examination of these ratings indicated that most municipal golf courses (such as Sharp Park) received lower ratings. Sharp Park received high ratings for layout, but lower ratings for off-course amenities (e.g., club house, restaurant) and course conditions. These lower ratings are likely a function of restricted budgets.

The City of San Francisco provided this study with recent attendance/revenue figures from June 2017 to May 2018; these results are presented in Table G1 below.

[1]See https://www.bloomberg.com/gadfly/articles/2017-05-25/off-for-a-round-of-golf-this-weekend-didn-t-think-so.
[2] For example, see https://www.economist.com/the-economist-explains/2015/04/02/why-golf-is-in-decline-in-america
[3] For example, see http://www.golf.com/tour-news/2018/05/01/15-numbers-you-need-know-about-us-golf-economy.
[4] See https://www.mercurynews.com/2016/01/15/bay-area-golf-courses-struggle-to-stay-in-the-game/.
[5] See https://www.golfdigest.com/story/worlds-100-greatest-golf-courses-2016-ranking.
[6] See https://www.golfadvisor.com/course-directory/678-san-francisco/.

Table G1: Round and Revenue Report For Sharp Park Golf Course (June 2017 through May 2018)[7]

Month of Activity	Rounds of Golf	Revenue
May 2018	2,495	$ 72,280
April 2018	1,941	$ 52,513
March 2018	1,346	$ 35,749
February 2018	2,128	$ 54,668
January 2018	1,515	$ 40,006
December 2017	2,267	$ 63,638
November 2017	2,192	$ 63,984
October 2017	3,144	$ 91,327
September 2017	3,022	$ 92,037
August 2017	3,025	$ 85,933
July 2017	3,726	$ 109,311
June 2017	3,492	$ 106,563
Total	**30,293**	**$ 868,009**
Avg Revenue/Round		**$ 28.65**

The data indicates that Sharp Park provided just over 30,000 rounds of golf in the period from June 2017 to May 2018 yielding, on average, revenue per round of $28.65. Table G2 below presents data on recent costs of operating and maintaining Sharp Park golf course. As one can see the total costs of operation ($1.5 million) significantly exceed the revenues ($868 thousand). This is not unusual for a municipal golf course—many are subsidized, as are other parks and recreational activities.

Table G2: 2017 Operations and Maintenance Costs for Sharp Park Golf Course

Operations	$	1,401,780.00
Natural Resource Management	$	51,555.00
Regulatory Compliance	$	93,159.00
Total	$	1,546,494.00
Operations Cost per Round of Golf	$	46.27
Total Costs per Round of Golf	$	51.05

However, the fact that the golf course loses money does not mean that it should be valued at less than zero. Although the average round of golf at Sharp Park costs $28.65, this figure is significantly lower than many private or some public golf courses. As with beach recreation, the willingness to pay (WTP) for a round of golf could be higher than current rates.

The San Francisco Public Golf Alliance provided this study with a detailed memo, dated June 27, 2018, which noted Sharp Park's historic/cultural status, and its designer, Alister MacKenzie. The memo also provided several golf courses in northern California that the alliance considers to be equivalent to Sharp Park: Pebble Beach golf links, Spanish Bay golf links (Pebble Beach), Half Moon Bay golf links, Pacific Grove golf course, Pasatiempo golf course, Santa Cruz. The course fees varied considerably, but were in a range of $68 to $525 for 18 holes.

[7] Data from San Francisco Dept. of Parks and Recreation; provided by Spencer Potter.

After examining the amenities as well as ratings by golf advisor, it was determined that all of these courses provided much higher level of amenities than Sharp Park. Most of these courses also have much higher ratings on golf advisor. The closest course in terms of amenity level is likely Pacific Grove golf course, which, according to the memo, charges $68 on weekdays and $73 on weekends. However, this fee includes a golf cart, so that the net price for just 18-holes w/o a golf cart would be in the same range as the Shoreline and Lone Tree golf courses discussed below.

This study also examined other golf courses in the Bay Area and northern California with similar rating on the web site golfadvisor.com. As mentioned earlier, the Sharp Park golf course, despite its setting and historic architect, receives average ratings as a golf course. Most other 3 star golf courses also municipal golf courses. The two most expensive public golf courses with similar ratings as Sharp Park were the Shoreline golf course in Mountain View the Lone Tree golf course in Antioch[8]. Shoreline lists its rates at $41 weekday and $57 weekend. Lone Tree lists its rates at $45 weekday, $55 weekends. These rates are in line with the actual costs of operations at Sharp Park. Consequently, the economic value of the Sharp Park golf course, as currently operated and given recent attendance data appears to be in line with the costs of the service—including green fees and the subsidy from the City of San Francisco. Table G3 summarizes our analysis, which determined that a reasonable valuation for one round of golf at SPGC is $47.34; our analysis rounded this estimate up to $47.50.

Table G3: Rates at Golf Courses Comparable to Sharp Park

Golf Course	Weekday Rate	Weekend Rate	Average
Shoreline	$ 41.00	$ 57.00	$ 46.34
Lone Tree	$ 45.00	$ 55.00	$ 48.34
Average			$ 47.34

Valuing Sharp Park Golf Course in the Future

As discussed in this appendix, Sharp Park golf course currently provides recreational services in line with the revenues generated and the subsidy provided by the City of San Francisco. Any evaluation of Sharp Park golf course also needs to account for the potential loss in environmental functions goods and services (EFGS) from the land being operated as a golf course, since the golf course contains sensitive habitat. Also, SPGC is one of a handful of golf courses in the US designed by Alistair Mackenzie, and any cultural or historical significance must also be accounted for.

For the purposes of this study, the loss in Golf course area was only evaluated as a loss in public property. After careful consideration, the consultants decided this approach was most appropriate given that the golf course currently breaks even in terms of recreational services to the community. If Sharp Park golf course is to be preserved, one must consider at a number of options including not only armoring, but also reconfiguring or reducing the number of holes. Reducing the number of holes below 18 would limit the opportunities for tournament play and discourage some golfers. However, there may be a demand for 9-hole golf or some other configuration.

[8] See http://www.shorelinelinks.com and http://www.lonetreegolfcourse.com/lonetreegolfcourse/content/1844594/Rates-Policies.