ESA PWA

550 Kearny Street
Suite 900
San Francisco, CA 94108
415.262.2300 phone
415.262.2303 fax

www.pwa-ltd.com

memorandum

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to San Francisco Littoral Cell CRSMP Stakeholder Advisory Group

from Bob Battalio and Doug George

subject Preliminary Implementation Options for San Francisco Littoral Cell CRSMP

Preliminary Implementation Options Overview

Coastal Armor by Reach

In 2005, NOAA Coastal Fellow Jennifer Dare developed a statewide coastal armor GIS database for the California Coastal Commission using a combination of oblique aerial images from the California Coastal Records Photo website and georeferenced orthoimages. The database contains polylines that represent coastal armor types including along-shore structures (bluff walls, infill, revetments, bulkheads, and seawalls) and other structures (breakwaters, groins, and jetties). ESA PWA updated the Dare 2005 geodatabase using California Coastal Records photos taken in 2010 (ESA PWA, 2012). Additionally, the representative polylines were moved from the single shoreline (as they were in the Dare 2005 database) to their actual cross-shore locations by heads-up digitizing the alignment using 2010 National Agriculture Imagery Program (NAIP) orthoimagery. Revetments were digitized in a separate polygon shapefile to capture their two-dimensional surface extent visible at the time the photo was taken.

For the purposes of the CRSMP, presence of coastal armor helps inform how active erosion may be in a location. The following types of coastal armor were defined (below) and quantified by reach to assist in identifying critical erosion areas in the study area (Table 1).

- Seawall – A wall that sits on the beach and does not extend all the way to the top of the bluff (that would be considered an upper bluff wall).
- Mid Bluff Wall – A wall that sits at an elevation above the beach but does not reach the top of the bluff.
- Upper Bluff Wall – A wall that may or may not start on the beach but extends to the top of the bluff. Includes walls sit on the top edge of the bluff.

- Revetment – A pile of rocks/boulders/hard features deliberately placed on a beach or along the base of a cliff. Revetments were classified using polygons since the size of the revetments can vary significantly from one revetment to the next and even within a single revetment. The objective was to avoid classifying piles of rocks/boulders that were not intentionally placed as armoring. However, it is not always obvious which rock piles were revetments and which were natural.

TABLE 1 – COASTAL ARMOR IN REACH

Reach	Length of Reach (feet)	Approximate Length of Shore-Parallel Armoring, by type (feet)			
		revetment	upper bluff wall	mid bluff wall	seawall
Baker Beach	8,300	0	332	571	1,737
China Beach	1,100	0	332	434	547
Pt Lobos	8,000	310	100	691	625
North Ocean Beach	5,600	0	0	886	5,055
Middle Ocean Beach	10,500	0	0	0	3,676
South Ocean Beach	7,500	1,970	236	428	103
Fort Funston	2,500	0	0	0	0
Daly City	14,700	2,220	0	2,499	0
Mussel Rock	1,800	470	0	301	0
Manor District	6,900	2,790	188	758	0
Beach Blvd	5,200	3,110	430	0	3,024
Sharp Park	4,000	1,400	0	0	0
Hidden Cove	3,200	0	0	0	0
Rockaway Cove	2,700	1,340	0	0	200
Linda Mar	7,500	0	0	0	1,142
Shelter Cove	3,000	0	0	0	117
Totals	**92,500**	**13,610**	**1,618**	**6,568**	**16,226**
Estimated % of Shoreline Armored*		**15%**	**2%**	**7%**	**18%**

**- the values for percent of shoreline armored are slight overestimates due to the geometry of the seawalls and bluff walls (not always shore parallel)*

Descriptions of Implementation Options

The following is a definition list of the implementation options ESA PWA will consider to address critical erosion areas along the shoreline. Options can also be combined.

- No Action – no onshore or offshore changes are recommended to affect sediment transport or sand retention. Natural erosion or deposition processes would be allowed to occur without intervention, and/or existing armoring or retreat practices are assumed to continue.

- Beach Nourishment – sand placement on beaches to widen them or maintain current width. Sand placement can include opportunistic and designed projects, such as sand back-passing inside a littoral sub-cell from downdrift to updrift. Sand placement could be accomplished by pumping sand onshore using hydraulic dredging techniques, or can be placed using trucks.

- Multi-purpose Reefs – reefs placed offshore of critical erosion areas to retain sediment and reduce wave exposure in specific locations. These reefs would vary in size and number depending on the needs at the location.

- Armor – construction of engineered structures (e.g., sea walls or revetments) on the coastline to protect infrastructure and/or impede erosion of the backshore. This is listed because of the extent of existing armoring and hence the likelihood that armoring will continue to be considered as an erosion mitigation measure.

- Allowed Erosion – similar to No Action, this option allows natural erosive processes to occur without intervention but on a smaller, targeted scale instead of the full reach.

- Managed Retreat –landward setback of infrastructure near the shore intended to offset the effects of erosion and sea level rise. Restoration of the shoreface and back beach areas could accompany managed retreat plans. This is listed because of the extent that existing projects and plans include retreat, as follows:

    - National Park Shores (northern reaches; Baker through Ft. Funston, Hidden Cove)

    - Ocean Beach Master Plan (Ocean Beach reaches)

    - Laguna Salada Natural Area Management Plan (Sharp Park south)

    - Linda Mar – Pacifica State Beach where managed retreat has been implemented and is part of the State Park Management Plan.

Options by Reach

A preliminary list of options for each reach was constructed by combining the shoreline erosion rates, presence of coastal armor and existing management plans (e.g. the Ocean Beach Master Plan or plans for Sharp Park) (Table 2). In the case of the Ocean Beach reaches, information was applied directly and is more developed than

the other reaches at this time. Quantification of beach nourishment volumes and frequencies is still underway. A summary table provides an overview of the preliminary options by reach (Table 3).

Opportunities for Sediment Sources

Beach nourishment is recommended for seven of the reaches. Three opportunities for source material are discussed below.

- Maintenance dredging of the San Francisco Bar Shipping Channel

  The US Army Corps of Engineers maintains a channel with navigable depth of 55 ft (MLLW) through the San Francisco Bar offshore of the Golden Gate. The channel, approximately 26,000 feet long and 2,600 feet wide, has yielded an average of 500,000 yd^3 of dredged sediment per year since 1975, although dredge volumes have been less than average every year since 2001 (Andes et al, 2011). The sediment is characterized as fine to coarse sand (0.1-0.5 mm) and most has been placed at SF-8 since 1975. From 2005-2007, 900,000 yd^3 of sediment were placed at SF-17 near Ocean Beach as part of a shoreline nourishment demonstration project; SF-17 is scheduled to be designated as the permanent placement location for future dredged sediment placements.

  Because of the proximity of Ocean Beach to the San Francisco Bar, the dredged sediment is most appropriate to be utilized along the San Francisco coastline. The Ocean Beach Master Plan (OBMP) recommends directly pumping dredged sediment onshore to Middle and South Ocean Beach. There is also the option of back-passing the sediment by pumping it from Pt. Lobos and North Ocean Beach to the two southern sections of Ocean Beach.

- Offshore dredge locations

  Preliminary data from the California Seafloor Mapping Program was provided to ESA PWA by the USGS in February 2012. Some of these data included bed sediment characterization for the southern half of the study area and sediment thickness along the counties of San Mateo, San Francisco and Marin. Those data, when combined with quantified surface grain size distributions from the USGS and Moss Landing Marine Laboratories, indicate areas that may supply offshore sediment for beach nourishment. The sediment on the shelf immediately west of Daly City and Pacifica is characterized as mostly unconsolidated fine sand with accumulation of up to 10 feet thick. Even thicker deposits of sediment (more than 15 feet thick) are found to the west of Point San Pedro in water depths deeper than 90 feet (NAVD88). Another area of thick sediment is approximately 2 miles offshore of South Ocean Beach on the edge of SF-17 with accumulations of 30-40 feet.

- Sediment from Caltrans road maintenance in the coastal areas of San Francisco and San Mateo counties

  Caltrans maintains several major roadways and highways inside and near the study area. Highway 1 in particular is a vital transportation connection from San Francisco southwards to Pacifica and Half Moon Bay. Many roadcuts through unconsolidated geology provide source material for land and rock slides onto the roadways and Caltrans is responsible for ensuring the sediment is removed. The frequent road closures and need for the new tunnel-bridge viaduct at Devil's Slide just south of the study area are examples of how active the coastal cliffs and bluffs can be. The sediment that once flowed to the shores and ocean through small coastal watersheds is now stopped by Highway 1 and other peripheral roads.

However, this sediment historically fed the beaches and nearshore environments and contains the natural background grain size distribution. Transporting the sediment accumulated on the roadways and in catchment basins to the coast would re-establish the former sediment pathways. Further, Caltrans has expressed interest to not landfill the removed sediment and deliver it the coast for economic reasons.

An example of how sediment removed by Caltrans can be re-introduced to the shoreline is found in Marin County at the State Route 1 - Lone Tree Slide Mitigation Bolinas Lagoon Mitigation Project. After the October 1989 Loma Prieta earthquake, the Lone Tree Slide closed Highway One between Muir Beach and Stinson Beach. The road was reopened in June 1991, after more than 750,000 yd^3 of soil and rock were removed from the slide face. The slide material was disposed into a large fill on the west side of Highway 1 with the seaward edge of the fill extending more than 200 feet into the ocean. This approach can be adapted to the CRSMP by identifying an active landslide area into the ocean within the study area and depositing sediment from the roadways at the head of the landslide. Natural processes would sort and transport the sediment towards the ocean. The reconnection of locally-derived terrestrial sediment sources to the shoreline would have a positive impact to the nearshore sediment budget while supplying Caltrans with a potentially economically-feasible solution to roadway maintenance.

- Sediment from GGRNA

  Watersheds that have been dammed collect sediment behind water retention structures. Areas within the jurisdiction of GGNRA have been trapping sediment that would have been delivered to the coast. This sediment could also be used for beach nourishment projects.

TABLE 2 – PRELIMINARY IMPLEMENTATION OPTIONS

Reach	Options
Baker	No Action
China	No Action
Pt. Lobos	No Action
North Ocean Beach (NOB)	No Action
Middle Ocean Beach (MOB)	1. Beach Nourishment by USACE dredging to pump 1.5 million yd^3 every 20-30 years onshore to widen beach and dunes by 50'. Move sand around with land-based equipment. 2. Beach Nourishment by sand back-passing, pumped from NOB/Pt. Lobos to Sloat and moved around with land-based equipment
South Ocean Beach (SOB)	1. Managed Retreat with Beach Nourishment of 0.5 million yd^3 every 20-30 years with same sources as MOB (Ocean Beach Master Plan nourishment approach) 2. Multi-purpose reefs with Beach Nourishment
Ft. Funston	No Action
Daly City	No Action
Mussel Rock	Special Case: relocate or reconfigure landfill to mitigate negative effects
Manor District	1. Beach Nourishment of unknown volume and frequency 2. Beach Nourishment with Multi-purpose Reefs 3. Armor in selective locations with Managed Retreat and Beach Nourishment in new pocket beaches formed from erosion between armored zones
Beach Blvd	1. Beach Nourishment of unknown volume and frequency 2. Beach Nourishment with Multi-purpose Reefs 3. Armor in selective locations with Managed Retreat and Beach Nourishment in new pocket beaches formed from erosion between armored zones
Sharp Park	1. Allowed Erosion: remove armor and allow levee to erode, capture sand and allow beach transgression 2. Beach Nourishment of unknown volume and frequency 3. Multi-purpose Reef 4. Hybrid approach using Allowed Erosion of levee, Beach Nourishment, and Multi-purpose Reefs
Hidden Cove	No Action
Rockaway Cove	1. Beach Nourishment of unknown volume and frequency 2. Managed Retreat 3. No Action
Linda Mar	1. Beach Nourishment of unknown volume and frequency 2. Managed Retreat 3. Managed Retreat, with added cobble and sand to let the beach build higher 4. No Action
Shelter Cove	No Action

TABLE 3 – SUMMARY OF PRELIMINARY OPTIONS

Reach	Options					
	No Action	Beach Nourish-ment	Multi-purpose Reefs	Armor	Allowed Erosion	Managed Retreat
Baker	●					
China	●					
Pt. Lobos	●					
North Ocean Beach (NOB)	●					
Middle Ocean Beach (MOB)		●				
South Ocean Beach (SOB)		●	●○			●○
Ft. Funston	●					
Daly City	●					
Mussel Rock*						
Manor District		●	●○	●○	●	●
Beach Blvd		●	●○	●○	●	●
Sharp Park		●○	●○		●	
Hidden Cove	●					
Rockaway Cove	●	●				●
Linda Mar	●	●○				●
Shelter Cove	●					

● – a primary option
○ – can be combined with other options
*- at Mussel Rock, relocation of landfill