Draft Memorandum

date January 20, 2012 Draft – Updated 1/24/2012
to Ballona Wetlands Science Advisory Committee (SAC)
from Ballona Wetlands Project Management Team (PMT) and ESA PWA
subject Ballona Wetlands Restoration

Summary of restoration plan refinements and SAC questions for discussion in the January 23, 2012 SAC meeting

1. INTRODUCTION

1.1 OVERVIEW

The PMT has refined the Ballona Wetlands Restoration plan and alternatives to balance habitat restoration potential with environmental and engineering considerations and address the SAC’s previous recommendations from the 2008 SAC memorandum. The purpose of this memorandum is to provide a summary of restoration project refinements and discussion items for the January 23, 2012 SAC meeting. This memorandum summarizes the following for discussion at the SAC meeting:

- Draft refined restoration goals (Section 2)
- Refinements to the restoration plan since the 2008 Feasibility Study (PWA and others 2008) and a description of the current proposed restoration (Section 3)
- Specific questions that the PMT requests the SAC’s input on in the January 23rd meeting (Section 4)
- Analyses in progress and planned to address previous SAC recommendations (Section 5).

Two previous memoranda document the alternatives refinement process:

- Preferred Alternatives Memorandum (PWA and others 2010). In this memorandum, on-site infrastructure and cultural resource constraints were reviewed and the preferred alternatives from the 2008 Feasibility Report (Alternative 4 and 5) were refined to include additional upland habitat restoration, accommodate wetland transgression with sea-level rise, and re-use material excavated for wetland restoration on-site.
- Preliminary assessment of Alternative 4 culverts to Marina del Rey (ESA PWA 2011). This memorandum evaluated infrastructure constraints associated with installing a new bank of culverts between Area A and Marina del Rey to restore the subtidal embayment proposed in Alternative 4 from the 2008 Feasibility Study. The PMT decided not to pursue Alternative 4 as a preferred alternative based on these infrastructure constraints, which are summarized in Section 3.2.1.1.

Relevant information from these memoranda is summarized in this memorandum.
1.2 ELEVATION DATUMS

Elevations in this memo are presented in the North American Vertical Datum of 1988 (NAVD). Table 1 lists tidal datums relative to NAVD, the mean lower low water (MLLW) tidal datum, and the National Geodetic Vertical Datum of 1929 (NGVD) for comparison. MLLW is the average low tide elevation, and the MLLW datum is commonly used as the project datum for marine projects. In Santa Monica Bay and at the Ballona Wetlands Restoration site, NAVD is similar to MLLW. NGVD is a superceded vertical datum, which is also referred to as the Sea-level Datum of 1929 or “Mean Sea Level” (which is different than the mean sea level or MSL tidal datum at the restoration site).

Table 1. Tidal datums at the Ballona Wetlands Restoration site in MLLW, NAVD and NGVD.

<table>
<thead>
<tr>
<th></th>
<th>MLLW (ft)</th>
<th>NAVD (ft)</th>
<th>NGVD (ft)</th>
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</thead>
<tbody>
<tr>
<td>100-year tide</td>
<td>9.1</td>
<td>8.9</td>
<td>6.5</td>
</tr>
<tr>
<td>Max. observed</td>
<td>8.5</td>
<td>8.3</td>
<td>5.9</td>
</tr>
<tr>
<td>HAT (12/2/1990)</td>
<td>7.3</td>
<td>7.1</td>
<td>4.6</td>
</tr>
<tr>
<td>MHHW</td>
<td>5.4</td>
<td>5.2</td>
<td>2.8</td>
</tr>
<tr>
<td>MHW</td>
<td>4.7</td>
<td>4.5</td>
<td>2.1</td>
</tr>
<tr>
<td>MTL</td>
<td>2.8</td>
<td>2.6</td>
<td>0.2</td>
</tr>
<tr>
<td>MSL</td>
<td>2.8</td>
<td>2.6</td>
<td>0.2</td>
</tr>
<tr>
<td>NGVD</td>
<td>2.6</td>
<td>2.4</td>
<td>0.0</td>
</tr>
<tr>
<td>MLLW</td>
<td>0.9</td>
<td>0.7</td>
<td>-1.7</td>
</tr>
<tr>
<td>NAVD88</td>
<td>0.2</td>
<td>0.0</td>
<td>-2.4</td>
</tr>
<tr>
<td>LAT (1/1/87)</td>
<td>-2.0</td>
<td>-2.2</td>
<td>-4.6</td>
</tr>
<tr>
<td>Min. observed</td>
<td>-2.8</td>
<td>-3.0</td>
<td>-5.5</td>
</tr>
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Notes: Tidal datums from NOAA/NOS Santa Monica Tide Station 9410840
NAVD to NGVD conversion from NOAA/NGS
100-year tide from FEMA (2008) Flood Insurance Study for Los Angeles County (based on studies completed in 1984)
HAT = highest astronomical tide
MHHW = mean higher high water
MHW = mean high water
MTL = mean tide level
MSL = mean sea level
MLW = mean low water
MLLW = mean lower low water
LAT = lowest astronomical tide

2. REFINED RESTORATION GOALS

The PMT is in the process of refining the restoration goals for the purposes of environmental review. The restoration goals were developed by the PMT, SAC, Ballona Wetlands Working Group, Agency Advisory Committee, and the consultant team and are documented in the 2008 Feasibility Report. The draft refined goals and corresponding goals from the 2008 Feasibility Report are listed in Table 2.
Table 2. Draft refined restoration goals.

<table>
<thead>
<tr>
<th>Draft Refined Goal</th>
<th>Corresponding goal from the 2008 Feasibility Report</th>
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<tbody>
<tr>
<td>1. Restore, enhance and create estuarine and associated habitats and processes to support a natural range of habitat structures and functions in the Ballona Wetlands Ecological Reserve (BWER), a regionally important habitat area that represents one of the largest and most important opportunities to restore coastal wetlands in Los Angeles County.</td>
<td>Goal 1</td>
</tr>
<tr>
<td>2. Establish processes and function within the BWER to support estuarine habitats by improving tidal circulation into the wetlands to enlarge the amount of area that is tidally inundated, increase tidal prism and excursion, lower residence time, ensure a more natural salinity gradient, and create a dynamic interaction between Ballona Creek, the Ballona Wetland, and the Santa Monica Bay.</td>
<td>Sub-goal 1.3</td>
</tr>
<tr>
<td>3. Provide landscape-level functions sustaining the multiple levels of biodiversity associated with estuarine systems by strategically preserving, restoring, enhancing, and developing multiple habitats and incorporating transitional and upland habitat links to the wetlands in order to support recruitment and the various life stages of a diverse native flora and fauna.</td>
<td>Goal 1 and sub-goal 1.2 and their objectives</td>
</tr>
<tr>
<td>4. Create a self-sustaining estuarine system by providing large, contiguous areas of diverse intertidal wetland habitat with wide transition and buffer areas to allow for adaptation to sea level rise, minimize the need for active management and reduce impacts of human activities and invasive species.</td>
<td>Goal 2 and sub-goals 2.1 &amp; 2.4</td>
</tr>
</tbody>
</table>
5. Develop and enhance public access, recreation, environmental education and interpretation opportunities within the BWER through the development of appropriate visitor facilities and connections to regional and local trails networks.  

Goal 2 and sub-goal 2.1

<table>
<thead>
<tr>
<th></th>
<th>6. Establish a restored estuarine system that protects and respects cultural and sacred resources, enables cultural use of the site by Native Americans and provides appropriate interpretive information about prior uses of the site.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sub-goal 2.2 and Native American consultation</td>
</tr>
</tbody>
</table>

7. Protect and avoid impacts to existing and planned roadways, utilities, adjacent properties and uses by maintaining or improving flood protection and stormwater management, ensuring consistency with future regional plans and limiting the need for significant modification to regionally important infrastructure.  

Additional goal developed subsequent to 2008 Feasibility Report

8. Ensure public safety, resource protection, and security for adjacent properties, while minimizing security and maintenance costs, by facilitating adequate law enforcement, providing for safe traffic and parking, reducing hazards, and providing appropriate access.  

Goal 2 and sub-goal 2.4

3. PROPOSED RESTORATION PLAN AND REFINEMENTS

The Proposed Restoration is shown in Figure 1a and described in Section 3.1. The Proposed Restoration is a refinement of Alternative 5 from the Feasibility Report. Figures 1b and 1c show previous versions of this alternative from the 2008 Feasibility Report and the 2010 Preferred Alternatives Memorandum, respectively. The primary refinements to the Proposed Restoration are summarized and explained in Section 3.2.  

As discussed in Section 3.2.1.1, the PMT is no longer pursuing Alternative 4 from the Feasibility Report (Figure 2) as part of the proposed restoration plan due to infrastructure constraints associated with installing a new culvert between Area A and Marine del Rey.

3.1 PROPOSED RESTORATION PROJECT DESCRIPTION

The Proposed Restoration would restore estuarine wetland and upland habitats that are connected to a realigned Ballona Creek. As shown in Figure 1a, the existing Ballona Creek levees would be removed and
the channel would be realigned to restore a more natural meandering channel. The site would be interconnected across Areas A and B, with shallow subtidal and mudflat habitats along the Ballona Creek channel banks sloping up to vegetated marsh, wetland-upland transition zone, and upland habitats. Tributary tidal channel networks would be created to extend from the realigned Ballona Creek through the restored wetlands. Figure 3 shows a preliminary draft layout sketch of tributary tidal channel networks, which is currently being refined and is included only to show the channel concept.

The following description of the Proposed Restoration is focused on the restoration layout, features, and grading plan. Other elements of the restoration plan are in development, including a revegetation plan, adaptive management plan, and public access plan.

3.1.1 Ballona Creek Channel Realignment

The Ballona Creek channel would be restored across the site, beginning west of the Culver Bridge and extending through the site to the southwest (downstream) project boundary. The existing levees would be removed, and a more sinuous channel with two meander bends would be created through the site. Channel depths would be similar to existing depths. The restored channel banks would be graded to slopes1 of approximately 5 to 10:1 to provide mudflat and low marsh habitat. The existing Ballona Creek channel would be filled between the meanders. The proposed channel alignment is designed to mimic natural channel forms and support the desired habitat, vegetation and wildlife species. The channel alignment is also intended to avoid cultural resource areas identified by a Tongva tribal representative.

Once constructed, the earthen channel would not be confined to a rigid alignment. Some gradual channel migration and localized erosion and sedimentation would occur. The overall channel location would be guided by the sloping restored marshplain and adjacent upland habitats. The channel alignment would only be fixed at those locations where it is required to protect adjacent infrastructure. In these locations, the restoration proposes some setback bank armoring (buried rock protection). The restored Ballona Creek banks and floodplain would experience periodic erosion and deposition, which are typical for a natural river/estuary environment. The goal is to accommodate and support this level of channel and floodplain dynamics, while protecting developed areas outside the project boundaries. While these active processes may require periodic maintenance and adaptive management, they will also benefit ecological processes such as natural disturbance regimes. Initial results of channel dynamics and erosion potential are discussed in Section 5.1. The channel alignment and expected range of changes will be assessed further during environmental review and future engineering design phases of the restoration.

3.1.2 Area B

Restoration of Area B would include:
- A new levee north of Culver Blvd. (Section 3.1.2.1)
- Creation of upland peninsulas and restored wetlands between the new levee and the realigned Ballona Creek channel (Section 3.1.2.2)
- Full tidal wetland restoration of the existing managed muted tidal marsh in west Area B (Section 3.1.2.3)
- Managed wetland and upland restoration inboard (behind) the new levee (Section 3.1.2.4)

3.1.2.1 Culver Levee

A new levee would be constructed north of Culver Blvd. to replace the existing south Ballona Creek levee and provide flood protection for Culver Blvd. and areas to the south. The existing roads and underground

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1 All slopes in this memo are given as the ratio of horizontal to vertical distance (i.e., horizontal:vertical).
high-voltage power transmission line within the southern Culver Blvd. road embankment would remain in place.

The levee would be constructed with gradual levee slopes of about 20:1 or flatter to provide an upland transition zone up to an elevation of about 11 ft NAVD. Section 3.2.3 describes how these transition and upland habitats would allow for wetland transgression with future sea-level rise. Above this gentle upland transition zone slope, a steeper slope of about 5:1 would be graded from 11 ft NAVD up to the crests of the new levee. The levee crest elevation may be up to about 20 ft NAVD, which would include an allowance for sea-level rise and improve the existing level of flood protection. Section 5.2 discussed flood management analysis planned for environmental review.

The new levee would be designed to allow future relocation of Culver Blvd. to the top of the levee and through the upland area between Culver Blvd. and Jefferson Blvd., as well as consolidation of portions of Culver Blvd. and Jefferson Blvd. The western section of the levee would be built with a wider top width to allow for the future option of Culver Blvd. to be raised on top of the levee by another agency and to re-use soil excavated to restore wetlands in Area A.

North of the businesses at the west end of Culver Blvd., the levee would be offset from the property boundary to allow for a vehicle access lane, bike path, and stormwater detention and treatment wetland to improve stormwater drainage and reduce localized flooding at the west end of Culver Blvd.

At the southwest corner of the restoration site, the new levee would tie in with the existing high ground along the western boundary of Area B. The northeastern end of the new levee would tie in with the existing Ballona Creek levee at the Culver Blvd. Bridge.

3.1.2.2 Upland Habitat Peninsulas and Adjacent Wetland Restoration

Between the new levee and the realigned portion of Ballona Creek, the restoration proposes to create two upland habitat peninsulas north of the new levee and a gently-sloping transition from upland habitats along the levee through vegetated marsh habitat and mudflat habitat along the restored Ballona Creek channel banks. The two upland peninsulas are intended to provide larger areas of upland habitat and high tide refuge for wildlife along the south side of the channel. The peninsulas are also intended to guide high creek flows through the realigned Ballona Creek channel and reduce the potential for the creek to cause erosion near the new levee, as well as beneficially re-use soil excavated to restore wetlands in Area A.

Existing elevations in this portion of Area B range from about 6 to 9 ft NAVD. The higher areas are filled to above current marsh habitat elevations. Fill would be placed to create the two peninsulas, and adjacent areas would be graded and excavated to create marsh habitats. The tops of the peninsulas would be at an elevation of about 11 feet NAVD and would gently slope down to marsh habitats at a slope of approximately 20:1 or less. The marsh habitats around the peninsulas would slope from upland habitats along the levee towards the channel at slopes of approximately 250 to 300:1.

3.1.2.3 West Area B Full Tidal Wetland Restoration

In west Area B (i.e., the existing managed pickleweed mid marsh, high marsh, and salt pan habitat northwest of Culver Blvd.), the existing muted tidal managed wetland habitat would be restored to full tidal wetland by removing the existing tide gate, creating an open tidal channel by breaching the existing Ballona Creek levee, and removing/ lowering the Ballona Creek levee. The open tidal channel would provide a full range of tides and creek water levels in west Area B. The existing levee would be lowered to create mid or high marsh (at an elevation around mean higher high water).
The west Area B managed marsh is at elevations that would support mudflat, low marsh, and mid marsh habitat after full tidal restoration. These areas would therefore remain at existing grade (without grading to raise or lower the marshplain). The existing salt pan and a large portion of the pickleweed vegetation in this area are at elevations that would support mudflat and low marsh under full tidal conditions. These areas are expected to convert to mudflat habitat over time after restoration because natural recruitment of cordgrass is not likely to occur at the Ballona restoration site (C. Nordby, pers. comm.) and the pickleweed may not persist at low marsh elevations. The PMT is considering the option of selectively planting and/or seeding native cordgrass to encourage low marsh habitat development in this area (see Section 4.3). The existing system of channels in the managed marsh would be enhanced by excavating new channels. The restoration plans to re-create salt pan habitat within the gently-sloping high marsh and transition zone habitats along the Culver levee and the perimeter of the restored wetlands in Area A (see Section 3.1.3).

The existing transition zone habitats (e.g., brackish marsh, riparian scrub, etc.) and dune habitat along the western edge of Area B would be retained. Portions of these habitats would be inundated during extreme high tide events and Ballona Creek flood events as discussed in Section 4.2. The ecological effects of increased inundation is a question identified for SAC input in Section 4.2.

The gas wells in west Area B would be decommissioned prior to restoration, and portions of the gas well pads and roads in the marsh would be lowered to marsh elevations and restored to wetland habitats.

3.1.2.4 Managed Wetland and Upland Restoration Inboard of the Culver Levee

Inboard or behind the new levee, the following areas would be restored:

- The existing muted tidal managed wetland south of Culver Blvd. and west of the Gas Company road (referred to as south Area B) would be retained and enhanced by restoring tidal channels.
- The existing non-tidal pickleweed seasonal wetland south of Jefferson Blvd. and east of the Gas Company road (southeast Area B) would be restored to managed tidal wetland by providing a new tidal connection and creating tidal channels.
- In the existing area of upland and seasonal wetland between Culver Blvd., Jefferson Blvd., and Lincoln Blvd., soil excavated to restore wetlands in Area A would be placed (up to an elevation of approximately 25 ft NAVD or height of approximately 20 ft) and upland habitats would be restored.

In the south Area B managed wetland enhancement and southeast Area B managed wetland restoration, culverts with self-regulating tide gates or similar structures would provide a full range of tides (up to an elevation acceptable for flood management), but would close during infrequent storm events in Ballona Creek to limit high water levels in south and southeast Area B. As shown in Figure 1a, a culvert and tide gate would be installed in the new levee (and under Culver Blvd.) between south and west Area B. A second culvert connection and tide gate may be installed to restore a tidal connection between southeast Area B and Ballona Creek under Jefferson and Lincoln Blvd. as shown in Figure 1a.

**Tidal channels.** The existing areas of pickleweed and other mid marsh plants in south Area B and southeast Area B are at the appropriate tidal elevations to persist as mid marsh habitat after restoration. New tidal channels would be excavated in south and southeast Area B to restore sinuous and branching networks of tidal channels through the wetlands. The largest channels would be about 3 ft deep at MLLW, or up to about 9 ft below the restored marshplain (channel bed elevations of about -3 ft NAVD). Smaller channels would be intertidal and would drain at low tide, with channel depths of about 2 to 5 ft below the restored marshplain (channel bed elevations of about 0 to 3 ft NAVD).
Brackish marsh. An area of brackish marsh would be created in southeast Area B, between the restored salt marsh and the Freshwater Marsh, with outflow from the Freshwater Marsh mixing with tidal flows to support the brackish marsh. The Freshwater Marsh would be retained and operated as it is at present; however, a portion of the Freshwater Marsh outflow would be routed through the restored brackish marsh via the existing overflow weir. The weir may be modified or a new culvert and gate may be installed in the Freshwater Marsh levee as needed to allow discharge from the Freshwater Marsh to southeast Area B. Freshwater Marsh outflows are expected to support some area of brackish marsh. The brackish marsh design will be detailed in future phases of the project and may include channels to connect to the Freshwater Marsh outflow, fill placement to raise the brackish marsh area to a higher elevation within the tide range to limit tidal inundation with saline water, or a low berm between the restored salt marsh and brackish marsh areas with water control structures (e.g., weirs) to manage the influence of saline tidal water in the brackish marsh. Brackish marsh salinities could be adaptively managed by adjusting water control structures to vary the amount of freshwater outflow and/or saline tidal inflows.

3.1.3 Area A

The existing elevations in Area A, which range from about 10 to 23 ft NAVD, are 5 to 18 ft above present-day wetland elevations due to the placement of dredged material during the construction of Marina Del Rey. The restoration proposes to excavate and grade Area A to restore marsh, transition zone, and upland habitats. The restoration would create a long gently-sloping transition from upland habitats along the northern perimeter of Area A down through vegetated marsh habitat and mudflat habitat along the banks of the restored Ballona Creek channel. Area A would generally slope from north to south from about 11 ft NAVD to 4.5 ft NAVD, with slopes of about 150 to 250:1. Section 3.2.3 describes how these gentle slopes are intended to accommodate wetland habitat transgression with future sea-level rise. This feature addresses the State Coastal Conservancy’s Climate Change Policy and the SAC’s recommendation to increase project resiliency to sea-level rise.

Salt pan habitat. The slopes would vary somewhat to create microtopography. Slight depressions would be created in high marsh and transition habitats to encourage the formation of salt pan habitat. Depressions may also be created higher up in transition and upland habitat to provide areas for future salt pan formation with sea-level rise. The design of salt pan habitat would be developed further in future phases of the project. Also, depending on the revegetation approach in restored marsh areas (i.e., if the restoration relies on natural recruitment of marsh vegetation), areas of unvegetated salt pan may develop and persist for some time before more complete vegetation colonization occurs.

Tidal channels. Sinuous and branching tidal channel networks would be excavated through the restored marsh habitats. These tidal channel systems would connect to the restored Ballona Creek channel to create tributary tidal channel networks. Channel depths would be similar to channel depths described for Area B (see Section 3.1.2.4 above), with the larger subtidal channels branching into smaller intertidal channels. Figure 3 shows a preliminary draft conceptual layout of tidal channels.

Perimeter levee and Fiji Channel. The upland perimeter around the restored wetlands would be raised and/or re-graded to provide a flood protection levee. This levee would replace the Ballona Creek levee and maintain or improve the existing level of flood protection for Fiji Way from Ballona Creek flooding. This levee would separate the restored wetlands from the Fiji channel. The Fiji channel would be realigned to create a new tidal channel that meanders through restored marsh habitat along the northern edge of Area A. The restored Fiji channel would maintain the same connection to Marina del Rey, and would not be connected to Ballona Creek.

Soil re-use. Material excavated from Area A would be used to construct the new levee, transition zones, and upland peninsulas in Area B. Additional excavated material would be re-used on-site to benefit the
restoration and reduce the amount of surplus soil that would otherwise need to be disposed of off-site. Up to approximately 1.5 million cubic yards of additional fill material may be available after construction of restoration elements in Areas A and B. This material would be placed in upland restoration areas in Areas B and C.

3.1.4 Area C

In Area C, the restoration would enhance and restore upland habitats in Area C, with an emphasis on Coastal Sage Scrub and native grassland habitat. Soil excavated to restore wetlands in Area A would be placed in Area C to create an elevated area of upland habitat. Existing elevations in Area C range from about 12 to 28 ft NAVD. Soil would be placed in Area C up to a height of about 15 to 20 ft (elevation 30 to 40 ft NAVD). Soil re-use in other areas of the site and/or off-site disposal of soil material would lower the height. Seasonal wetland habitat may be restored at the base and/or top of the upland areas. The upland areas would be graded so that rainfall would flow into and support seasonal wetlands and other upland habitats in Area C.

An existing storm drain ditch runs through northwest Area C from Culver Blvd. to the Lincoln Blvd. storm drain system, with an overflow culvert under Lincoln Blvd. to the Fiji channel. The existing ditch would be replaced with a buried culvert to maintain the Culver Blvd. storm drain.

A small treatment wetland would also be constructed along the north boundary of Area C to treat off-site stormwater runoff that flows through this area before draining to Ballona Creek.

3.2 RESTORATION PLAN REFINEMENTS

A synthesis of the key refinements to the Proposed Restoration is discussed below. Note that the PMT is no longer considering Alternative 4 from the Feasibility Study as part of the proposed restoration plan due to the infrastructure constraints discussed in Section 3.2.1.

3.2.1 Restoration Construction Considerations

The selection and refinement of the Proposed Restoration based on restoration construction considerations is summarized below, including the PMT’s decision to not pursue Alternative 4 as part of the proposed restoration plan.

3.2.1.1 Feasibility Report Alternative 4 Culvert Construction Constraints

ESA PWA (2011) reviewed infrastructures constraints and technical issues associated with constructing new culvert tidal connections between Area A and Marina del Rey under Fiji Way for Alternative 4 from the 2008 Feasibility Report. Based on this review, new culvert construction for Alternative 4 was found to be significantly constrained by potential impacts to the existing Marina del Rey sea wall and multiple underground utilities in Fiji Way. Culvert construction is also constrained by the easements and agreements and long-term maintenance that would be required, and by the potential effects on navigation at the culvert entrance in Marina del Rey. These constraints are likely to complicate planning, design and construction and increase construction costs and timelines, as well as long-term maintenance costs. Due to these constraints, the PMT decided not to pursue Alternative 4 as part of the proposed restoration plan.

3.2.1.2 Construction Considerations & Refinements for the Proposed Restoration

After the completion of the 2008 Feasibility Report, an engineering review of construction considerations and infrastructure constraints was performed and the Proposed Restoration was refined to balance habitat
restoration potential with environmental and construction considerations. The key considerations and refinements were:

- **On-site re-use of material excavated to restore wetlands.** The Proposed Restoration was refined to balance the volume of excavated material (from Area A) with the volume of material placed to construct the new levee in Area B and in upland habitat restoration areas in Areas C, B, A. Including upland habitat in Areas A, B, and C creates a diverse mix of habitat and allow for soil placement in these upland areas. The Area A restoration was refined to include a gradual transition from wetland through transition and upland habitats, which reduced the excavation volume and increased the restoration’s resiliency to sea-level rise as discussed in Section 3.2.3. The on-site re-use of all excavated material would eliminate or reduce the need to dispose of excavated material off-site, which reduces the cost and complexity of restoration implementation.

- **Avoid modifications to the existing roadways and high voltage power transmission line.** The Proposed Restoration was refined to include a new levee north of Culver Blvd. so that Culver Blvd., Jefferson Blvd., and the high voltage power transmission line buried in the shoulder of Culver Blvd. would not need to be modified. This refinement reduces construction costs and complexities as well as potential impacts associated with realigning these roads and the power transmission line. As a result of this refinement, the wetlands south of the levee would be restored as managed wetlands with culverts and tide gate connections through the levee to the full tidal restored wetlands and Ballona Creek.

- **Avoid potential cultural resources sites.** The configuration of the Proposed Restoration was refined to avoid potential cultural resource sites identified by a Tongva tribal representative (PWA and others 2010).

### 3.2.2 Refined Mix of Habitats

**Upland habitat.** The Proposed Restoration was refined to include a larger proportion of restored upland and transition zone habitats connected to wetland habitats. This provides a greater diversity of habitat, supports wetland transition and upland ecotone and buffer functions, and allows for on-site re-use of soil excavated to restore wetlands. This refinement also addresses the SAC’s recommendation to evaluate the “ability to include additional upland habitat for both intrinsic value and as a buffer to the restored wetlands” and to “…consider restoring Area C as primarily upland or transitional habitat” (SAC 2008).

The restored upland and transition habitat areas include the perimeter of Area A, Area C, and the following areas within Area B:

- Gradual upland and transition zone habitat slope (20:1) along the new Culver levee.
- Area between Culver Blvd., Jefferson Blvd., and Lincoln Blvd.
- Upland habitat peninsulas. These peninsulas provide larger areas of upland refuge habitat connected to the wetlands to supplement the narrower perimeter of upland habitat along the levee. The peninsulas are also intended to guide flow in the realigned Ballona Creek channel and beneficially re-use excavated soil.

Restored upland habitats would consist primarily of Coastal Sage Scrub and native grasslands. Seasonal wetlands and/or vernal pools would also be restored as possible/appropriate, primarily on the tops of the restored upland areas in Area C and in Area B between Culver Blvd., Jefferson Blvd., and Lincoln Blvd. The mix of upland habitats and the revegetation plan will be developed in future phases of the restoration. This refinement addresses the SAC’s recommendation to pursue “opportunities to create regionally significant habitat including vernal pools and native grasslands… but not at the expense of the restoration of estuarine habitat” (SAC 2008).
Salt pan. As discussed in Section 3.1.3, the formation of salt pan habitat would be encouraged by creating slight microtopography depressions in the wide high marsh/transition zone habitat perimeter around Area A and along the narrower high marsh/transition zone habitat perimeter along the new Culver levee.

Managed wetland. As discussed in Section 3.1.2.4, wetland areas inboard of the new levee would be restored as managed wetlands with culvert and tide gate connections. The design and management of the restored managed wetlands will be developed further in future phases of the project. These restored managed wetlands would be designed to provide a full range of tides (up to an elevation acceptable for flood management) and the flexibility to manage water levels for specific habitats and/or species. As sea level rises over time, the managed marsh habitat could be maintained by muting the tide range and high tide level, which would progressively decrease the tide range. This will likely be necessary in southeast Area B to maintain high tide levels below acceptable levels for operation of the Freshwater Marsh.

Target species analysis. A potential target species analysis was performed per the SAC’s recommendation and is documented in the 2010 Preferred Alternatives Memo (PWA and others 2010). This analysis addressed the SAC’s previous comment that the restoration should consider the “potential ability of the restored wetland to support target species (to be defined in coordination with the SAC) as an additional measure of change…” and that the restoration alternatives “should be evaluated for both the species that it would or would not be likely to support” (SAC 2008). The results of the potential target species analysis indicated that the restoration would provide significant improvements to habitats that support species considered in the analysis, which included terrestrial and aquatic invertebrates, fishes, birds, herpetofauna, and mammals. The results showed that the restoration would support a diverse mix of habitats focused on salt marsh habitat (low marsh to transition), which support a wide range of species either as essential primary habitat (e.g., many plant, bird, invertebrate, small mammal and herpetofauna species) or secondary habitat (e.g., many fish species).

3.2.3 Resiliency to Sea-level Rise

The Proposed Restoration was refined to include broad transitional slopes between wetland and upland habitats to allow wetland habitats to transgress landward with sea level rise as the primary sea-level rise adaptation strategy for the restoration (PWA and others 2008). This refinement is consistent with the State Coastal Conservancy’s Climate Change Policy, which calls for assessing project vulnerability and, to the extent feasible, reducing expected risks and increasing resiliency to sea-level rise. This refinement also addresses the SAC’s comment to assess the “potential effects of sea level rise on long-term sustainability and/or adaptability of restored wetlands” (SAC 2008). Potential adaptive management responses to sea-level rise may also be considered within an adaptive management plan.

Sediment supply from the Ballona Creek watershed and Santa Monica Bay is expected to be low, as are sedimentation and accretion/aggradation of the restored wetland surface (marshplain). Wetland accretion rates are not expected to keep pace with sea-level rise over time. Wetland habitats types are generally found within a range of elevations related to specific tidal inundation frequencies that are suitable for associated plant types. As tide levels and wetland inundation frequencies increase with sea level rise, wetland habitat types would likely be converted to habitats that occupy lower portions of the tide frame (e.g., conversion of vegetated marsh to mudflat) (see Section 3.3 for habitat projections for sea-level scenarios including wetland accretion estimates).

To better accommodate future sea level rise, the Proposed Restoration includes grading long gradually sloping transitions from mudflat to upland habitat in Area A. These gradual slopes are intended to allow wetland habitats to transgress up slope with rising sea levels through the conversion of upland transition habitats to wetland habitats. This process of “coastal rollover” has occurred over geologic time, and is expected to continue and accelerate with projected sea level rise.
Figure 4 shows a conceptual cross-section of the restored grade for the Proposed Restoration from the south (Ballona Creek) to the north (Fiji Way). Habitat types expected post-restoration are shown conceptually, with narrow bands of mudflat and low salt marsh along the Ballona Creek channel bank and broad areas of mid marsh, high marsh, transition zone, and upland habitats. With 1.3 ft (16 in.) of sea-level rise and associated increased inundation frequencies, mid marsh may be converted to mudflat and low marsh, high marsh may be converted to mid marsh, and the transition zone may “squeeze” upland habitats into a narrow band along the steeper upland/levee slope. With 4.6 ft (55 in.) of SLR, the site may be converted to a mix of mudflat, low marsh, and mid marsh, with high marsh and transition zone habitats “squeezed” onto the levee slope. The restored slopes of Area A are intended to maintain the restored area of vegetated mid marsh with 55 in. of SLR. The Proposed Restoration therefore includes large areas of upland and transition zone habitats around the perimeter of Area A that are expected to be converted to wetland habitats over time. These restored upland and transition habitats are expected to provide interim habitat benefits and avoid the cost of initially grading these areas to wetland habitat elevations.

This simplified conceptual model of restored wetland response to sea-level rise does not consider more complex ecological processes and responses that will likely occur.

3.2.4 Project Phasing

Restoration project phasing was refined by identifying a series of construction stages. Attachment 1 includes a summary and figures of construction stages. Each stage is expected to require multiple years of construction. Phasing the project in this way will allow for evaluation of the outcomes of early restoration stages and refinement of the restoration design for later stages based on these results. This refinement addresses the SAC’s previous comment that the restoration “should be implemented in phases to allow mid-course corrections and re-evaluation of progress toward achieving project goals” and “so that impacts to existing species and habitats can be minimized as restoration proceeds” (SAC 2008). Future phases of restoration planning will further consider existing species and habitat management within the phasing plan.

3.3 HABITAT ACREAGES AND PROJECTIONS

Restored habitat acreage estimates. Table 3 lists restored habitat acreages estimated for the Proposed Restoration. As mentioned above, wetland habitats types are generally found within a range of elevations related to specific tidal inundation frequencies that are suitable for associated plant types. The restored habitat acreage estimates are based on the proposed restoration grading (restored wetland elevations) and habitat elevation ranges defined by specific tide levels (a surrogate for inundation frequency). Table 3 lists the habitat elevation ranges and Figure 5a shows the restored habitat zones. Note that the acreage estimates assume the restored low marsh habitat would be vegetated marsh, which may depend on the low marsh revegetation approach (see Section 4.3).

For comparison, Table 3 includes existing habitat acreages from the California Department of Fish & Game’s (2007) habitat and vegetation mapping (shown in Figure 6), as well as historic habitat acreages from the Historical Wetlands of the Southern California Coast Atlas (Grossinger and others 2011) interpretation of the 1876 topographic map and historical records (shown in Figure 7). Note that the basis and habitat categories used for the historic, existing, and restored habitat acreage estimates differ.

Projected habitat acreages for sea-level rise scenarios. Table 3 also includes estimated habitat acreages projected for future sea-level rise scenarios. The sea-level projections are based on U.S Army Corps of Engineer’s sea-level rise guidance (NRC-III sea-level rise curve), which agree with and are within the range of sea-level rise projections recommended for State planning. The scenarios are:
• 2030: 0.54 ft (6.5 in) of sea-level rise
• 2050: 1.36 ft (16.3 in) of sea-level rise (compared to 10 – 17 in per State planning guidance)
• 2100: 4.58 ft (55 in) of sea-level rise (compared to 31 – 69 in per State planning guidance)

Wetland accretion was estimated using a vertical estuarine sedimentation model. The model calculates vertical accretion based on a constant suspended sediment concentration, the depth and duration of tidal inundation from a tide series and sea-level rise curve, and the bulk density of deposited material. An average suspended sediment concentration of 50 mg/L was selected based on an initial review of event-based sediment sampling data from LA County and SCCWRP and professional judgment. The modeled accretion includes an organic accretion rate of 1 mm/yr within vegetated marsh habitat zones. The resulting modeled accretion rate is 5 mm/yr for subtidal areas, and tapers off to approximately 1.5 mm/yr for marshes near the elevation of mean higher high water, which are inundated less frequently and therefore experience less sediment deposition. This preliminary accretion rate estimate is subject to future refinement.

The modeled accretion curves were applied to the restored wetland elevation surface to simulate wetland accretion. Projected habitat acreages were estimated from the simulated future wetland elevation surface and habitat elevation ranges adjusted for sea-level rise. Figures 5b, c, and d show the projected habitat zones for 2030, 2050, and 2100, respectively.
Table 3. Habitat acreage estimates and projections.

<table>
<thead>
<tr>
<th>Habitat Type</th>
<th>1876 Habitat</th>
<th>Existing Habitat</th>
<th>Restored Habitat Post-rest.</th>
<th>Restored Habitat 2030 Projection</th>
<th>Restored Habitat 2050 Projection</th>
<th>Restored Habitat 2100 Projection</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ac</td>
<td>%</td>
<td>ac</td>
<td>%</td>
<td>ac</td>
<td>%</td>
<td>ac</td>
</tr>
<tr>
<td>Subtidal</td>
<td>103</td>
<td>6%</td>
<td>40</td>
<td>27%</td>
<td>43</td>
<td>14%</td>
<td>44</td>
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<tr>
<td>Mudflat</td>
<td>281</td>
<td>16%</td>
<td>15</td>
<td>10%</td>
<td>40</td>
<td>13%</td>
<td>47</td>
</tr>
<tr>
<td>Vegetated marsh</td>
<td>1238</td>
<td>70%</td>
<td>70</td>
<td>47%</td>
<td>200</td>
<td>66%</td>
<td>203</td>
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<tr>
<td>Low salt marsh</td>
<td>NA</td>
<td>NA</td>
<td>9</td>
<td>6%</td>
<td>49</td>
<td>16%</td>
<td>61</td>
</tr>
<tr>
<td>Mid salt marsh</td>
<td>NA</td>
<td>NA</td>
<td>18</td>
<td>12%</td>
<td>103</td>
<td>34%</td>
<td>99</td>
</tr>
<tr>
<td>High salt marsh</td>
<td>NA</td>
<td>NA</td>
<td>41</td>
<td>28%</td>
<td>34</td>
<td>11%</td>
<td>30</td>
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<tr>
<td>Brackish marsh</td>
<td>NA</td>
<td>NA</td>
<td>3</td>
<td>2%</td>
<td>13</td>
<td>4%</td>
<td>13</td>
</tr>
<tr>
<td>Salt pan</td>
<td>135</td>
<td>8%</td>
<td>22</td>
<td>15%</td>
<td>20</td>
<td>6%</td>
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<td>3</td>
<td>NA</td>
<td>3</td>
<td>NA</td>
<td>3</td>
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<td>Estuarine TOTAL</td>
<td>1757</td>
<td>99.7%</td>
<td>148</td>
<td>22%</td>
<td>354</td>
<td>53%</td>
<td>368</td>
</tr>
<tr>
<td>Full tidal</td>
<td>1757</td>
<td>99.7%</td>
<td>54</td>
<td>8%</td>
<td>254</td>
<td>38%</td>
<td>267</td>
</tr>
<tr>
<td>Managed</td>
<td>0</td>
<td>0%</td>
<td>94</td>
<td>14%</td>
<td>100</td>
<td>15%</td>
<td>100</td>
</tr>
<tr>
<td>Fresh water marsh</td>
<td>NA</td>
<td>NA</td>
<td>1</td>
<td>1%</td>
<td>1</td>
<td>4%</td>
<td>1</td>
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<tr>
<td>Seasonal wetland</td>
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<td>NA</td>
<td>86</td>
<td>77%</td>
<td>4</td>
<td>13%</td>
<td>4</td>
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<tr>
<td>Riparian scrub</td>
<td>NA</td>
<td>NA</td>
<td>22</td>
<td>19%</td>
<td>22</td>
<td>73%</td>
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<td>Riparian woodland</td>
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<td>100%</td>
<td>3</td>
<td>3%</td>
<td>3</td>
<td>10%</td>
<td>3</td>
</tr>
<tr>
<td>Freshwater/Riparian TOTAL</td>
<td>5</td>
<td>0.3%</td>
<td>111</td>
<td>17%</td>
<td>30</td>
<td>4%</td>
<td>29</td>
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<tr>
<td>Grassland / Herbaceous</td>
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<td>NA</td>
<td>176</td>
<td>62%</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Coastal Scrub</td>
<td>NA</td>
<td>NA</td>
<td>94</td>
<td>33%</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
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<tr>
<td>Coastal Dunes</td>
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<td>NA</td>
<td>12</td>
<td>4%</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Forest / Woodland</td>
<td>NA</td>
<td>NA</td>
<td>1</td>
<td>0%</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Upland TOTAL</td>
<td>NA</td>
<td>NA</td>
<td>283</td>
<td>43%</td>
<td>171</td>
<td>26%</td>
<td>157</td>
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<tr>
<td>The Freshwater Marsh</td>
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<td>NA</td>
<td>40</td>
<td>32%</td>
<td>NA</td>
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<td>40</td>
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<td>Gas Co. parcel</td>
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<td>19</td>
<td>16%</td>
<td>19</td>
<td>18%</td>
<td>19</td>
</tr>
<tr>
<td>Other (roads, etc.)</td>
<td>NA</td>
<td>NA</td>
<td>64</td>
<td>52%</td>
<td>52</td>
<td>47%</td>
<td>52</td>
</tr>
<tr>
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<td>19%</td>
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<td>111</td>
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<tr>
<td>Total</td>
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<td>100%</td>
<td>665</td>
<td>100%</td>
<td>665</td>
<td>100%</td>
<td>665</td>
</tr>
</tbody>
</table>

NA = not available / not applicable
1 - Existing estuarine/marsh habitat type is based on vegetation; restored estuarine habitat type is based on elevation within the tide frame as noted
2 - Percentages for sub-habitats shown as the percentage of the total habitat type (e.g., for vegetated marsh post-restoration, X% of the estuarine habitat is vegetated marsh)
3 - Transition zone not included/not estimated for historic and existing acreages
4 - Transition zone is not included in the restored estuarine sub-habitat percentages to allow for comparison of estuarine habitat distribution between historic, existing, and restored conditions
5 - Top of mudflat at 1 ft above MTL, similar to San Dieguito (Josselyn and Whelchel 1999)
6 - Top of low marsh at MHW, similar to (0.2 ft lower than) San Dieguito (Josselyn and Whelchel 1999)
7 - Top of mid marsh is 1 ft above MHHW, consistent with San Dieguito (Josselyn and Whelchel 1999); exceeded by spring tides
8 - Top of high marsh 0.2 ft above Highest Astronomical Tide (HAT) and 1 ft below highest observed tide level. Consistent with Zedler (2001).
9 - Top of transition zone per Zedler (2001)
4. QUESTIONS FOR THE SAC

The PMT requests the SAC’s input on the following questions to inform further refinement and evaluation of the proposed restoration.

4.1 WEST AREA B FULL TIDAL RESTORATION

The Proposed Restoration includes full tidal restoration of the existing west Area B muted tidal wetland based on the benefits and tradeoffs of full tidal wetlands compared to managed wetlands summarized below. The restoration will evaluate the potential effects of full tidal restoration on existing habitats in west Area B and consider maintaining west Area B as managed muted tidal wetland as a restoration alternative during environmental review. The PMT requests the SAC’s input on potential effects and the approach to evaluating these effects.

A general question for the SAC to consider is whether full tidal restoration of the existing muted tidal managed wetland in west Area B and conversion of this marsh/salt pan area to mudflat over time (with development of marsh and salt pan habitat in other areas of the restoration) is preferable to maintaining the existing muted tidal wetland habitat. Specific questions relating to the potential effects of increased inundation of the existing marsh vegetation and transitional/dune habitats are discussed in Section 4.1.1 and 4.1.2, respectively.

Benefits and tradeoffs of full tidal wetlands and managed wetlands. The benefits and tradeoffs between restoring full tidal wetlands and maintaining managed muted tidal wetlands in West Area B are briefly summarized below in terms of hydrology, water quality, biology, sustainability to sea-level rise, and operations & maintenance based on the 2008 Feasibility Report.

Hydrology. Hydrology considerations include:
- Breaches provide full tidal circulation and a full tide range
- The open connection between the Area B wetlands and Ballona Creek would create brackish and freshwater conditions within the wetlands during Ballona Creek storm events
- A larger restored open channel would have lower flow velocities characteristic of natural tidal wetlands compared to the existing culverts
- The potential for blockage is greater for gates and culverts, compared to an open breach, due to the smaller size of the opening and the presence of moving parts.
- Failure of a gate in the open position, due to trapping of debris or the failure of the control mechanism, may allow increased water levels in the restored wetlands
- Failure of a gate in the closed position could delay drainage of tidal habitats.

Water quality. Gated culverts provide the ability to close the gates and prevent Ballona Creek storm flows and associated pollutants from entering the restored wetlands. Alternatively, the restored wetlands are expected to provide some water quality treatment functions. Full tidal restoration allows for any potential stormwater treatment benefits to occur within the wetlands. Water quality and pollutant effects will be analyzed further as discussed n Section 5.3.

Biology. Gates and trash grilles can impede the movement of sediment, seeds, fish and fish larvae. These restrictions would not be present with breaches. The open levee breaches would function as natural tidal channels for access by fish and other biota.

Sustainability to sea-level rise. The existing culverts would become submerged with sea-level rise. The culverts may increasingly function more as siphons as sea level rises (i.e., the culverts would be below the
tide levels), which may be less desirable for fish access. High tides can be muted to maintain the vegetated marsh in west Area B for a certain period of time; however, the increase in low tide levels in Santa Monica Bay and Ballona Creek with sea-level rise will gradually reduce the tide range and tidal circulation in the muted tidal wetlands. Eventually, pumps would be required to manage water levels to maintain the vegetated marsh. Alternatively, the muted high tide level could be increased over time, which would eventually lead to conversion of the vegetated marsh to mudflat habitat.

In comparison, full tidal wetlands in west Area B are expected adapt to sea-level rise over-time as discussed in Section 3.3 and illustrated in Figures 5a – 5d.

**Operations & maintenance.** O&M requirements differ for managed wetlands with gated culverts versus full tidal wetland with open levee breaches. In general, gated culverts require greater and more frequent O&M activities and have higher O&M costs than open levee breaches, which in contrast are designed to be self-maintaining.

### 4.1.1 West Area B Muted Tidal Pickleweed Marsh

The existing muted tidal marsh in the west Area B consists of mid and high marsh vegetation species, including *Salicornia virginica*, *Jaumea carnosa*, *Salicornia subterminalis*, *Cressa truxillensis*, and *Distichlis spicata*. Existing marsh elevations range from approximately 3.5 to 4.5 ft NAVD. Under existing muted tidal conditions, this habitat is inundated approximately 0% - 23% of the time (PWA and others 2008). With full tidal restoration, the pickleweed habitat would be at low marsh habitat elevations (between 1 ft above mean tide level and mean high water) and would be inundated approximately 28% - 51% of the time. Data from Zedler (2001) shows the lowest elevations surveyed for these marsh vegetation types in San Diego County range from 4.1 to 4.8 ft NAVD. Figure 8 shows the elevation of the existing vegetation relative to the lower elevation limit for the dominant vegetation type (i.e., how far above or below the vegetation is relative the lower limit for that particular type of vegetation). Thus, a portion of the existing marsh vegetation is at a lower elevation than found in the surveyed full tidal wetlands and may therefore be subject to greater inundation than this vegetation can normally tolerate.

The PMT requests the SAC’s input on evaluating how the existing marsh vegetation would respond to this increase in inundation, and whether slowly increasing tidal inundation by managing water levels with the existing self-regulation tide gate prior to full tidal restoration would help to maintain the vegetation after full tidal restoration.

### 4.1.2 West Area B Transition and Dune Habitats

With full tidal restoration of the existing muted tidal managed marsh in west Area B, portions of the existing transition and dune habitats along the western boundary of the restoration project area would be inundated during extreme tide events and Ballona Creek flood events. A preliminary assessment of the potential increased inundation of the West Area B dunes is summarized below. The PMT requests the SAC’s input to inform the evaluation of the ecological effects of this potential inundation of the West Area B dunes.

The following figures show potential inundation of the western portion of Area B under full tidal restoration conditions:

- Figure 9a. Planview, Post-Restoration Conditions
- Figure 9b. Planview, 2050 Sea-Level Rise Scenario
- Figure 10a. Transect 1, Post-Restoration Conditions
- Figure 10b. Transect 1, 2050 Sea-Level Rise Scenario
This preliminary inundation assessment shows that for post-restoration conditions (Figures 8a, 9a, and 10a), the existing transition habitats between the wetlands and the dunes (e.g., brackish marsh, riparian scrub, etc.) would be inundated during extreme tides (100-year tide and below) and intermediate to extreme storm events (5-year storm and higher). The dune habitat would only be inundated during more extreme tide and storm events, and the duration of inundation would only be a few hours. For the 2050 sea-level rise scenario (14 in of sea-level rise; Figures 8b, 9b, and 10b), the preliminary results show that inundation would become more frequent; however, the dune habitat would still only be inundated during extreme tide and storm events.

The PMT requests the SAC’s input on evaluating how these transition zone and dune habitats would respond to this level of inundation.

4.2 SEA-LEVEL RISE ADAPTIVE MANAGEMENT MEASURE

As discussed in Section 3.3 and illustrated in Figures 5a – 5d, some areas of restored vegetated marsh habitat are expected to convert to mudflat and subtidal habitat at some time in the future in response to projected sea-level rise (e.g., in west Area B and along the banks of Ballona Creek). As a future adaptive management measure, the restoration may consider placing fill to raise areas that are converted to mudflat by future sea-level rise to recreate vegetated wetland habitat. The PMT requests the SAC’s input on this potential sea-level rise adaptive management measure.

4.3 LOW MARSH HABITAT AND CORDGRASS PLANTING

The proposed restoration includes low marsh habitat zones shown in Figures 1a and 5a (defined by an elevation range 3.5 to 4.5 ft NAVD, which is from 1 ft above mean tide level to mean high water). Cordgrass (Spartina foliosa) is not known to currently exist in the Ballona Wetlands, and available historical records do not indicate the presence of cordgrass. The PMT requests the SAC’s input on appropriate vegetation species and revegetation approaches for restored low marsh areas, specifically including the following questions:

- Should cordgrass be planted/established in the restored low marsh?
- If cordgrass is not planted, would other marsh vegetation species establish in the low marsh or would the low marsh zone develop as intertidal mudflat?

4.4 TRANSITION ZONE HABITAT DESIGN AND DEVELOPMENT

The proposed restoration includes a wide (approximately 200 to 500 ft) zone of transition habitat in Area A, and also along the slopes of the Culver levee in Area B as shown in Figures 1a and 5a. The transition zone is defined by an elevation range between:

- 7.3 ft NAVD (0.2 ft above the Highest Astronomical Tide and 1 ft below the highest observed tide) and
- 9.6 ft NAVD (0.6 ft above the 100-year extreme tide, but inundated during Ballona Creek flood events greater than a 5-year flood event).

The PMT requests the SAC’s input on the transition zone revegetation plan and plant palette.
The PMT also requests the SAC’s input on how the restored transition (and upland) habitat vegetation and ecology would respond to increased inundation with sea-level rise and transgression of wetland habitats.

5. ANALYSES ADDRESSING SAC RECOMMENDATIONS

Additional analyses that address other SAC recommendations are in progress or planned for future phases of restoration planning and design. The sections below summarize initial results of the realigned Ballona Creek channel dynamics analysis (Section 5.1) and the analysis plans for flood management, pollutant effects, and salinity and brackish conditions.

5.1 CHANNEL DYNAMICS, SCOUR, AND SEDIMENT DEPOSITION

ESA PWA performed preliminary hydrodynamic modeling of Ballona Creek flood events under restored conditions to evaluate the dynamics and the potential for erosion in the realigned Ballona Creek channel and the restored wetlands. This preliminary analysis addresses the SAC’s recommendation to “evaluate the effect of erosive shear stress associated with high velocity storm flows on sustainability of the marsh plain” (SAC 2008). Additional hydrodynamic and sediment transport modeling, sediment budget analysis, and reference site assessments are anticipated in future phases of the project to further evaluate the potential effects of scour and deposition.

The preliminary hydrodynamic modeling was performed for existing conditions and a previous iteration of the Proposed Restoration, similar to the current alternative. The 5-year and 50-year return period Ballona Creek discharge events were modeled to simulate a range of extreme flood events. To assess the effect of the tide level on erosion potential, each discharge event was modeled to coincide with low tide in one set of model runs, and to coincide with high tide in a second set of runs. Model velocities for existing and restored conditions were compared to assess the potential change in erosion potential resulting from the restoration. The existing Ballona Creek channel is a soft-bottom channel with armored banks through the restoration site, and appears stable in terms of bed erosion under current conditions.

Figures 12a and 12b show the peak modeled velocities. The results show a significant decrease in channel velocity (from approximately 2.5 m/s to 1.4 m/s) due to the increased conveyance of the restored wetland floodplain. Two zones of high velocity occur where the flow diverges from the existing channel upstream into the restored wetlands (and the water surface elevation drops) and where the flow converges back into the existing channel alignment at the upland peninsula. The channel design will be refined in these areas to reduce velocities and armor the channel as necessary (e.g., an armored sill upstream and/or buried rock protection in the upland peninsula). Modeled velocities are relatively low on the restored marshplain (0 – 1 m/s) and are not expected to be erosive. Further analyses of shear stress and erosion potential in the realigned channel, channel banks, and restored marshplain are anticipated in future phases of the project.

5.2 FLOOD MANAGEMENT

ESA PWA has developed a preliminary flood management plan description as part of the project description information for the EIR. This preliminary flood management plan identifies the locations of new levees (e.g., north of Culver Blvd. and around the perimeter of Area A) and buried rock protection (e.g., at the southwest corner of Area A).

Removal of the existing Ballona Creek levees will require a U.S. Army Corps of Engineers’ Section 408 approval for modifications to this Corps-authorized flood protection system. A detailed analysis of flood risk and uncertainty will be performed in the next phase of the project to meet the Section 408 approval requirements and for the EIR impact analysis. This planned analysis will also address the SAC’s
recommendation to perform a “refined analysis of potential flood elevations” and to consider “the need for new/additional flood protection measures if the Ballona Flood Channel levees are removed” (SAC 2008).

5.3 POLLUTANT EFFECTS

Analyses of pollutant effects are planned for the EIR, including analyses of water and sediment quality, trash, and debris and development of any necessary management measures. These analyses are intended to analyze impacts as required for the EIR and address the SAC’s previous comment to assess the “ability to manage potential adverse effects of pollutant input to the wetlands until such time as upstream management measures reduce watershed contaminant loading” (SAC 2008). Note that the restoration plan anticipates continued operation of the existing trash boom upstream of the restored wetlands.

5.4 SALINITY AND BRACKISH CONDITIONS

Additional analysis of salinity dynamics and brackish conditions in the restored wetlands is anticipated in future phases of the project. This analysis will address the SAC’s comment to assess “projected salinity and temperature … to determine if defining estuarine transitions … will be present (as opposed to primarily marine conditions) … including the effect of potential salinity reduction and productivity-inducing effects of freshwater influxes” (SAC 2008). Salinity in the full tidal wetlands connected to Ballona Creek in Area A and West Area B will be governed by the influence of Ballona Creek flows (dry-weather and wet-weather). We understand that marsh vegetation type is generally controlled by peak summer soil salinity. Water column salinity would be modeled for dry-weather and wet-weather conditions as a surrogate for soil salinity.

In the southeast Area B restored managed marsh, outflow from the Freshwater Marsh would be managed to encourage brackish marsh development in this area as discussed in Section 3.1.2.4. The management and design of this brackish marsh area will be further developed and evaluated in future phases of the project.

The PMT may request the SAC’s input on salinity ranges for Southern California brackish marsh habitats for use in future assessments.

6. REFERENCES

California Department of Fish and Game 2007. Existing habitat units field survey.


7. LIST OF FIGURES AND ATTACHMENTS

Figures

Figure 1a. Proposed Restoration – Preliminary Sketch
Figure 1b. Refinement of Alternative 5 from the 2010 Preferred Alternatives Memo
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Figure 10a. West Area B Transect 1, Post-Restoration Conditions
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Figure 12a. Modeled velocities for 5-year flood
Figure 12b. Modeled velocities for 50-year flood

Attachments

Attachment 1. Project Phasing Description and Figures
Figure 1a

Ballona Wetlands Restoration

Proposed Restoration

Preliminary Sketch
Figure 1b
Refinement of Alternative 5 from the 2010 Preferred Alternatives Memo

SOURCE: PWA and others, 2010
Alternative 5 from the 2008 Feasibility Report

SOURCE: PWA and others, 2008
Figure 2
Alternative 4 from the 2008 Feasibility Report
Figure 3

Ballona Wetlands Restoration

Tributary Tidal Channel Network Concept Sketch
Preliminary Draft
Figure 4
Conceptual Cross-Section Showing Sea-Level Rise Transgression
NOTES: Salt pan, brackish marsh, and tributary marsh channel habitat not shown
Managed wetlands inboard of Culver levee shown as being managed to maintain marsh habitat over time.
NOTES: Salt pan, brackish marsh, and tributary marsh channel habitat not shown
Managed wetlands inboard of Culver levee shown as being managed to maintain marsh habitat over time.

Ballona Wetlands Restoration
Figure 5b
Restored Habitat Zones
2030 Projection (0.5 ft of sea-level rise)
Ballona Wetlands Restoration

**Figure 5c**
Restored Habitat Zones
2050 Projection (1.4 ft of sea-level rise)

NOTES: Salt pan, brackish marsh, and tributary marsh channel habitat not shown
Managed wetlands inboard of Culver levee shown as being managed to maintain marsh habitat over time.
Ballona Wetlands Restoration

Figure 5d
Restored Habitat Zones
2100 Projection (4.6 ft of sea-level rise)

NOTES: Salt pan, brackish marsh, and tributary marsh channel habitat not shown
Managed wetlands inboard of Culver levee shown as being managed to maintain marsh habitat over time.
Figure 6
Existing Habitat Units

SOURCE: CDFG 2007
Figure 7
1876 Habitats

SOURCE: Grossinger and others 2011
Source: Existing vegetation data: CDFD 2007
Existing elevation data: PSOMAS 2005
Lower elevation limit: Zedler 2001
Notes: SV = Salicornia virginica, JC = Jaumea carnosa,
SS = Salicornia subterminalis, CT = Cressa truxillensis,
and DS = Distichlis spicata

PRELIMINARY DRAFT

Figure 8
West Area B Vegetation Elevation Relative to Lower Elevation Limit (Feet)
NOTES: MHHW = Mean Higher High Water  
HAT = Highest Astronomical Tide  
5 yr storm = Ballona Creek Water Level During 5 yr Storm Event  
100 yr tide = 100 yr Tide Level

Ballona Wetlands Restoration  
Figure 9a  
West Area B Planview  
Post-Restoration Conditions
Ballona Wetlands Restoration

Figure 9b
West Area B Planview
2050 Sea-Level Rise Scenario

NOTES: MHHW = Mean Higher High Water
HAT = Highest Astronomical Tide
5 yr storm = Ballona Creek Water Level During 5 yr Storm Event
100 yr tide = 100 yr Tide Level
Figure 10a
West Area B Transect 1
Post-Restoration Conditions

NOTE: MHHW = Mean Higher High Water
HAT = Highest Astronomical Tide
5 yr storm = Ballona Creek Water Level During 5 yr Storm Event
100 yr tide = 100 yr Tide Level

Ballona Wetlands Restoration.
Figure 10b
West Area B Transect 1
Sea-Level Rise Scenario

NOTE: MHHW = Mean Higher High Water
HAT = Highest Astronomical Tide
5 yr storm = Ballona Creek Water Level During 5 yr Storm Event
100 yr tide = 100 yr Tide Level
Sea level rise of 14" applied for 2050 scenarios
NOTE: MHHW = Mean Higher High Water
HAT = Highest Astronomical Tide
5 yr storm = Ballona Creek Water Level During 5 yr Storm Event
100 yr tide = 100 yr Tide Level
NOTE: MHHW = Mean Higher High Water
HAT = Highest Astronomical Tide
5 yr storm = Ballona Creek Water Level During 5 yr Storm Event
100 yr tide = 100 yr Tide Level
Sea level rise of 14” applied for 2050 scenarios

Ballona Wetlands Restoration.

Figure 11b
West Area B Transect 2
Sea-Level Rise Scenario
Figure 12a
Modeled Velocities for the 5-Year Flood
Figure 12b
Modeled Velocities for the 50-Year Flood
1) **Stage 1. Area A and C Restoration**
   a) Fiji Channel restoration (may be performed with Stage 1b)
   b) Area A wetland restoration
      - Area A wetland and channel meander excavation
      - Area A perimeter levee
      - North Ballona Creek levee breaches
      - Area B Culver levee/embankment fill and south Area B culvert
      - Area C fill *(and optional Area C wetland)*
      - Area B fill between Culver, Jefferson, and Lincoln
      - West Culver Blvd. drainage improvement
   c) Northeast Ballona Creek levee lowering/removal (may be performed in Stage 1b)
      *(Note: Northwest Ballona Creek levee section retained for construction access in Stage 2a, step 3)*

2) **Stage 2. East Area B Restoration**
   a) Northeast Area B wetland restoration *(construction sequence/steps may vary)*
      **Step 1: Area A channel realignment**
      - Block and fill section of the existing Ballona Creek channel on the inside of the restored Area A channel meander to realign Ballona Creek
      **Step 2: Area B channel meander (may be performed in Step 1)**
      - Northeast Area B wetland grading and channel meander excavation
      - Northeast Culver levee with temporary levee along upland peninsula
      - South Ballona Creek levee breaches
      - Southeast Ballona Creek levee lowering/removal
      **Step 3: Area B channel realignment.**
      - Block and fill section of the existing Ballona Creek channel on the inside of the restored Area B channel meander to realign Ballona Creek
      - Northwest Ballona Creek levee lowering/removal
   b) Southeast Area B managed wetland restoration (may be deferred to Stage 3)
      - Culvert with tide gate (or similar) (culvert installation may begin in Stage 2a)
      - Tidal channel excavation
   c) South Area B managed wetland tidal channel enhancement (may be deferred to Stage 3, or performed in Stage 1b)

3) **Stage 3. West Area B Restoration**
   a) West Area B wetland restoration
      - West Area B channel enhancement
      - Culver and West Area B levees
      - North Ballona Creek levee breach at existing tide gate
   b) Northwest Ballona Creek levee lowering/removal (may be performed in Stage 3a)
Construction Stages

Stage 1. Area A and C Restoration
Stage 2. East Area B Restoration
Stage 3. West Area B Restoration
Stage 1c. Northeast Ballona Creek levee lowering/removal (may be performed in Stage 1b)
Stage 2a. Northeast Area B wetland restoration

Stage 2b. Southeast Area B managed wetland restoration*

Stage 2c. South Area B managed wetland tidal channel enhancement*

*Note Stage 2b and 2c may be deferred to Stage 3

Figure 2
Stage 2: East Area B Restoration
Stage 3b. Northwest Ballona Creek levee lowering/removal (may be performed in Stage 3a)

Figure 3
Stage 3: West Area B Restoration
Stage 1. Area A and C Restoration

a) Fiji Channel restoration (may be performed with Stage 1b)
b) Area A wetland restoration
c) Northeast Ballona Creek levee lowering/removal (may be performed in Stage 1b)
Stage 1a. Fiji Channel restoration (may be performed with Stage 1b)

Stage 1b. Area A wetland restoration with levee breaches

Figure 1a-b
Stage 1. Area A and C Restoration

Stage 1a. Fiji Channel restoration & Stage 1b. Area A wetland restoration
Stage 1c. Northeast Ballona Creek levee lowering/removal (may be performed in Stage 1b)
Stage 2 detail

Stage 2. East Area B Restoration

a) Northeast Area B wetland restoration
   *(construction sequence/steps may vary)*
   
   *Step 1*: Area A channel realignment
   *Step 2*: Area B channel meander *(may be performed in Step 1)*
   *Step 3*: Area B channel realignment.

b) Southeast Area B managed wetland restoration
   *(may be deferred to Stage 3)*

c) South Area B managed wetland tidal channel enhancement
   *(may be deferred to Stage 3, or performed in Stage 1b)*
Stage 2a, Step 1: Area A channel realignment

Figure 2a-i
Stage 2: East Area B Restoration
Stage 2a. Northeast Area B wetland restoration
Step 1: Area A channel realignment
Stage 2a, Step 2: Area B channel meander (may be performed in Step 1)
Stage 2a, Step 3: Area B channel realignment

Ballona Wetlands Restoration

Figure 2a-iii
Stage 2: East Area B Restoration
Stage 2a. Northeast Area B wetland restoration
Step 3: Area B channel realignment
Stage 2a. Northeast Area B wetland restoration

Stage 2b. Southeast Area B managed wetland restoration*

Stage 2c. South Area B managed wetland tidal channel enhancement*

*Note Stage 2b and 2c may be deferred to Stage 3

Ballona Wetlands Restoration

Figure 2b-c
Stage 2: East Area B Restoration
Stage 2b. Southeast Area B managed wetland restoration &
Stage 2c. South Area B managed wetland tidal channel enhancement
Stage 3 detail

Stage 3. West Area B Restoration

a) West Area B wetland restoration

c) Northwest Ballona Creek levee lowering/removal (may be performed in Stage 3a)
Stage 3a. West Area B wetland restoration with levee breach

Figure 3a
Stage 3: West Area B Restoration
Stage 3a: West Area B wetland restoration
Stage 3b. Northwest Ballona Creek levee lowering/removal (may be performed in Stage 3a)