Final

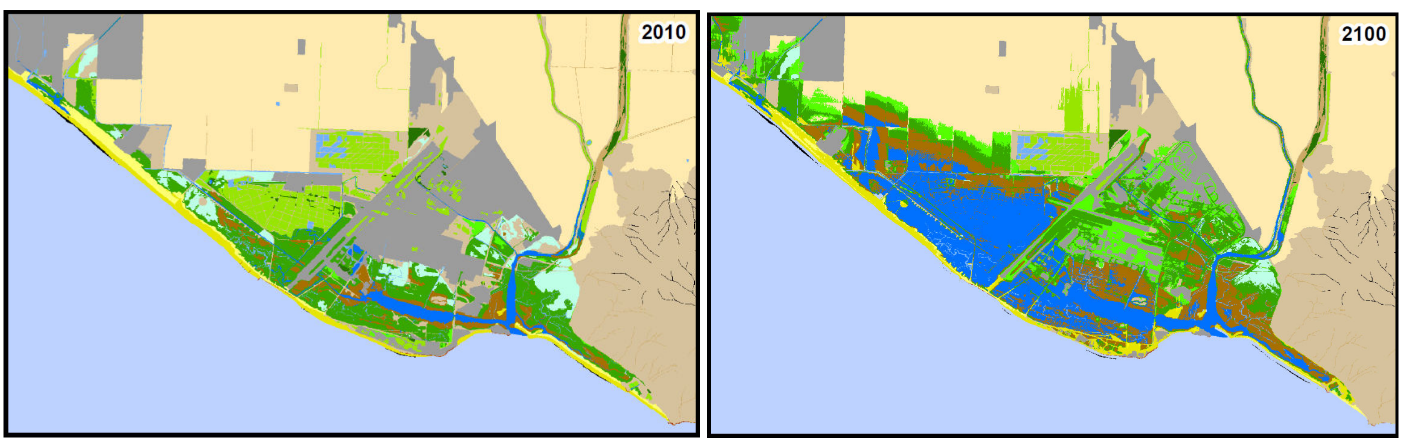
COASTAL RESILIENCE VENTURA

Technical Report for Sea Level Affecting Marshes Model (SLAMM)

Prepared for
The Nature Conservancy

March 18, 2014

ESA PWA



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1. Introduction

1.1 Purpose

This report presents technical documentation of the methods used to assess the evolution and vulnerability of the major wetland habitats under various future climate and management scenarios for the Ventura County, California coast from Ormond Beach to Point Mugu. The data that result from this work will be part of The Nature Conservancy's Coastal Resilience Ventura project. This report documents data sources and technical methods used in the ecological vulnerability assessment.

1.2 Project Background

The Nature Conservancy is leading Coastal Resilience Ventura – a partnership to provide science and decision-support tools to aid conservation and planning projects and policymaking to address conditions brought about by climate change. The primary goals of Coastal Resilience Ventura are to assess the vulnerabilities of human and natural resources and identify solutions that help nature help people.

Steering Committee

The Coastal Resilience Ventura project has been guided directly by stakeholders and local decision-makers to develop tools and information to answer questions related to local climate change impacts. The steering committee consists of city, regional, state, and national government agencies and public and private organizations[1]. The committee provided input to the methods and results described in this report as well as provided data and input on deliverables throughout the project including four in-person meetings in Ventura.

Science Advisory Committee

The Science Advisory Committee (SAC) is a group of local and regional technical experts that was developed to provide scientific and technical input to the Coastal Resilience Ventura project. The foundation of the SAC was the Ormond Beach Science Advisory Committee, which was formed as part of the joint efforts of The Nature Conservancy and the California State Coastal Conservancy to Restore the Ormond Beach Wetlands[2]. A number of additional experts were added to the group for the Coastal Resilience Ventura project. The committee provided input to the following SLAMM modeling aspects during a web-conference (December 2011) and three in-person meetings (August 2012 and February 2013 in Ventura, August 2013 in Los Angeles):

- Availability and quality of ecological datasets
- SLAMM study area boundaries
- Reclassification and peer review of disparate habitat and vegetation data sets
- The level of taxonomic detail and spatial explicitness necessary for maps to prove useful for supporting land management decisions related to conservation and restoration of biodiversity and ecosystem function along the Ventura coastline

[1] A complete list of the agencies and organizations represented on the steering committee can be found on the Coastal Resilience Ventura website at http://coastalresilience.org/geographies/ventura-county/partners (Accessed 3 April 2013).
[2] More information available at http://scc.ca.gov/2010/01/07/ormond-beach-wetlands-restoration-project/ (Accessed 20 May 2013).

- Review of preliminary SLAMM results and recommendations for subsequent model runs based on knowledge of Ventura County wetlands systems.
- Input on the management strategies and climate scenarios used in the analysis

Previous Modeling for Coastal Resilience Ventura

ESA PWA conducted modeling of the precipitation and sea level rise impacts of climate change to coastal and fluvial hazards as a previous phase of Coastal Resilience Ventura. These methods are described in a separate technical report titled Coastal Resilience Ventura: Technical Report for Coastal Hazards Mapping (ESA PWA 2013). Results and interim data sets generated during that modeling were incorporated whenever possible into the SLAMM model. For example, the SLAMM model used erosion rates generated in the coastal erosion analysis.

1.3 Model Background and Summary

This is one of the first detailed applications of Sea Level Affecting Marshes Model (SLAMM) to the California coastline[3]. SLAMM was first developed in the mid-1980s with EPA funding to evaluate changes to east coast habitats and wetlands and has evolved over time with support from many other funding sources, including TNC. SLAMM was chosen for use in this study because it is well known by policymakers and has been applied widely in the U.S. The software is open source and freely available.

SLAMM simulates the dominant processes involved in wetland conversions during long-term sea level rise: inundation, erosion, overwash, saturation, and accretion. A complex decision tree incorporates both geometric and qualitative relationships to model habitat conversions in coastal habitats through spatial relationships (e.g. adjacency, elevation). It is important to note that while the dominant processes are represented, this is not a hydrodynamic or sediment transport model. The following model processes are applied at each time step:

- Inundation: As sea level rises, land elevations lower relative to mean sea level. This causes habitats to convert to habitats found lower in the tide frame. Inundation is calculated based on the minimum elevation and slope of a cell. Figure 1 shows the decision tree for inundation, as understood from the SLAMM technical documentation.

- Erosion: Horizontal erosion triggered given a minimum fetch threshold and proximity of the marsh to estuarine water or open ocean.

- Saturation: Migration of coastal swamps and fresh marshes onto adjacent uplands as driven by a rising water table.

- Accretion: Vertical rise of marsh due to buildup of organic and inorganic matter on the marsh surface.

- Overwash: Overwash occurs at a specified interval (i.e. every 20 years) causing barrier islands to migrate inland over time. The overwash module has been disabled for this project since barrier islands and the associated overwash by major U.S. East Coast storms (i.e. hurricanes) are not applicable to the Ventura County study areas.

[3] SLAMM has also been applied in South San Francisco Bay, Elkhorn Slough in Monterey County, Tijuana Estuary in San Diego, and Carpinteria Marsh in Santa Barbara.

The primary inputs to SLAMM include a high resolution digital elevation model, a map of current wetland habitats, future sea level rise projections, marsh accretion rates, tide ranges, and erosion rates. These inputs and many others are described later in Sections 4 and 5. This project used SLAMM version 6.2 beta.

1.4 Mugu Lagoon Study Area

The initial SLAMM study areas were selected during the first in-person Science Advisory Committee meeting (see Section 1.2). The study area limits are shown in Figure 2. This final ecological vulnerability study focuses on the Mugu Lagoon site, which includes the coastal wetland habitats from Ormond Beach to Point Mugu. Two other major coastal wetland systems exist in Ventura County: The Santa Clara River and Ventura River Estuaries. Both of these lagoon systems are bar built estuaries that are seasonally closed. Water levels in these systems are determined more by coastal and beach processes than tide levels. During initial efforts to apply SLAMM to these estuaries it became clear that the conceptual model in SLAMM version 6.2 (the most recent version) does not account for many of the dominant processes occurring in these highly dynamic, seasonally closed systems. Therefore, subsequent effort was focused on Mugu Lagoon, a large open tidal system where wetland extent and habitats have been relatively stable through time. Section 6 describes the modeling efforts and limitations at the Santa Clara River and Ventura River Estuaries.

Ventura County is located within the southern California Bight, where the north-south trending U.S. West Coast takes an abrupt turn to a west-east trending shoreline. Point Conception in the northwest and the Channel Islands to the south, create a narrow swell window that shelters much of the Ventura coast from extreme wave events. The Mediterranean climate of southern California results in mild annual temperatures and low precipitation punctuated by episodic and often extreme events frequently associated with El Niños. The sand found on these beaches moves eastward along the coast of southern Santa Barbara and Ventura Counties to the Point Mugu submarine canyon at the mouth of Mugu Lagoon. Tidal fluctuations in this area range from ~3 feet during a neap cycle and up to ~7.5 feet on a spring tide cycle.

Mugu Lagoon lies within Naval Base Ventura County (NBVC) and is bordered by approximately 900 acres of salt marsh with a network of tidal channels (Figure 3). The Ventura County Game Preserve maintains a series of artificially-managed ponds for duck habitat northwest of NBVC. Calleguas Creek, which drains part of the Santa Monica Mountains National Recreation Area, flows into the northeast corner of Mugu Lagoon. This stream is currently a perennial stream[4] fed continuously by treated wastewater flows, groundwater infiltration, and urban/agricultural run-off. The volume of this daily flow, however, is negligible compared to stormwater during rainfall events. While large freshwater flow events occur periodically, the wetland habitats in Mugu Lagoon are generally saline. The lagoon mouth, which is partially controlled by armoring constructed by the Navy, is tidally dominated, with a large diurnal tidal prism compared to overall volume. This results in an open lagoon mouth, year-round. Wetland habitats are driven primarily by their elevation relative to the tides (duration of inundation), which is the primary wetland process modeled by SLAMM. Salinity, coastal winds, morning fog, mild air temperatures, and variable rainfall affect habitats to a lesser extent, but these processes are not modeled in SLAMM.

[4] Historically, Calleguas Creek flow was intermittent, flowing in the wet winters and drying in the summers (Beller et al 2011).

2. Summary of GIS Deliverables

This section summarizes the GIS deliverables developed as a result of this work and points to the sections in this document that describe how they were developed in more detail. All GIS deliverables are provided in WGS 1984 Web Mercator Auxiliary Sphere projected coordinates[5]. Horizontal units are meters. SLAMM was run with a 10-year time step, and results were provided at each time step from 2010 to 2100. This includes the same planning horizons (2030, 2060, and 2100) that were used in the coastal hazards analysis.

2.1 Future Scenarios

The following scenarios were developed in discussions with TNC, the Science Advisory Committee, and the Steering Committee to provide the most utility to decision making. Section 6 explains how these scenarios were implemented in SLAMM by modifying the input maps (Section 4) and site parameters (Section 5). Each combination was modeled, for a total of 24 model runs.

Table 1. SLAMM Scenarios

Type	Scenarios
Sea Level Rise	• High (1.47 meters between 2010 and 2100) • Low (0.44 meters between 2010 and 2100)
Management	• Allow marshes to transgress into dry land • Fortify developed dry land (excluding agricultural land) • Fortify developed dry land (including agricultural land) • Fortify developed dry land (including agricultural land and managed ponds)
Accretion/Sedimentation Rate	• High • Low (half of high rates)
Erosion of New Inlet[6]	• No erosion of new inlet west of the NBVC runway • With erosion of new inlet west of the NBVC runway

Sea Level Rise

The sea level rise scenarios used in this study are based on recent National Research Council (NRC, 2012) and U.S. Army Corps of Engineers (USACE, 2011) guidance[7]. The USACE medium curve was selected as the low curve in this study because it is the lowest of all the USACE and NRC projections that incorporates future increases in the rate of sea level rise. It was also included because steering committee members acknowledged that some future projects may require federal funding, and any analysis used for such project funding sources must use the USACE methodology. The high end curve is based on the high end range of models discussed in the NRC 2012 report. Both curves include an

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[5] All SLAMM analysis was conducted in NAD 1983 UTM Zone 11N meters. The final results were projected at the request of TNC for simplifying web display and incorporation into the online decision support tool (maps.coastalresilience.org/ventura/).

[6] It is unlikely that given the longshore sand transport in the area and/or the existing tidal prism that both inlets would be maintained without active management. ESA PWA recommends that this management scenario NOT be included in the data layers available to the public.

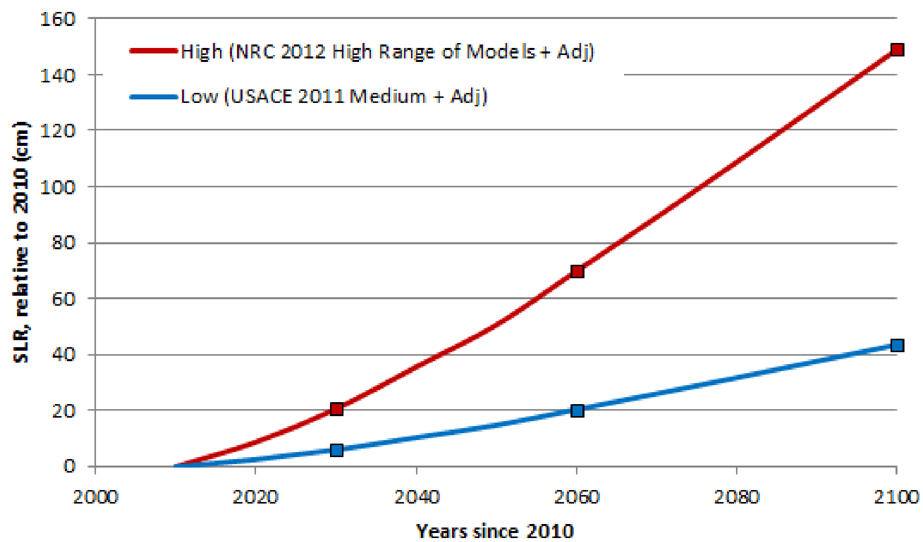
[7] While the state of California guidance on sea level rise prescribed the use of 55 inches of rise by 2100, this present study attempted to combine federal and scientific guidance in anticipation of revised guidance expected to be issued by the state shortly after the completion of this study.

adjustment for local vertical land motion using the Santa Monica tide station (NOAA #9410840). The sea level rise at each planning horizon is shown in Table 2 and marked in Figure 4.

Table 2. Sea Level Rise Projections, relative to 2010

Year	*Low SLR*	*High SLR*
2030	6 cm (2.3 inches)	20 cm (8.0 inches)
2060	19 cm (7.4 inches)	64 cm (25.3 inches)
2100	44 cm (17.1 inches)	148 cm (58.1 inches)

Figure 4 – Sea Level Rise Scenarios (Local SLR, relative to 2010)



Management

The management scenarios presented in Table 1 represent a wide range of trade-offs between allowing marshes to transgress inland with sea level rise and holding the line or “fortifying” current development or agricultural land (e.g. by building levees and seawalls). The fortification scenarios are modeled by preventing marshes from transgressing into developed areas, agriculture, and the managed ponds, as applicable. This study does not assess the feasibility of these scenarios from a cost/engineering perspective. Rather, it focuses on how wetland habitats are likely to develop in response to future management.

Normally, SLAMM is only used to model the “allow marshes to transgress” and the “protect developed area” scenarios. However, the Mugu Lagoon study area includes large expanses of low lying agricultural land that will be at risk with future sea level rise. Additionally, two stretches of ponds, managed by the Ventura County Game Preserve for duck habitat, are already at or below tide levels and will require increasing levels of management to protect in place with sea level rise. The implications of these low-salinity ponds on greenhouse gas emissions are assessed in a separate memo (ESA PWA 2014). In discussions with TNC and the SAC it became clear that it was important to differentiate between developed areas (such as the Navy Base and residential areas), agricultural land, and the managed ponds.

Accretion/Sedimentation

Marshes build vertically through two processes: inorganic surface sedimentation and organic growth and accretion. Both processes are controlled by flooding patterns and duration of inundation, among other factors. Rising sea levels affect these processes by increasing the time of inundation. Accretion rates in Mugu Lagoon are highly dependent on sediment supply and can vary widely based on location in the marsh. Since the response of accretion rate to sea level rise (and other climate changes) is not well understood, high and a low accretion[8] scenarios were modeled. The high and low values were selected based on a literature review of accretion studies in Mugu Lagoon and other Southern California wetlands and with input from the Science Advisory Committee. Section 5.4 describes this process and explains how the feedback between inundation time and accretion rates was implemented in SLAMM.

Erosion

In the SAC and stakeholder meetings, participants asked what could happen if accelerating erosion caused a breach in the beach/dune system and increased the hydraulic connection with the back barrier wetlands. This was investigating by modeling the “erosion of new inlet” scenario, which assumed a breach somewhere west of the NBVC runway. This would bypass the tidal damping caused by the series of culverts and result in a wider tide range across the western portion of the Mugu site.

Geomorphically, however, it is unlikely that a new inlet would persist. Since an additional inlet would only breach during an extreme storm event, and given the high rates of alongshore sand transport in this region, we do not anticipate that a new inlet would persist. There are no other examples of multiple-inlet systems along the Southern or Central California coast. In addition, the current lagoon mouth discharges near the head of the Mugu Submarine Canyon, which geologically controls the inlet location. In recent years, the head of this submarine canyon has been headcutting, migrating across the continental shelf toward the entrance to Mugu Lagoon (Xu et al 2010). As a result of these factors, ESA PWA recommends that this scenario (“Erosion of a New Inlet”, e2) NOT be presented on the CRV website as a viable future scenario.

2.2 File Naming Convention

The naming conventions for the GIS deliverables are based on future scenarios and planning horizons, as follows:

Sea level rise scenarios:
ec – Existing conditions (2010)
s1 – Low sea level rise
s3 – High sea level rise

Accretion/Sedimentation scenarios:
a1 – Low accretion/sedimentation
a2 – High accretion/sedimentation

Erosion scenarios:
e1 – No erosion of new inlet
e2 – With erosion of new inlet

Management scenarios:
m1 – Allow marshes to transgress into all dry land
m2 – Fortify developed dry land (excluding agricultural land)
m3 – Fortify developed dry land (including agricultural land)
m4 – Fortify developed dry land (including agricultural land and managed ponds)

[8] The terms “accretion” and “sedimentation” are used somewhat interchangeably in this report because SLAMM does not differentiate between organic accretion and inorganic sedimentation.

Years:
The SLAMM outputs are provided at 10 year intervals from 2010 to 2100.

Example: The model output at 2100 with low sea level rise (s1), high accretion/sedimentation (a2), no erosion of a new inlet (e1), and fortification of developed dry land (including agricultural land) (m3) is named s1a2e1m32100.

A complete list of GIS deliverables is provided in Appendix A.

2.3 Recommended Map Display

There are 26 different habitat types in SLAMM. Displaying all of these habitats in the Coastal Resilience online tool would result in a very large legend and make the map difficult to interpret. Below we recommend a classification that will simplify display and make the maps easier to understand. The SLAMM outputs were post processed to include these simplified categories in an attribute called “SimpCat” for easy display on the web map.

SLAMM Habitat IDs	General Category
1	Developed Dry Land
2	Undeveloped Dry Land
100	Agricultural Land
3, 5, 22	Freshwater Non-Tidal
6, 23	Freshwater Tidal
7, 26	Transitional
8, 20	Salt Marsh
11	Mud Flat
10, 12, 14, 22	Beach or Gravel Shore
15, 16, 17, 18, 19	Open Water

3. Disclaimer and Use Restrictions

Funding Agencies

These data and this report were prepared as the result of work funded by The Nature Conservancy, and the County of Ventura (collectively "the funding agencies"). It does not necessarily represent the views of the funding agencies, their respective officers, agents and employees, subcontractors, or the State of California. The funding agencies, the State of California, and their respective officers, employees, agents, contractors, and subcontractors make no warranty, express or implied, and assume no responsibility or liability, for the results of any actions taken or other information developed based on this report; nor does any party represent that the uses of this information will not infringe upon

4. Input Maps

This section describes the original data sources and post processing used to develop map inputs for SLAMM. All model inputs and outputs have 5 meter cell size. This resolution was selected based on review of SLAMM applications in other regions, input from the Science Advisory Committee, and computational time. The majority of existing SLAMM studies covered areas 2 to 100 times as large as the Mugu Lagoon study area and used 10 to 30 meter resolution (Clough and Larson 2010, Clough and Larson 2009a,b, Glick et al 2007, Warren Pinnacle Consulting 2011). A smaller resolution was selected for the Ventura project due to the small study area, high resolution (1 meter) topography, and availability of detailed vegetation studies. Table 3 summarizes optional map inputs that were not used and explains the purpose for each input and the rationale for excluding it in this analysis.

Table 3. Map inputs excluded from the Ventura SLAMM

Model Input	Purpose	Rationale for Exclusion
Map of percent impervious	This input can be used when a good habitat map is not available to identify "developed" areas.	Many high resolution datasets of land cover and habitats were available in Ventura County, making this input unnecessary.
Raster output sites	This creates outputs for specific output sites within the overall modeled region.	The SLAMM study area is already small compared to typical SLAMM models, so the site was not subdivided into smaller output sites.
VDATUM map	This map allows for spatial variations in the conversion between the NAVD88 and MTL vertical datums.	Because each of the individual sites was modeled separately, and because the sites are small, we assume that the conversion between NAVD88 and MTL does not vary spatially.
Uplift/Subsidence map	Allows for spatial variation of relative sea level rise.	While uplift of the mountainous areas within Ventura County is relatively well documented, the amount and spatial distribution of vertical land motion within the Oxnard Plain was not available. Relative land motion is partially considered in the long term local sea level trend at the Santa Monica tide gage, which was used to develop the sea level rise scenarios (see Section 2.1). This scenario does not, however, consider localized subsidence.

4.1 Topography

Elevation and land cover maps are the two most important inputs to SLAMM. The relationship between elevation (relative to the tide range) and habitat is what drives habitat changes under sea level rise. The 2009 – 2011 California Coastal Conservancy Coastal LiDAR Project Hydro-Flattened Bare Earth DEM was downloaded from the NOAA Digital Coast Data Access Viewer (NOAA, 2012a). This data was collected in November 2009 for the Ventura study area and has 1 meter resolution with a horizontal accuracy of ± 50 cm and a vertical accuracy of ± 9 cm. The LiDAR data was reclassified, filtered, edited, and hydro-flattened by the DEM creators using 3D hydro breaklines to develop the final DEM[9]. This was the primary DEM used for conducting topographic analysis and mapping coastal erosion and flood hazard zones.

The DEM was modified in a few ways to address connectivity and resolution issues.

1. In order to improve the mapped projections of future habitat transgression it was important to represent the hydraulic connectivity not apparent from the digital elevation model (e.g. through culverts or under bridges). Within the Ventura County study area, this is most relevant for the Mugu Lagoon area, which is characterized by a series of low-lying ponds, interconnected by underground culverts. Martin Ruane at Naval Base Ventura County (NBVC) provided culvert data as a GIS polyline shapefile. This dataset covered the extent of the NBVC Point Mugu property, which includes Mugu Lagoon. These polylines were buffered in GIS, assigned a low

[9] Detailed metadata describing DEM development is available on the NOAA Digital Coast Data Access Viewer at this link: http://csc.noaa.gov/dataviewer/webfiles/metadata/ca2010_coastal_dem.html (Accessed April 2, 2013).

elevation (0 m NAVD88), and overlaid on the above DEM. This ensures that the low-lying areas connected by culverts are considered connected in the SLAMM model.

2. The dike elevations around the managed ponds in the Mugu study area were modified in the 5 meter DEM, as described in Section 4.3.

3. In the process of hydroflattening, many of the mudflats in Mugu Lagoon were inadvertently lowered below MLW. Since the lower limit for mudflats in SLAMM is MLW, this caused the mudflats to convert to open water in the first timestep. High resolution bathymetry, collected in September 2012, was provided by Sean Anderson at California State University Channel Islands and added to the existing conditions topography to address this problem in many areas. However, the surveyed bathymetry did not cover the entire lagoon. In the other areas a reasonable elevation was assigned to the hydroflattened mudflat areas. The elevation selected, 0.94 m NAVD88, is 1 standard deviation below the mean observed mudflat elevation. This agreed very well with non-hydroflattened mudflats that were close in proximity.

SLAMM also requires a topographic slope map. This was developed by applying the ArcGIS spatial analyst slope function to the above digital elevation model.

4.2 Habitat Map (SLAMM Categories)

Multiple datasets were combined to create an existing conditions habitat layer, which is the main input to SLAMM. The datasets are described in order of prioritization (first is highest priority) in Table 4.

SLAMM (version 6.2) accepts land cover data in the form of 24 habitat classes. Each of the sources described in Table 4 uses a different vegetation/land cover classification scheme. Kirk Klausmeyer at The Nature Conservancy reviewed each classification scheme and developed a “crosswalk” for each source that linked each source’s habitat class to a SLAMM habitat class. The SLAMM technical documentation includes a crosswalk between some (but not all) of the NWI classes and the SLAMM classes. Since many of the SLAMM habitat names are specific to the East and Gulf Coasts, the habitats were renamed to better reflect the naming conventions in Ventura County. The Science Advisory Committee (see Section 1.2) provided input to the habitat map during two review meetings. The committee provided input and peer review to the habitat crosswalk, renaming of habitats, and SLAMM’s assumptions about habitat conversions with sea level rise. For clarity, all subsequent references to habitats use the Ventura name with the SLAMM ID number in parentheses. Table 5 provides a summary of the SLAMM habitats, corresponding Ventura names, and acreage in the Ormond Beach and Mugu Lagoon study area. Figure 3 shows a map of the Mugu Lagoon and Ormond Beach habitats. Agricultural land is not modeled in SLAMM, but was added in after modeling as this is an important upland classification in the vicinity of Mugu Lagoon.

Table 4. Data Sources for SLAMM Habitat Map

Habitat Data Source	Description
1. Expert input	The Science Advisory Committee provided significant input to the habitat map during two meetings.
2. Dune habitats	Brian Cohen at The Nature Conservancy digitized dunes in Ventura County using recent aerial imagery.
3. WRA vegetation map	Vegetation mapping conducted by WRA in 2007 at Ormond Beach
4. Santa Clara River estuary habitat map[10]	Detailed habitat mapping conducted by Stillwater Sciences (2010) at the mouth of the Santa Clara River. This field survey was conducted in September 2009.
5. Southern California Wetlands[11] Mapping Project	This project builds on NWI mapping in Southern California and uses NWI methodology. Mapping is based on 2005 aerial imagery and covers the Santa Clara River Estuary and Mugu Lagoon study areas.
6. U.S. Fish & Wildlife Service National Wetlands Inventory (NWI)[12]	This dataset is based on 2002 aerial imagery and covers the Ventura River Estuary study area.
7. Farmland Mapping and Monitoring Program (FMMP)[13]	This dataset covers upland (non-wetland) areas and is based on 2010 aerial imagery.

Note: Shaded datasets do not apply to the Mugu Lagoon study area, but were used to develop a county-wide existing habitats map that is currently displayed on the Coastal Resilience Ventura web map.

[10] Obtained from Scott Dusterhoff at Stillwater Sciences in November, 2012.
[11] Available at http://www.socalwetlands.com/website/main.htm (Downloaded February 2012).
[12] Available at http://www.fws.gov/wetlands/Data/index.html (Downloaded February 2012).
[13] Available at: http://www.conservation.ca.gov/dlrp/fmmp/Pages/Index.aspx (Downloaded November 2012).

Table 5. SLAMM Habitats and Acreages in the Ormond Beach/Mugu Lagoon Study Area

ID	SLAMM Name	Ventura Name	Approximate Area, acres (%)
1	Developed Dry Land	Developed Uplands	2446.7 (10.3%)
100*	N/A (Added after SLAMM)	Agricultural Land	6314 (26.6%)
2	Undeveloped Dry Land	Undeveloped Uplands	2897.2 (12.2%)
3	Swamp	Freshwater Wetland with Trees/Shrubs/ Riparian Forest	82.8 (0.3%)
4	Cypress Swamp	N/A – Not Present	Not Present
5	Inland Fresh Marsh	Inland Fresh Marsh	737.7 (3.1%)
6	Tidal Fresh Marsh	Tidal Fresh Marsh	4.2 (0%)
7	Trans. Salt Marsh (Scrub Shrub)	Tidal Estuarine Wetland with Trees/Shrubs	31.1 (0.1%)
8	Regularly Flooded Marsh	Emergent Salt Marsh	1224 (5.2%)
9	Mangrove	N/A – Not Present	Not Present
10	Estuarine Beach	N/A – Not Present	Not Present
11	Tidal Flat	Mud Flat	322.3 (1.4%)
12	Ocean Beach	Coastal Strand	267.3 (1.1%)
13	Ocean Flat	N/A – Not Present	Not Present
14	Rocky Intertidal	Rocky Intertidal	6.9 (0.03%)
15	Inland Open Water	Open Water	85.3 (0.4%)
16	Riverine Tidal Open Water	Riverine Tidal	16.9 (0.1%)
17	Estuarine Water	Open Water Subtidal	230 (1%)
18	Tidal Creek	Tidal Channel	80 (0.3%)
19	Open Ocean	Open Ocean	8266.8 (34.8%)
20	Irreg. Flooded Marsh	Rarely Flooded Salt Marsh / Salt Pans	411.9 (1.7%)
21	Not Used	N/A – Not Present	Not Present
22	Inland Shore	Arroyo / Gravel / Shore	123.7 (0.5%)
23	Tidal Swamp	Tidal Wetland with Trees/Shrubs	5.7 (0.02%)
24	Not Used	N/A – Not Present	Not Present
25	Vegetated Tidal Flat	N/A – Not Present	Not Present
26	Backshore	Dunes	183.2 (0.8%)
		TOTAL	23,738 (100%)

**Agricultural Land is not recognized in SLAMM. An ID of 100 was arbitrarily assigned to this classification. Agricultural land was added to the SLAMM results after modeling was completed to differentiate between developed dry land, undeveloped dry land, and agricultural land.*

4.3 Diked Areas

Diked areas are considered in SLAMM using two mechanisms: high resolution topography or a spatial map of diked areas. The first option requires that the DEM be detailed enough to delineate the crest of a levee around a diked area. One low point (which can sometimes happen inadvertently when converting the 1-meter DEM to the 5-meter resolution used in this analysis) can cause the entire diked area to be flooded when in fact it is still protected by dikes. The second option uses a spatial map of diked areas to represent areas that are protected from sea level rise and intrusion of saline water.

Areas are designated as either diked (1) or not diked (0 or No Data). In this option, the diked areas are assumed protected until 2 meters of sea level rise has occurred, at which point the protected areas become inundated.

Four data sources were considered in identifying the locations of diked areas:

1. Expert consultation with Martin Ruane at Ventura County Naval Base. He reviewed and provided input to the dike map for the Mugu Lagoon study area. He also provided the alignment of the flood control levee along Calleguas Creek.

2. National Wetlands Inventory (NWI). The NWI wetlands classification scheme includes a modifier, “h” that indicates that an area is diked.

3. Southern California Wetlands Mapping Project. This dataset is a more recent version of the NWI map for Ventura County, with the same “h” modifier.

4. USACE National Levee Database[14]. This database primarily showed areas protected from fluvial flood events and was not used in identifying areas protected from coastal inundation and sea level rise.

Ultimately, only expert consultation with Martin Ruane was used. Most of the “diked areas” identified in the NWI and Southern California Wetlands Map occur in the Mugu Lagoon area. According to Martin Ruane, many of these areas are actually connected by culverts. He provided a culvert dataset as a GIS polyline shapefile that covered the extent of the Naval Base Ventura County Point Mugu property, which includes Mugu Lagoon. He delineated two stretches of diked managed ponds on the northeast side of the airport runway. The rest of the “diked areas” have some connectivity with the ocean and are assumed unprotected by dikes for this analysis. The high resolution (1 meter) DEM was inspected to identify the approximate minimum crest elevation of the dikes around the managed ponds. The coarser DEM was then modified as needed to ensure that these ponds were diked to this elevation. Therefore, no “diked areas” map was used. This approach is far more reasonable than assuming the diked ponds will not be inundated until 2-meters of sea level rise will occur. The crest elevation for the southern ponds is currently only ~ 65 cm above mean tide level at the ocean.

5. Input Site Parameters

5.1 Overview

This section discusses non-map inputs to SLAMM, such as water levels, tide ranges, erosion rates, and accretion/sedimentation rates. Four sub-sites were delineated within the larger study area to account for differences in tide range, source data, likely accretion/sedimentation rates, and erosion rates:

- Mugu Lagoon West 1 (MLW1): Wetlands and agricultural land west of the NBVC airport runway. This region currently has the smallest tide range and includes the managed ponds.

- Mugu Lagoon West 2 (MLW2): Wetlands and Navy Base infrastructure between the runway and Laguna Road.

[14] Available online: http://nld.usace.army.mil/egis/f?p=471:32:559674793604701::NO (Accessed May 21, 2013).

- Mugu Lagoon Center (MLC): Adjacent to the mouth of Mugu Lagoon, this area has the largest tide range (with the exception of open ocean) and includes the downstream portion of Calleguas Creek.

- Mugu Lagoon East (MLE): This is the eastern arm of Mugu Lagoon, which has a large tide range and no other inflows. Wetland evolution is constrained by steep mountains along the north side.

These sites are delineated in Figure 3. Global parameters were specified for areas not included in one of these sub-sites.

Table 6. Summary of SLAMM input parameters for Ormond Beach and Mugu Lagoon

Parameter	***Global***	***MLW1***	***MLW2***	***MLC***	***MLE***
Habitat Map Year	2005	2005	2005	2005	2005
DEM Year	2009	2009	2009	2009	2009
Offshore Direction	South	South	South	South	South
Frequency of Overwash	Not used.				
Use Elev Pre-Processor?	No				
Water Levels					
Historic Sea Level Trend (mm/yr)	1.7 mm/year for all (see discussion in Section 6.1)				
MTL to NAVD88 (m)	0.798	0.85	0.85	0.82	0.82
Great Diurnal Tide Range (m)	1.65	0.66	1.01	1.37	1.37
Salt Elevation (m above MTL)	1.20	0.46	0.68	1.05	1.05
Horizontal Erosion Rates (horizontal meters/year, + is erosion)					
Marsh (5, 6, 7, 8, 18, 20, 23)	0.1	0.1	0.1	0.1	0.1
Freshwater Wetland with Shrubs (3)	0.1	0.1	0.1	0.1	0.1
Mud Flat (11) & Coastal Strand (12)	0.9	0.1	0.1	0.1	0.1
Constant Accretion/Sedimentation Rates (mm/year)					
Emergent Salt Marsh (8)	Elevation/accretion-sedimentation feedback relationship used instead, see below.				
Rarely Flood Salt Marsh/Pan (20)					
Tidal Fresh Marsh (6)					
Inland Fresh Marsh (5)					
FW Wetland w/ Trees/Shrubs (3)	1	1	1	1	1
Tidal Wetland w/ Trees/Shrubs (23)	1	1	1	1	1
Coastal Strand (12)	1	1	1	1	1
Accretion/Sedimentation Rate Extremes for Elevation Feedback* (see Section 5.4) (mm/year)					
Emergent Salt Marsh (8), min	1	1	2	3	2
Emergent Salt Marsh (8), max	4	4	6	8	6
Rare Flood Salt Marsh (20), min	1	1	2	3	2
Rare Flood Salt Marsh (20), max	4	4	6	8	6
Tidal Flat (11), min	1	1	2	3	2
Tidal Flat (11), max	4	4	6	8	6
Tidal Fresh Marsh (6), min	1	1	2	3	2
Tidal Fresh Marsh (6), max	5	5	7	9	7

**These accretion rates represent the "high accretion" scenario (described in Section 2.1). The "low accretion" scenario used half the rates presented here (e.g. the Emergent Salt Marsh (8), Global min for "low accretion" was 0.5 mm/year).*

5.2 Water Levels and Salt Elevation

Elevation ranges for each habitat type in SLAMM are specified based on three water level parameters:

- Conversion between Mean Tide Level (MTL) and the vertical datum NAVD88
- Great Diurnal Tide Range
- Salt Elevation

Mean Tide Level (MTL) is the vertical datum used in SLAMM. As sea level rises, the land elevations are lowered relative to MTL. The SLAMM technical documentation describes how habitat categories switch with rising sea level and changes to the above three water level parameters (WPC 2012). This section describes how these parameters were selected using existing studies. Table 6 reports values selected for each study area.

The "salt elevation" is a threshold elevation that determines when dry lands and freshwater wetlands convert to salt marsh (unless a freshwater influence is identified, as described in Section 5.5). This is the elevation below which salt water has an influence on the habitat type. This elevation is defined as the elevation that is inundated by salt water less than every 30 days, or approximately a one month. This value was estimated for each nearby tide station by calculating the average maximum monthly water level (Table 7).

Table 7. Regional Tidal Datums

Tide	**Rincon Island**** #9411270 *m NAVD88*	**Santa Barbara** #9411340 *m NAVD88*	**Santa Monica** #9410840 *m NAVD88*	**Los Angeles** #9410660 *m NAVD88*
Highest Observed Water Level	2.350	2.213	2.533	2.352
Salt Elevation*	1.997	1.990	2.002	2.003
Mean Higher High Water	1.634	1.606	1.596	1.611
Mean High Water	1.404	1.376	1.371	1.386
Mean Tide Level***	0.838	0.818	0.798	0.805
Mean Sea Level	0.831	0.811	0.792	0.799
Mean Low Water	0.271	0.260	0.226	0.224
Mean Lower Low Water	-0.030	-0.039	-0.057	-0.062
Lowest Observed Water Level	-0.737	-0.921	-0.924	-0.894

*Salt Elevation was calculated by calculating the median of the maximum monthly high water for all available data from each tide station. This is the water level that is reached approximately once per month.
** Rincon Island station has was decommissioned in 1990
*** This is the MTL-NAVD88 conversion, one of the inputs to SLAMM.

The Great Diurnal Tide Range is important in SLAMM because it associates the habitat and elevation relationship with the tidal variability across the site. Across the Mugu wetlands, substantial tidal variations exist because of the complex hydraulic connections between various basins, bridges, and culverts. In 2003, RMA conducted a numerical modeling study that provided many of the tide range inputs for the Mugu Lagoon study area (RMA 2003). Water levels were collected at two locations in Mugu Lagoon for model calibration. Figure 5 shows the locations of the gages ("Mugu West" and "Mugu

North") and compares the various tidal water levels observed during the month-long period to the Santa Monica tide gage. "Mugu North" is located north of the central lagoon channel. It experienced approximately 80% of the Santa Monica gage tide range. For subsite MLC we use 83% of the GDTR from the Santa Monica tide gage (1.37 meters). This value was also applied to subsite MLE, which is not separated from the main lagoon by any water control structures. "Mugu West" is located just east (ocean-side) of five 30" culverts under L Avenue (Figure 3). This gage is located past a 30' box culvert under Laguna Road, which probably causes much of the damping observed in the gage data. Subsite MLW2 was assigned a GDTR of 61% of the Santa Monica GDTR (1.01 meters). While gage data was not available inside of the culverts under the airport runway, we assume that the tide range will be further reduced in this region. A GDTR of 40% of the Santa Monica tide range was assigned to sub-site MLW1.

The RMA water level comparison also found that mean sea level was slightly different between the three tide gages. The Mugu West and Mugu North gages experienced a MSL 5 and 2 cm higher than the Santa Monica gage, respectively. The MTL-NAVD88 conversion from the Santa Monica tide gage was adjusted to account for this difference. The salt elevation in each sub-site was estimated by reducing the salt elevation at the Santa Monica gage by the observed % reduction of high tides shown in Figure 5 (56% for Mugu West and 87% for Mugu North).

CH2M Hill (2008) collected water level data in the Ormond Beach Lagoon over a 3-month period during which the lagoon breached multiple times (Figure 6). When the lagoon is open, the high water levels match the tide level at the ocean and the lower tides are clipped, likely due to water ponding in the lagoon at low tides. Based on this dataset it appears that Ormond Lagoon experiences high tides similar to those at the ocean, so no reductions in high tide range were applied to this site.

5.3 Horizontal Erosion Rates

SLAMM requires estimates of horizontal erosion (e.g. shoreline or bank erosion) for coastal strand, marshes, freshwater wetlands, and mudflats. Mudflats and coastal strand are assumed to erode continuously at a specified rate (unless using the Bruun rule, as described in the next paragraph). Marshes are predicted to undergo erosion if they directly interface open water with over 9 km of fetch available for wind setup. This minimum fetch distance is hardcoded in SLAMM and, based on discussions with the Science Advisory Committee, may not accurately represent the rates of marsh erosion in Ventura's wetland systems. Model results (acreages of habitats) are relatively insensitive to horizontal erosion rates compared to vertical accretion/sedimentation rates. Table 6 presents a summary of input parameters, including the horizontal erosion rates.

By default, SLAMM uses the Bruun rule for beach erosion with an assumed beach slope of 1:100. This means that for every meter of sea level rise, the beach erodes by 100 meters. While this may be applicable to natural, flat, East Coast beaches, the beaches along the Ventura shoreline are far steeper. This module causes the beaches to disappear by 2020, which is not anticipated based on the prior erosion analysis. Therefore, this module was disabled. Instead, coastal strand and mudflat erosion rates (SLAMM uses the same rate for these two habitats) were based on a shoreline change analysis conducted for the Coastal Resilience Ventura coastal hazards analysis (ESA PWA 2013). This prior study calculated average short term (1970s to 2010) and long term (1850s to 2010) shoreline erosion rates for 500 meter or smaller along-shore study "blocks". The erosion rates used in the erosion study were averaged within each SLAMM study area (Figure 2) as the global Coastal Strand (12) erosion rate. In either case the beaches narrow significantly in SLAMM, and the dunes slowly disappear.

Marsh erosion rates were not readily available within the Ventura study areas, so estimates from Elkhorn Slough in Monterey Bay were implemented. Elkhorn Slough, which is an actively eroding system, has experienced 15 – 35 cm/year of marsh bank erosion over the past 10 years (Wasson 2011). Therefore, a marsh erosion rate of 10 cm/year was assumed for all study areas, as these systems are not known to be actively eroding.

5.4 Vertical Accretion and Sedimentation Rates

Vertical accretion/sedimentation[15] is a key factor in determining whether or not a marsh can persist in the face of sea level rise and will be increasingly important with accelerated sea level rise. Vertical accretion is driven by a variety of factors such as sediment supply, duration of tidal inundation, and rate of plant growth. SLAMM incorporates average annual marsh accretion and beach sedimentation rates for various habitat types into estimates of relative sea level rise. Vertical marsh growth is a combination of inorganic sediment deposition and organic soil production (bioaccumulation). Our literature review found a wide range of accretion rates in estuaries in Central/Southern California, which are summarized below. The subsequent section describes how accretion rates were modeled in the Ventura SLAMM.

Literature Review

Deposition in southern California estuaries tends to be episodic and storm-driven rather than continuous and tidally-driven as observed in larger estuaries like South San Francisco Bay (Wallace et al 2005, Weis et al 2001, Cahoon et al 1996, and Onuf 1987). Major storms in 1978 and 1980 filled nearly 40% of the volume of Mugu Lagoon, which had previously been dredged by the Navy (Onuf 1987). Chan and Ambrose (unpublished, as cited in Rosencranz 2012) found accretion rates of 2 mm/year over a 13-year period. In contrast, a recent study in Mugu Lagoon (Rosencranz 2012) observed no net vertical accretion during an unusually dry monitoring period (August 2011 to May 2012). Few studies exist that report long term average annual sedimentation/accretion rates in Ventura County wetland systems.

Accretion measurements do exist for some nearby estuaries. Most understanding of marsh accretion in southern California comes from studies at the Tijuana Estuary National Estuarine Research Reserve, which lies just south of San Diego Bay. Mudie & Byrne (1980) estimate that the vertical accretion rate in Tijuana estuary has been approximately 1 mm/year over the last 1100 years, which is comparable to the rate of sea level rise over that period (1-3 mm/yr). Cahoon et al (1996) observed 1-2 mm of accretion in the high marshes and 85 mm of accretion in the low marshes of Tijuana Estuary during a 17 month monitoring period (October 1992 – March 1994). Almost all of this accretion occurred due to mineral sedimentation during a 2 month period of storm-induced river flows. Wallace et al (2005) monitored a restoration site in Tijuana Estuary for 3.5 years and measured 4 to 11 mm/year net accretion.

Elkhorn Slough, in the center of the Monterey Bay coast, has no major rivers providing pulses of sediment and has experienced gradual accretion. Watson (2008) measured 2 to 3 mm/year of salt marsh accretion since 1950, when the Army Corp of Engineers dredged a navigational channel and built a pair of entrance jetties. Before construction, accretion was << 1mm/year. More recent measurements suggest that the average marsh surface elevation gain has averaged about 1 mm/yr since 2006 (Van Dyke 2012).

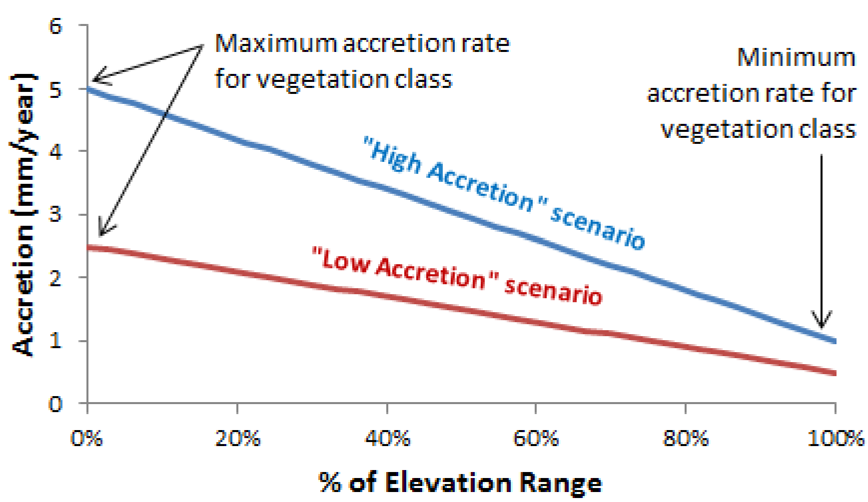
[15] Vertical growth of the marsh or wetland.

Model Implementation

Land management practices, sediment supply, ecology, and many other factors influence accretion rates and vary among southern California systems. For the purposes of predicting future accretion rates in the Ventura County SLAMM study areas, we implemented an elevation-accretion relationship where wetlands that are higher in the tide range and inundated less often experience lower accretion rates. This inverse relationship between elevation and accretion has been measured (Cahoon et al 1996, Cahoon and Reed 1995, Stoddart et al. 1989, Marion et al 2009) and observed in physical models (Krone 1985). This inverse relationship appears to be true for both storm-induced sedimentation and long term tidal deposition. This feedback would cause wetlands to accrete more quickly as the rate of sea level rise increases, up to a threshold (Morris et al 2002, Friedrichs and Perry 2001). This outcome relies heavily on the amount of sediment available for sedimentation. Here we make the assumption that the feedback relationship, which is based on historic trends and historic sediment supply, remains the same into the future.

For simplicity, we assume a linear relationship between accretion rate and elevation. Figure 7 shows an example of such a relationship with a maximum and minimum accretion rate of 5 and 1 mm/year and 2.5 and 0.5 mm/year for the “High” and “Low” accretion scenarios, respectively. Maximum and minimum accretion rates were selected based on regional accretion rates (at Elkhorn Slough and Tijuana Estuary) and relative sediment supply from each fluvial system (Inman and Jenkins 1999), with some judgment and input from the SAC to select rates for each wetland type. The rates selected for each study area and marsh type are reported in Table 6. The elevation feedback curve is only available for four habitat types which are subject to the greatest variability in inundation depth. A long term accretion rate of 1 or 2 mm/year was selected for the other wetland types, depending on the sediment supply. These wetland types occur at higher elevations and are inundated less frequently.

Figure 7 – Conceptual Relationship between Elevation and Accretion Rate



The low accretion limit for each habitat type was set at 1 mm/year or 2 mm/year as this tends to be the lower limit of longer term studies that included some storm events. The upper limit for tidal fresh marsh was set higher than salt marsh as freshwater wetlands tend to be more productive and experience higher rates of organic accretion.

While the rates of accretion were selected after this literature compilation and discussion with the Science Advisory Committee, there have been few long term measurements in Mugu Lagoon. However, another way to view these “assigned” accretion rates is that various sediment management or restoration practices could be implemented to support higher accretion rates and thus improve the resiliency of these various wetland habitats in the face of accelerating sea level rise. It should also be noted that precipitation projections in the region show a slight increase in precipitation to 2030 and then a steady decline through 2100 (ESA PWA 2013). Reduced precipitation and river run-off can reduce fluvial sediment delivery to coastal marshes. However, changes to accretion rates driven by changes in river flows were not modeled in this SLAMM study due to high uncertainty in future watershed management, river flows, and amount of sediment delivery.

5.5 Freshwater Flows

Freshwater runoff into Mugu Lagoon tends to occur rapidly and for short periods of time between November to April. During these periods the lagoon is essentially flushed and becomes fresh for short periods of time (Onuf 1987). Except for immediately at the junction between Calleguas Creek and Mugu Lagoon, the lagoon experiences marine salinities during the rest of the year, when flows from Calleguas Creek are very low. The wetlands in Mugu Lagoon are dominated by salt-tolerant plants. With future sea level rise and the possibility for decreased freshwater runoff, we anticipate that this condition will persist.

The existing wetlands at Ormond Beach are also dominated by salt water vegetation, so no “freshwater-influenced” area was delineated. There is some Freshwater Marsh (5), but it occurs at higher elevations and is expected to convert to salt marsh as sea level rises and salt water inundation occurs more frequently. No major source of constant freshwater feeds and maintains these freshwater marshes.

For these reasons, no SLAMM freshwater module was applied to the Mugu Lagoon and Ormond Beach study area. The freshwater module was, however, considered in the Ventura and Santa Clara River models, as described in Section 7.2.

6. Modeling Implementation of Future Scenarios

This section explains how the future scenarios (described in Section 2.1) were implemented in SLAMM by adjusting the input maps (Section 4) and/or site parameters (Section 5).

Sea Level Rise

SLAMM (version 6.2) calculates sea level rise based on projections that start in 1990. Since the Ventura sea level rise projections are taken relative to 2010, it was necessary to input a higher sea level rise relative to 2010 to “trick” SLAMM into implementing the correct amount of sea level rise between 2010 and 2100. Taking the high sea level rise scenario as an example, the “Custom SLR by 2100” input in the SLAMM execution options was set to 1.66 meters by 2100, relative to 1990, to obtain 1.48 meters by 2100, relative to 2010. SLAMM then uses the custom sea level rise amount to scale the A1B scenario curve to obtain the custom SLR by 2100. Additionally, SLAMM adjusts the global sea level rise to a local sea level rise using the difference between historic local and historic global (1.7 mm/year, from IPCC 2007). Since these corrections were done outside of SLAMM for the Ventura project, we set the “Historic Trend” site parameter to 1.7 mm/year to remove this unnecessary adjustment.

Management

As described in Section 2.1, SLAMM was used to model four future management scenarios: allow wetlands to transgress into all dry land, fortify developed dry land (excluding agricultural land), fortify developed dry land (including agricultural land), and fortify developed dry land (including agricultural land and managed ponds). SLAMM focuses on wetland habitats and does not model upland habitats, other than to convert them to wetlands when sea level rise causes high tides to inundate new areas. SLAMM only recognizes two types of upland areas: developed and undeveloped. Since the two fortification scenarios protect different expanses of developed dry land, two input habitat maps were created. One mapped agricultural land as “Undeveloped Dry Land” and another mapped it as “Developed Dry Land”. In the “Fortify developed dry land (including agriculture and managed ponds)” scenario, the two stretches of diked ponds are assumed to be protected. This would require fortifying/raising the levees around the ponds and extensive water management in the future, as they are currently low-lying compared to the tide frame. This scenario was implemented in SLAMM by adding a dike raster with a value of 1 in diked and “No Data” other areas. SLAMM does not allow diked areas to change habitats with sea level rise.

Accretion

Model implementation of the “High” accretion scenario is described in Section 5.4, with accretion rates presented in Table 6. The low scenario was implemented by halving the “maximum” and “minimum” accretion rates presented in Table 6.

Erosion

The “erosion of new inlet west of the NBVC” scenario was implemented by setting the tide range in site MLW1 equal to the tide range in site MLC, which is located near the main inlet.

7. The Santa Clara and Ventura River Estuaries

The Ventura River and Santa Clara River Estuaries are the two other major wetland systems in Ventura County. These regions were originally included as part of the ecological vulnerability modeling (Figure 2). This section summarizes the approach taken and explains why SLAMM was not sufficient for modeling wetland evolution with future sea level rise in these estuaries.

7.1 Site Descriptions

The Ventura River Estuary (VRE) is a bar built estuary supplied by the Ventura River (watershed area = 224 mi^2) with perennial flow and occasional extreme flood events. The lagoon is separated (closed) from the ocean by a cobble/sand bar except during and shortly after storms. The lagoon is brackish when the mouth is open, but stratifies during periods of closure (fresh on top and brackish on the bottom). Figure 8 shows an aerial photo and habitat map of this study area, and Table 8 reports habitat acreages.

The Santa Clara River Estuary (SCRE) is a bar built estuary at the end of the Santa Clara River (watershed area = 1600 mi^2). Estuary dynamics are driven by flows from the Santa Clara River (which vary greatly throughout the year), tides, wave overwash, and effluent from the Ventura Water Reclamation Facility (VWRF). The estuary tends to be open during the winter and spring, when the river flows are greatest, and closed by a sandbar during the summer and fall due to low river flows and smaller waves. Figure 9 shows an aerial photo and habitat map of this study area, and Table 8 reports habitat acreages. Both the Ventura and Santa Clara River Estuaries are dominated by freshwater wetland habitats.

Table 8. SLAMM Habitats and Acreages in the Ventura and Santa Clara River Estuaries

			Approximate Acreage (% of total area)	
ID	SLAMM Name	Ventura Name	Ventura River Estuary	Santa Clara River Estuary
1	Developed Dry Land (Including agricultural land)	Developed Uplands	1790.3 (51.2%)	6704.8 (46.9%)
2	Undeveloped Dry Land	Undeveloped Uplands	526.5 (15.1%)	583.3 (4.1%)
3	Swamp	Freshwater Wetland with Trees/Shrubs/ Riparian Forest	72.5 (2.1%)	379.2 (2.6%)
4	Cypress Swamp	N/A – Not Present	*Not Present*	*Not Present*
5	Inland Fresh Marsh	Inland Fresh Marsh	7 (0.2%)	101.3 (0.7%)
6	Tidal Fresh Marsh	Tidal Fresh Marsh	*Not Present*	*Not Present*
7	Trans. Salt Marsh (Scrub Shrub)	Tidal Estuarine Wetland with Trees/Shrubs	0.6 (0.02%)	*Not Present*
8	Regularly Flooded Marsh	Emergent Salt Marsh	6.4 (0.2%)	4.7 (0.03%)
9	Mangrove	N/A – Not Present	*Not Present*	*Not Present*
10	Estuarine Beach	N/A – Not Present	*Not Present*	2.5 (0.02%)
11	Tidal Flat	Mud Flat	1.7 (0%)	1.3 (0.01%)
12	Ocean Beach	Coastal Strand	85.4 (2.4%)	204.2 (1.4%)
13	Ocean Flat	N/A – Not Present	*Not Present*	*Not Present*
14	Rocky Intertidal	Rocky Intertidal	0.4 (0.01%)	4.6 (0.03%)
15	Inland Open Water	Open Water	0.9 (0.02%)	55.9 (0.4%)
16	Riverine Tidal Open Water	Riverine Tidal	1.4 (0.04%)	*Not Present*
17	Estuarine Water	Open Water Subtidal	9.1 (0.3%)	446.1 (3.1%)
18	Tidal Creek	Tidal Channel	*Not Present*	*Not Present*
19	Open Ocean	Open Ocean	933.1 (26.7%)	5245 (36.6%)
20	Irreg. Flooded Marsh	Rarely Flooded Salt Marsh / Salt Pans	0.9 (0.03%)	*Not Present*
21	Not Used	N/A – Not Present	*Not Present*	*Not Present*
22	Inland Shore	Arroyo / Gravel / Shore	14.5 (0.4%)	182.5 (1.3%)
23	Tidal Swamp	Tidal Wetland with Trees/Shrubs	17.9 (0.5%)	*Not Present*
24	Not Used	N/A – Not Present	*Not Present*	*Not Present*
25	Vegetated Tidal Flat	N/A – Not Present	*Not Present*	*Not Present*
26	Backshore	Dunes	26.9 (0.8%)	395.7 (2.8%)
		TOTAL	**3,495 (100%)**	**14,311 (100%)**

7.2 Seasonal Closures and Episodic Disturbances

There are two aspects of the Ventura and Santa Clara River estuaries that make them a challenge to model using SLAMM:

1. Seasonal Closures: Tide range and salinity depend almost entirely on the extent to which the estuaries are open or closed. This is a process that is not considered in SLAMM.

2. Episodic Disturbances: Habitats, geomorphology, and topography are highly dependent on rare storm events rather than a steady-state relationship with the tides. The estuary topography and habitats often change drastically during major storm events, but this is not modeled by SLAMM.

The mouths of these rivers cycle between open and closed tidal conditions and are largely controlled by the elevation of the sand bar at the entrance, which affects the duration of inundation and can cause water levels to far exceed ocean tide levels (Figure 10). These bar built systems differ significantly from Mugu lagoon and the SLAMM conceptual model, which depend on daily tidal fluctuations. Seasonally closed systems are rather unique in the U.S. and found primarily along the Southern and Central California Coast. Constructive long period waves (typically present in summer) steadily rebuild the beach, reducing the tide range and salinity exposure in the lagoon. Incoming river flows gradually raise lagoon water levels behind the beach berm, inundating higher habitats with buoyant freshwater. This results in a shift in habitats vertically relative to the open ocean tidal regime. The SLAMM conceptual model for inundation (Figure 1) assumes that wetland habitats exist in specific elevation ranges, defined by the tides rather than a higher lagoon water level. We attempted to “trick” SLAMM[16] by lifting the tide range within the lagoons to encourage wetland transgression into dry lands, but this only resulted in all the freshwater marshes converting to salt marsh at the first time step.

We anticipate that with a similar wave climate, enough sediment, and similar river flows, the estuary habitats would continue to be largely controlled, by closed lagoon water levels. If we assume that the height of the berm is related to coastal processes (waves and tides) and that the current wave climate and sediment supply persist, the typical summer berm elevation should rise at a rate similar to sea level rise. This, in turn, would likely result in higher summer lagoon water levels, allowing wetland habitats to migrate further inland.

Salinity is a very important factor in vegetation establishment, growth, and habitat function. Once the barrier beach closes, any salt water remaining in the estuary gradually seeps out through the closed beach causing a freshening of the estuary water over the summer of the lagoon. Salinity can be modeled in two ways in SLAMM. The first applies to classic salt wedge estuaries, where a relatively constant source of freshwater flows into a large estuary and a gradual transition occurs between fresh and saltwater. Vegetation type in the estuary depends on the salinity of the water at each location. The VRE and SCRE wetland systems do not function in this way – they tend to be fresh or saline, switching for short periods of time during storms or breaching events. The second option is a simpler approach, in which it is possible to delineate an area as “freshwater influenced”. Within these areas, regardless of connectivity to the ocean, freshwater wetlands follow a separate decision tree of freshwater wetland types before converting to salt marsh. However, this approach still assumes that freshwater habitats are controlled by ocean tides, which is not the case. This module was added in the most recent version of SLAMM, and according to the model developers, is still in development. The elevation that converts dry land to salt marsh (the salt elevation) is the same elevation that converts dry land to freshwater

[16] Since SLAMM is open source, it could be modified to account for the vertical shifts in elevation bands observed in seasonally closed lagoons. However, reprogramming SLAMM would be a substantial effort and likely involve collaboration with the model developers.

marsh. Changing this would require re-coding of SLAMM and a good understanding of the elevation, relative to mean sea level, that leads dry land to convert to wetland.

As a result of the complexities of these two bar built estuaries and the lack of adequate representation of the formative physical processes in SLAMM, these two systems were removed from further analysis after consultation with the Science Advisory Committee and Project Development team.

8. List of Preparers

This report was prepared by Elena Vandebroek, P.E. and David Revell, Ph.D.

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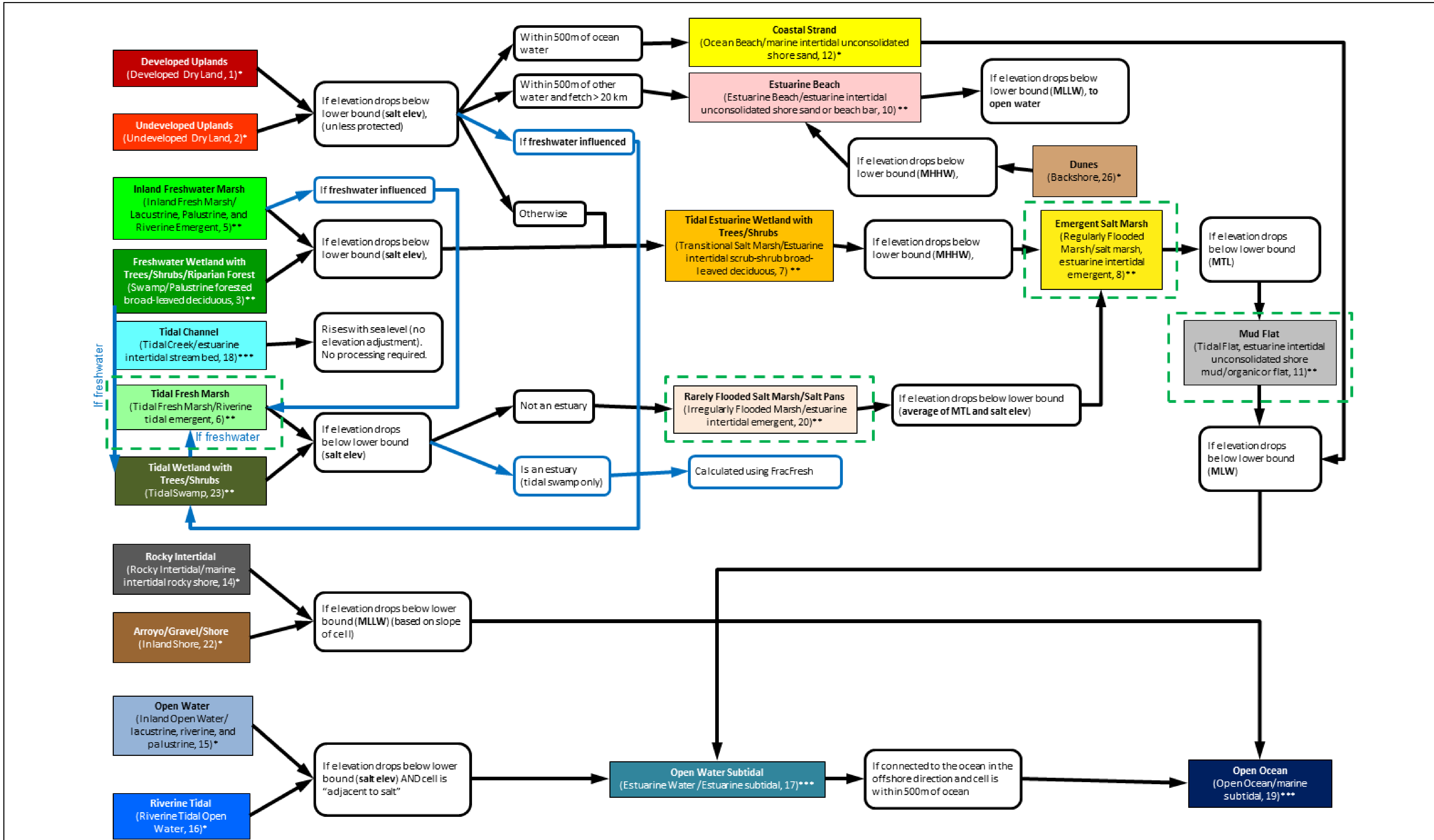


* Adjusted for SLR only
** Adjusted with equations (8) & (9) for SLR and accretion (if not protected by a dike).
*** Assumed to rise with sea level, so no elevation adjustment required.

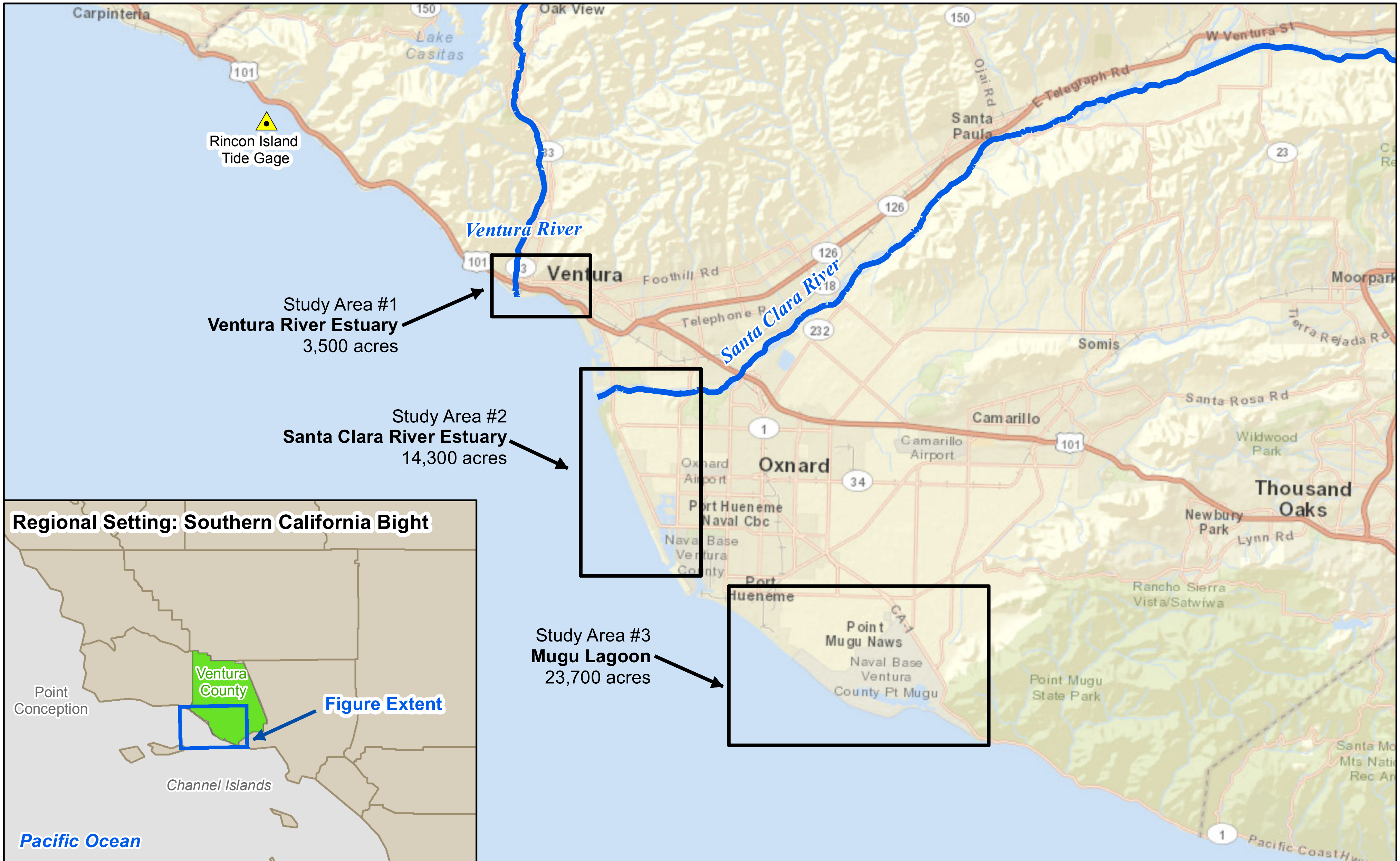
Note: This is one of the decision trees that exist in SLAMM. Others exist for erosion and saturation. This chart was developed by ESA PWA using the SLAMM 6.2 Technical Documentation as the primary reference.

figure 1
Ventura County Climate Change Vulnerability Assessment

SLAMM Conceptual Model for Inundation

ESA PWA Ref# D211452.00

ESA PWA



Basemap Credits: Sources: Esri, DeLorme, NAVTEQ, USGS, Intermap, iPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, 2013

2/24/2014

N

0 2.5 5 Miles

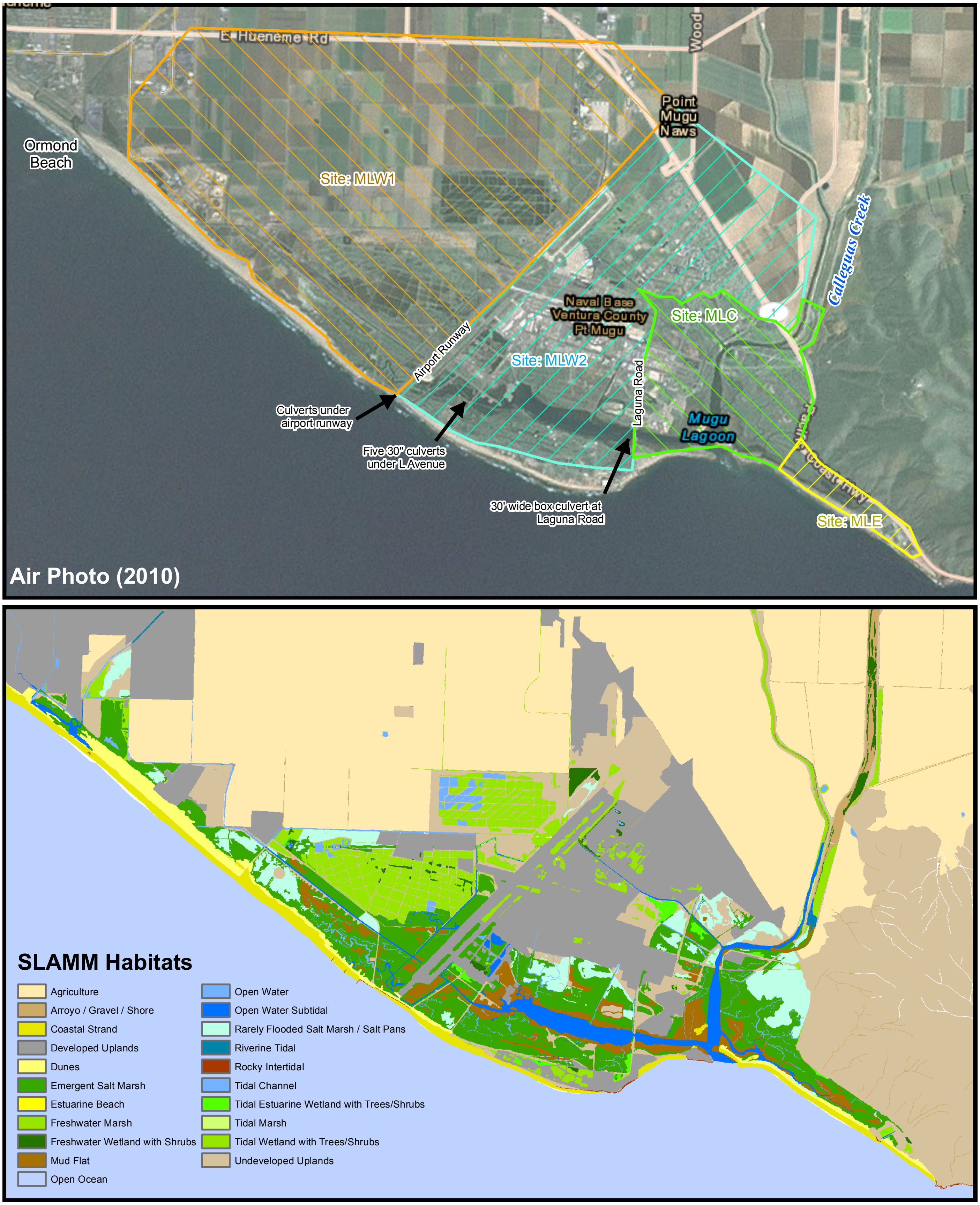
figure 2

Ventura County Climate Change Vulnerability Study

SLAMM Study Areas

ESA PWA Ref# - D211452

ESA PWA



N

0 2,500 5,000 Feet

figure 3

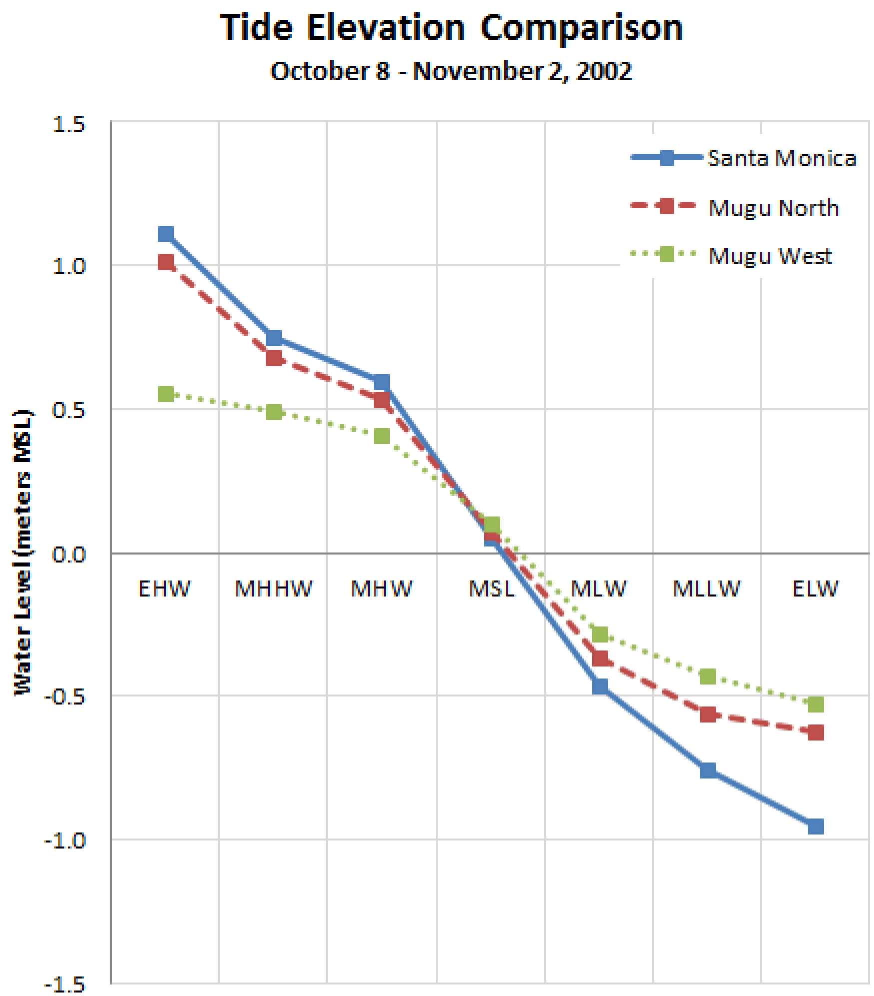
Ventura County Climate Change Vulnerability Study

Site Map: Mugu Lagoon and Ormond Beach

ESA PWA Ref# - D211452

ESA PWA

Relative to Santa Monica	Mugu West	Mugu North
MHHW relative to MSL	56%	87%
Change in Mean Sea Level	+5.2 cm	+2.4 cm
Reduction in GDTR	61%	83%



Source: RMA (2003). Mugu Lagoon Numerical Model Development, Final Report. Prepared for U.S. Army Corps of Engineers Los Angeles District. May 2003.

figure **5**

Ventura County Climate Change Vulnerability Assessment

Mugu Lagoon Tidal Water Level Comparison

ESA PWA Ref# D211452.00

ESA PWA

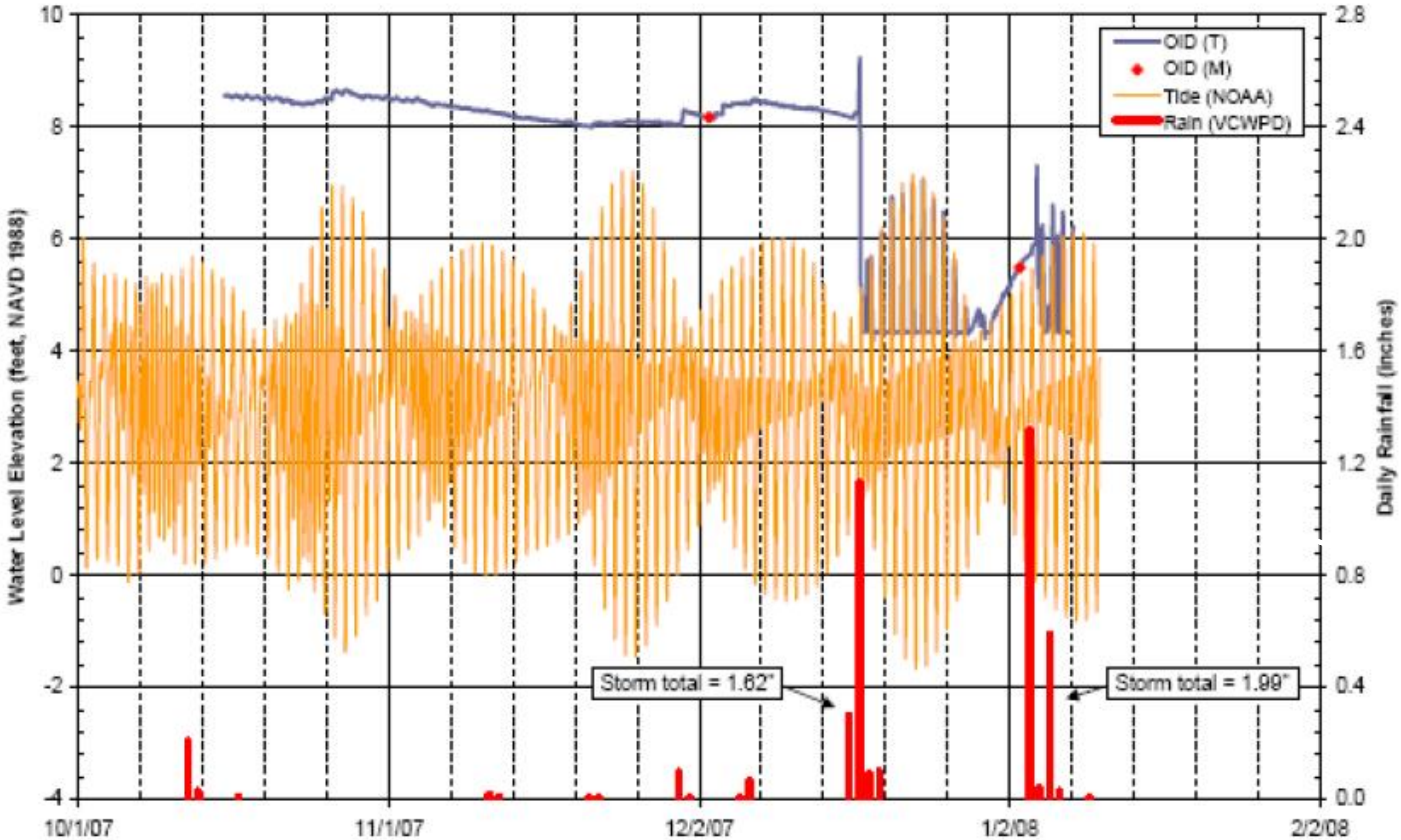


Figure 5.9. Water level in the lagoon 10/2007 – 1/2008 (CH2M Hill 2008).

Source: CH2M Hill (2008) as cited in HDR (2008) J Street Drain/Ormond Beach Lagoon Coastal Engineering Report. Prepared for the Ventura County Watershed Protection District. November 2008.

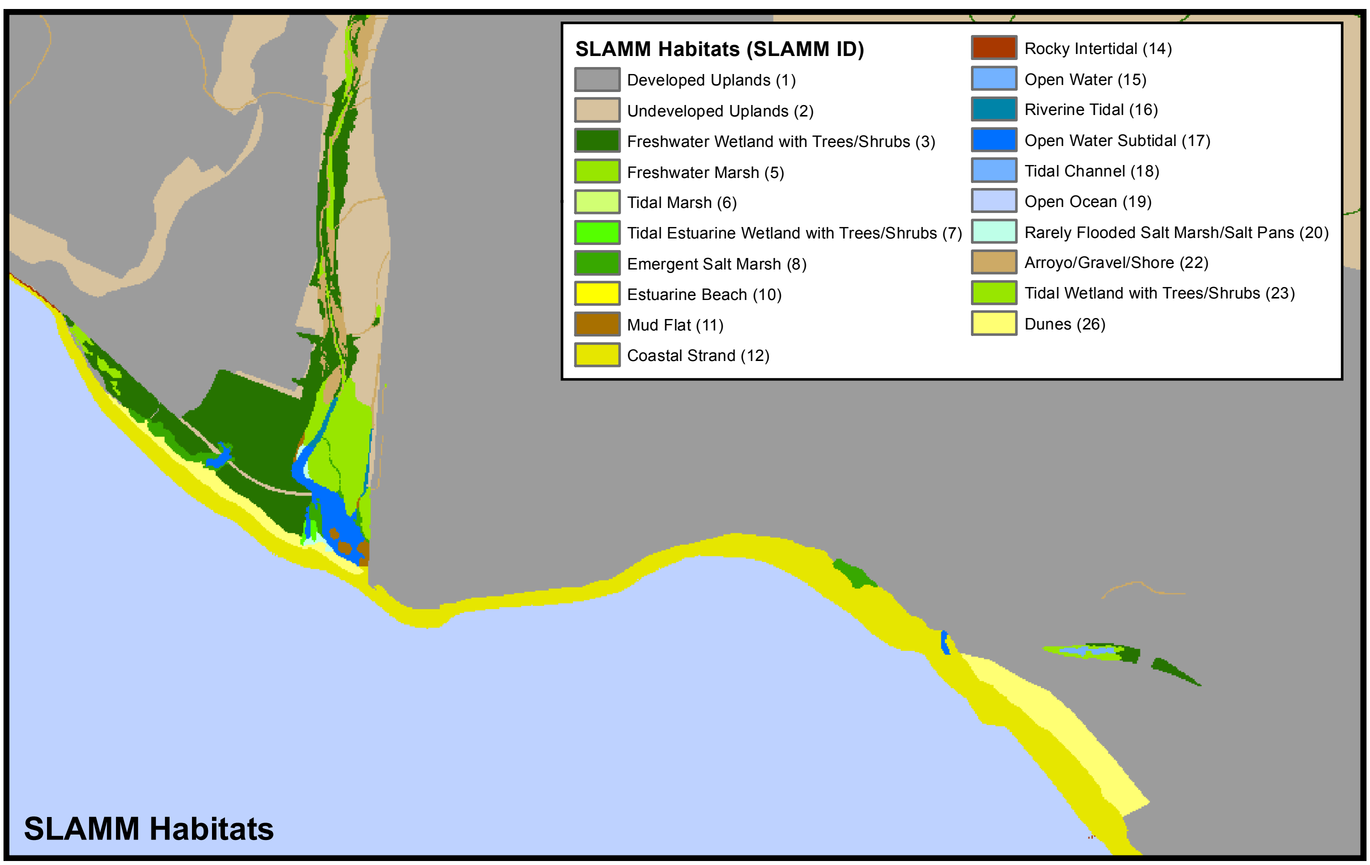
figure ***6***

Ventura County Climate Change Vulnerability Assessment

Ormond Beach Lagoon Water Levels

ESA PWA Ref# D211452.00

ESA PWA



Please see Figure 2 for a regional map.

N

0 1,000 2,000 Feet

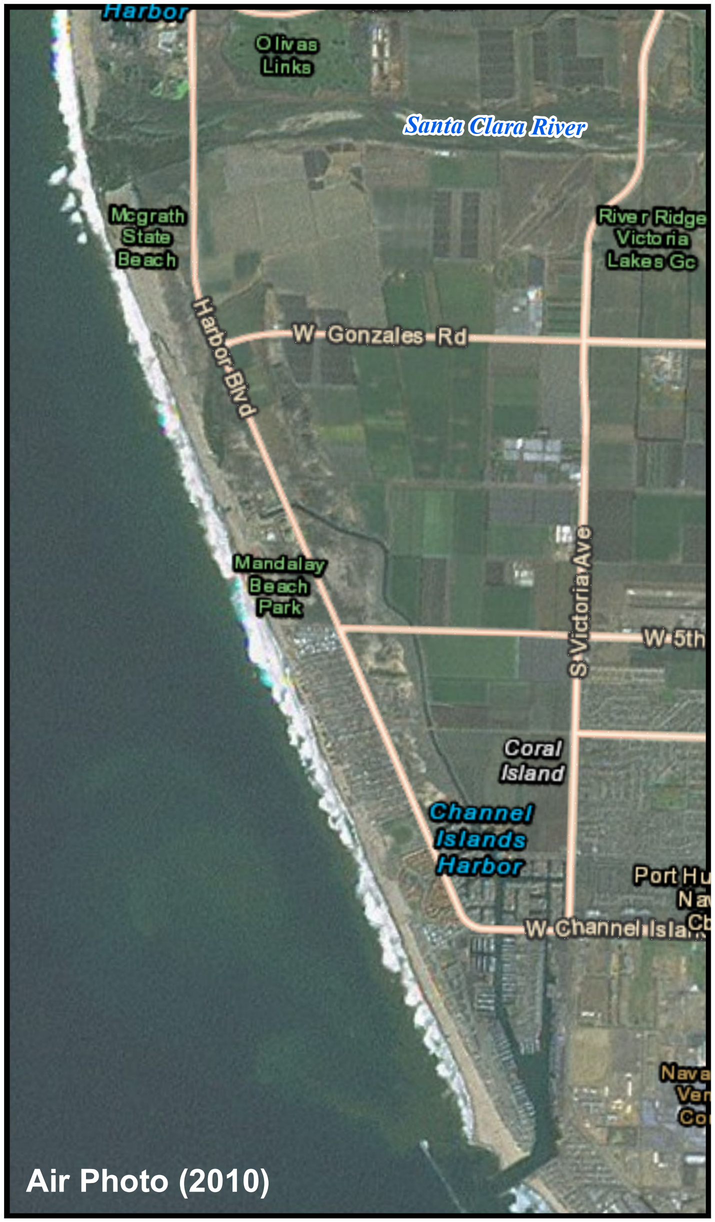
figure 8

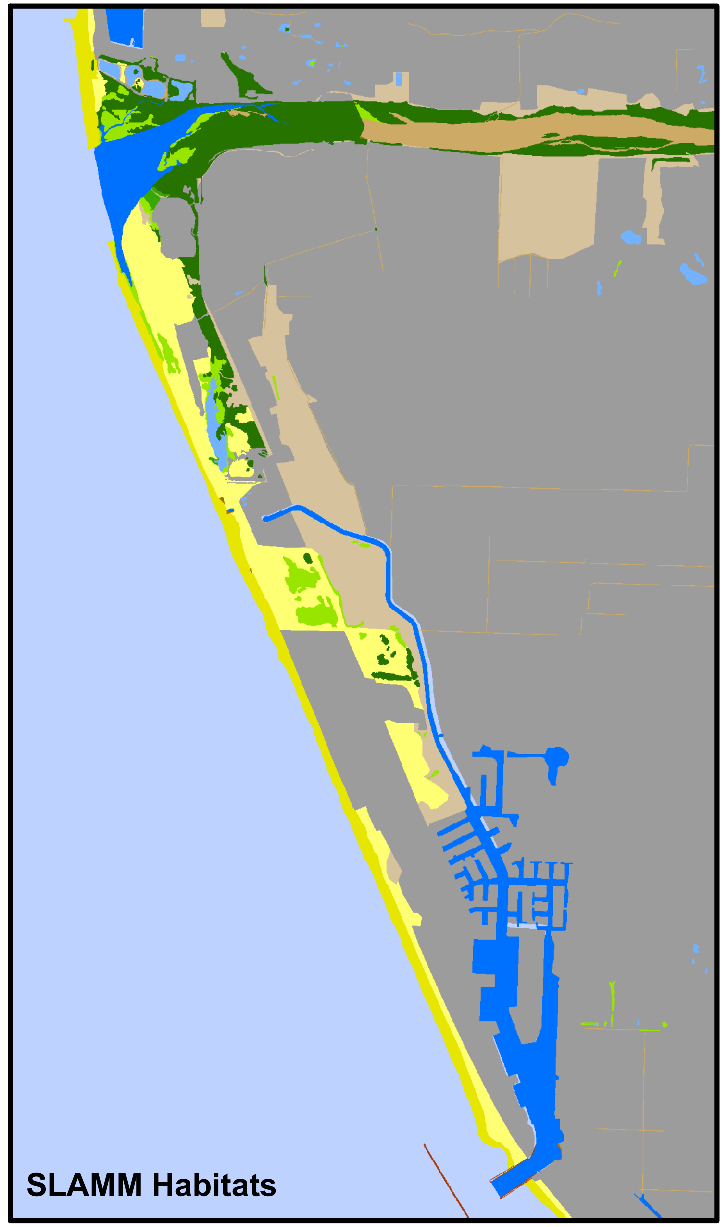
Ventura County Climate Change Vulnerability Study

Site Map: Ventura River Estuary

ESA PWA Ref# - D211452

ESA PWA





SLAMM Habitats (SLAMM ID)

- Developed Uplands (1)
- Undeveloped Uplands (2)
- Freshwater Wetland with Trees/Shrubs (3)
- Freshwater Marsh (5)
- Tidal Marsh (6)
- Tidal Estuarine Wetland with Trees/Shrubs (7)
- Emergent Salt Marsh (8)
- Estuarine Beach (10)
- Mud Flat (11)
- Coastal Strand (12)
- Rocky Intertidal (14)
- Open Water (15)
- Riverine Tidal (16)
- Open Water Subtidal (17)
- Tidal Channel (18)
- Open Ocean (19)
- Rarely Flooded Salt Marsh/Salt Pans (20)
- Arroyo/Gravel/Shore (22)
- Tidal Wetland with Trees/Shrubs (23)
- Dunes (26)

Please see Figure 2 for a regional map.

N

0 2,500 5,000 Feet

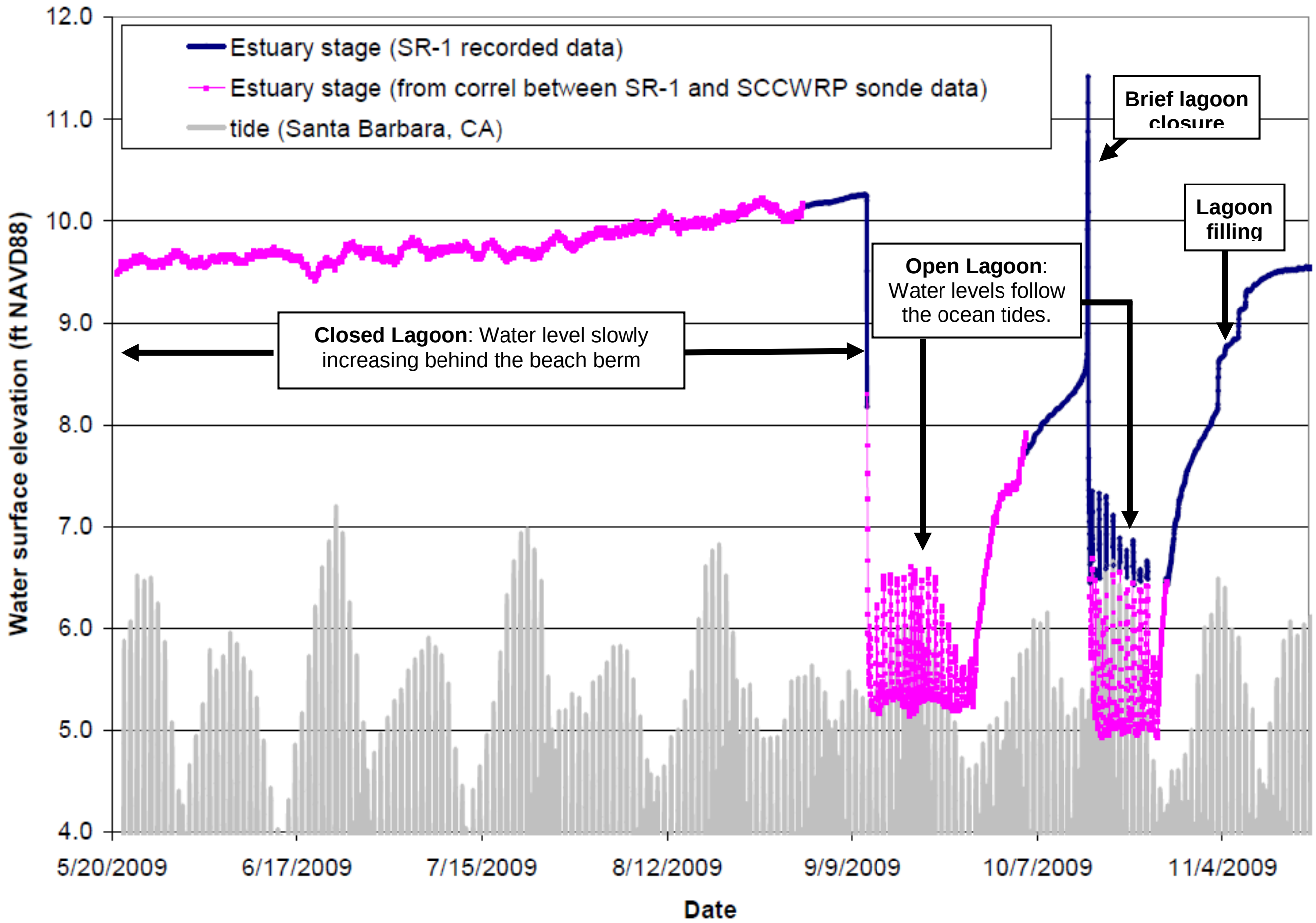
figure 9

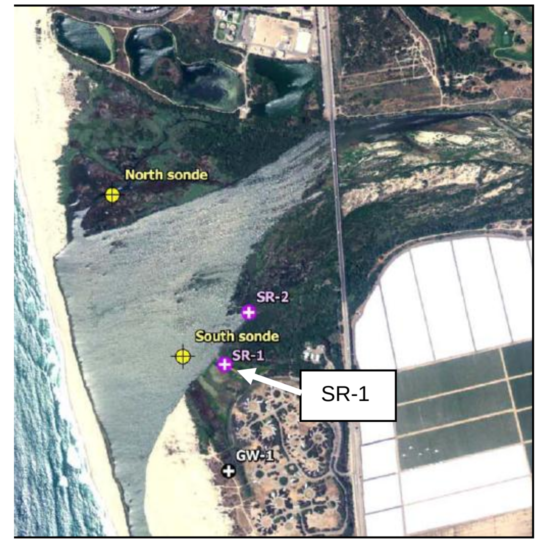
Ventura County Climate Change Vulnerability Study

Site Map: Santa Clara River Estuary

ESA PWA Ref# - D211452

ESA PWA





Source: Adapted from Stillwater Sciences (2010). City of Ventura Special Studies: Estuary Subwatershed Study, Draft Year One Data Summary and Assessment. Prepared by Stillwater Sciences, Berkeley California for the City of Ventura. January 2010.

figure **10**

Ventura County Climate Change Vulnerability Assessment

Water Levels in the Santa Clara River Estuary

ESA PWA Ref# D211452.00

ESA PWA

\\sfo-file01\esapwa\Data\projects_211XXX - 2011 Projects\D211452.00 - VenturaClimateChangeTNC\04 Deliverables\SLAMMTechDoc\Figures\WordTemplates\Fig X - SCR Water levels.doc

Appendix A. Table of SLAMM Deliverables

Note: The "allow erosion of new inlet" scenario is not recommended for display on the web map or for release to the public. The file names of these outputs are highlighted in ***red*** *. Please see section 6.3 of main report for explanation.*

		Scenarios										
		Sea Level Rise		Accretion		Erosion of New Inlet		Management		Planning Horizon	Figure	ESA Model Run
File Name	File Type	*Description*	*sym*	*Description*	*sym*	*Description*	*sym*	*Description*	*sym*	*Year*	*in Appendix B*	*#*
ec_2010	GRID Raster	None	ec	N/A	N/A	N/A	N/A	N/A	N/A	2010	All	N/A - input
s1a1e1m12020	GRID Raster	Low	s1	Low	a1	No	e1	Allow marshes to transgress into dry land	m1	2020	--	Run3-47
s1a1e1m12030	GRID Raster	Low	s1	Low	a1	No	e1	Allow marshes to transgress into dry land	m1	2030	B.2	Run3-47
s1a1e1m12040	GRID Raster	Low	s1	Low	a1	No	e1	Allow marshes to transgress into dry land	m1	2040	--	Run3-47
s1a1e1m12050	GRID Raster	Low	s1	Low	a1	No	e1	Allow marshes to transgress into dry land	m1	2050	--	Run3-47
s1a1e1m12060	GRID Raster	Low	s1	Low	a1	No	e1	Allow marshes to transgress into dry land	m1	2060	B.2	Run3-47
s1a1e1m12070	GRID Raster	Low	s1	Low	a1	No	e1	Allow marshes to transgress into dry land	m1	2070	--	Run3-47
s1a1e1m12080	GRID Raster	Low	s1	Low	a1	No	e1	Allow marshes to transgress into dry land	m1	2080	--	Run3-47
s1a1e1m12090	GRID Raster	Low	s1	Low	a1	No	e1	Allow marshes to transgress into dry land	m1	2090	--	Run3-47
s1a1e1m12100	GRID Raster	Low	s1	Low	a1	No	e1	Allow marshes to transgress into dry land	m1	2100	B.2	Run3-47
s1a1e1m22020	GRID Raster	Low	s1	Low	a1	No	e1	Fortify developed dry land (excluding agriculture)	m2	2020	--	Run3-47
s1a1e1m22030	GRID Raster	Low	s1	Low	a1	No	e1	Fortify developed dry land (excluding agriculture)	m2	2030	B.3	Run3-47
s1a1e1m22040	GRID Raster	Low	s1	Low	a1	No	e1	Fortify developed dry land (excluding agriculture)	m2	2040	--	Run3-47
s1a1e1m22050	GRID Raster	Low	s1	Low	a1	No	e1	Fortify developed dry land (excluding agriculture)	m2	2050	--	Run3-47
s1a1e1m22060	GRID Raster	Low	s1	Low	a1	No	e1	Fortify developed dry land (excluding agriculture)	m2	2060	B.3	Run3-47
s1a1e1m22070	GRID Raster	Low	s1	Low	a1	No	e1	Fortify developed dry land (excluding agriculture)	m2	2070	--	Run3-47
s1a1e1m22080	GRID Raster	Low	s1	Low	a1	No	e1	Fortify developed dry land (excluding agriculture)	m2	2080	--	Run3-47
s1a1e1m22090	GRID Raster	Low	s1	Low	a1	No	e1	Fortify developed dry land (excluding agriculture)	m2	2090	--	Run3-47
s1a1e1m22100	GRID Raster	Low	s1	Low	a1	No	e1	Fortify developed dry land (excluding agriculture)	m2	2100	B.3	Run3-47
s1a1e1m32020	GRID Raster	Low	s1	Low	a1	No	e1	Fortify developed dry land (including agriculture)	m3	2020	--	Run3-47b
s1a1e1m32030	GRID Raster	Low	s1	Low	a1	No	e1	Fortify developed dry land (including agriculture)	m3	2030	B.4	Run3-47b
s1a1e1m32040	GRID Raster	Low	s1	Low	a1	No	e1	Fortify developed dry land (including agriculture)	m3	2040	--	Run3-47b
s1a1e1m32050	GRID Raster	Low	s1	Low	a1	No	e1	Fortify developed dry land (including agriculture)	m3	2050	--	Run3-47b
s1a1e1m32060	GRID Raster	Low	s1	Low	a1	No	e1	Fortify developed dry land (including agriculture)	m3	2060	B.4	Run3-47b
s1a1e1m32070	GRID Raster	Low	s1	Low	a1	No	e1	Fortify developed dry land (including agriculture)	m3	2070	--	Run3-47b
s1a1e1m32080	GRID Raster	Low	s1	Low	a1	No	e1	Fortify developed dry land (including agriculture)	m3	2080	--	Run3-47b
s1a1e1m32090	GRID Raster	Low	s1	Low	a1	No	e1	Fortify developed dry land (including agriculture)	m3	2090	--	Run3-47b
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s1a1e1m42020	GRID Raster	Low	s1	Low	a1	No	e1	Fortify developed dry land (including agriculture and managed ponds)	m4	2020	--	Run3-47c
s1a1e1m42030	GRID Raster	Low	s1	Low	a1	No	e1	Fortify developed dry land (including agriculture and managed ponds)	m4	2030	B.5	Run3-47c
s1a1e1m42040	GRID Raster	Low	s1	Low	a1	No	e1	Fortify developed dry land (including agriculture and managed ponds)	m4	2040	--	Run3-47c
s1a1e1m42050	GRID Raster	Low	s1	Low	a1	No	e1	Fortify developed dry land (including agriculture and managed ponds)	m4	2050	--	Run3-47c
s1a1e1m42060	GRID Raster	Low	s1	Low	a1	No	e1	Fortify developed dry land (including agriculture and managed ponds)	m4	2060	B.5	Run3-47c
s1a1e1m42070	GRID Raster	Low	s1	Low	a1	No	e1	Fortify developed dry land (including agriculture and managed ponds)	m4	2070	--	Run3-47c
s1a1e1m42080	GRID Raster	Low	s1	Low	a1	No	e1	Fortify developed dry land (including agriculture and managed ponds)	m4	2080	--	Run3-47c
s1a1e1m42090	GRID Raster	Low	s1	Low	a1	No	e1	Fortify developed dry land (including agriculture and managed ponds)	m4	2090	--	Run3-47c
s1a1e1m42100	GRID Raster	Low	s1	Low	a1	No	e1	Fortify developed dry land (including agriculture and managed ponds)	m4	2100	B.5	Run3-47c

Appendix A. Table of SLAMM Deliverables

Note: The "allow erosion of new inlet" scenario is not recommended for display on the web map or for release to the public. The file names of these outputs are highlighted in ***red***. *Please see section 6.3 of main report for explanation.*

		Scenarios										
		Sea Level Rise		Accretion		Erosion of New Inlet		Management		Planning Horizon	Figure	ESA Model Run
File Name	File Type	*Description*	*sym*	*Description*	*sym*	*Description*	*sym*	*Description*	*sym*	*Year*	*in Appendix B*	*#*
s1a1e2m12020	GRID Raster	Low	s1	Low	a1	Yes	e2	Allow marshes to transgress into dry land	m1	2020	--	Run3-51
s1a1e2m12030	GRID Raster	Low	s1	Low	a1	Yes	e2	Allow marshes to transgress into dry land	m1	2030	B.6	Run3-51
s1a1e2m12040	GRID Raster	Low	s1	Low	a1	Yes	e2	Allow marshes to transgress into dry land	m1	2040	--	Run3-51
s1a1e2m12050	GRID Raster	Low	s1	Low	a1	Yes	e2	Allow marshes to transgress into dry land	m1	2050	--	Run3-51
s1a1e2m12060	GRID Raster	Low	s1	Low	a1	Yes	e2	Allow marshes to transgress into dry land	m1	2060	B.6	Run3-51
s1a1e2m12070	GRID Raster	Low	s1	Low	a1	Yes	e2	Allow marshes to transgress into dry land	m1	2070	--	Run3-51
s1a1e2m12080	GRID Raster	Low	s1	Low	a1	Yes	e2	Allow marshes to transgress into dry land	m1	2080	--	Run3-51
s1a1e2m12090	GRID Raster	Low	s1	Low	a1	Yes	e2	Allow marshes to transgress into dry land	m1	2090	--	Run3-51
s1a1e2m12100	GRID Raster	Low	s1	Low	a1	Yes	e2	Allow marshes to transgress into dry land	m1	2100	B.6	Run3-51
s1a1e2m22020	GRID Raster	Low	s1	Low	a1	Yes	e2	Fortify developed dry land (excluding agriculture)	m2	2020	--	Run3-51
s1a1e2m22030	GRID Raster	Low	s1	Low	a1	Yes	e2	Fortify developed dry land (excluding agriculture)	m2	2030	B.7	Run3-51
s1a1e2m22040	GRID Raster	Low	s1	Low	a1	Yes	e2	Fortify developed dry land (excluding agriculture)	m2	2040	--	Run3-51
s1a1e2m22050	GRID Raster	Low	s1	Low	a1	Yes	e2	Fortify developed dry land (excluding agriculture)	m2	2050	--	Run3-51
s1a1e2m22060	GRID Raster	Low	s1	Low	a1	Yes	e2	Fortify developed dry land (excluding agriculture)	m2	2060	B.7	Run3-51
s1a1e2m22070	GRID Raster	Low	s1	Low	a1	Yes	e2	Fortify developed dry land (excluding agriculture)	m2	2070	--	Run3-51
s1a1e2m22080	GRID Raster	Low	s1	Low	a1	Yes	e2	Fortify developed dry land (excluding agriculture)	m2	2080	--	Run3-51
s1a1e2m22090	GRID Raster	Low	s1	Low	a1	Yes	e2	Fortify developed dry land (excluding agriculture)	m2	2090	--	Run3-51
s1a1e2m22100	GRID Raster	Low	s1	Low	a1	Yes	e2	Fortify developed dry land (excluding agriculture)	m2	2100	B.7	Run3-51
s1a1e2m32020	GRID Raster	Low	s1	Low	a1	Yes	e2	Fortify developed dry land (including agriculture)	m3	2020	--	Run3-51b
s1a1e2m32030	GRID Raster	Low	s1	Low	a1	Yes	e2	Fortify developed dry land (including agriculture)	m3	2030	B.8	Run3-51b
s1a1e2m32040	GRID Raster	Low	s1	Low	a1	Yes	e2	Fortify developed dry land (including agriculture)	m3	2040	--	Run3-51b
s1a1e2m32050	GRID Raster	Low	s1	Low	a1	Yes	e2	Fortify developed dry land (including agriculture)	m3	2050	--	Run3-51b
s1a1e2m32060	GRID Raster	Low	s1	Low	a1	Yes	e2	Fortify developed dry land (including agriculture)	m3	2060	B.8	Run3-51b
s1a1e2m32070	GRID Raster	Low	s1	Low	a1	Yes	e2	Fortify developed dry land (including agriculture)	m3	2070	--	Run3-51b
s1a1e2m32080	GRID Raster	Low	s1	Low	a1	Yes	e2	Fortify developed dry land (including agriculture)	m3	2080	--	Run3-51b
s1a1e2m32090	GRID Raster	Low	s1	Low	a1	Yes	e2	Fortify developed dry land (including agriculture)	m3	2090	--	Run3-51b
s1a1e2m32100	GRID Raster	Low	s1	Low	a1	Yes	e2	Fortify developed dry land (including agriculture)	m3	2100	B.8	Run3-51b
s1a1e2m42020	GRID Raster	Low	s1	Low	a1	Yes	e2	Fortify developed dry land (including agriculture and managed ponds)	m4	2020	--	Run3-51c
s1a1e2m42030	GRID Raster	Low	s1	Low	a1	Yes	e2	Fortify developed dry land (including agriculture and managed ponds)	m4	2030	B.9	Run3-51c
s1a1e2m42040	GRID Raster	Low	s1	Low	a1	Yes	e2	Fortify developed dry land (including agriculture and managed ponds)	m4	2040	--	Run3-51c
s1a1e2m42050	GRID Raster	Low	s1	Low	a1	Yes	e2	Fortify developed dry land (including agriculture and managed ponds)	m4	2050	--	Run3-51c
s1a1e2m42060	GRID Raster	Low	s1	Low	a1	Yes	e2	Fortify developed dry land (including agriculture and managed ponds)	m4	2060	B.9	Run3-51c
s1a1e2m42070	GRID Raster	Low	s1	Low	a1	Yes	e2	Fortify developed dry land (including agriculture and managed ponds)	m4	2070	--	Run3-51c
s1a1e2m42080	GRID Raster	Low	s1	Low	a1	Yes	e2	Fortify developed dry land (including agriculture and managed ponds)	m4	2080	--	Run3-51c
s1a1e2m42090	GRID Raster	Low	s1	Low	a1	Yes	e2	Fortify developed dry land (including agriculture and managed ponds)	m4	2090	--	Run3-51c
s1a1e2m42100	GRID Raster	Low	s1	Low	a1	Yes	e2	Fortify developed dry land (including agriculture and managed ponds)	m4	2100	B.9	Run3-51c

Appendix A. Table of SLAMM Deliverables

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		Scenarios										
		Sea Level Rise		Accretion		Erosion of New Inlet		Management		Planning Horizon	Figure	ESA Model Run
File Name	File Type	*Description*	*sym*	*Description*	*sym*	*Description*	*sym*	*Description*	*sym*	*Year*	*in Appendix B*	*#*
s1a2e1m12020	GRID Raster	Low	s1	High	a2	No	e1	Allow marshes to transgress into dry land	m1	2020	--	Run3-46
s1a2e1m12030	GRID Raster	Low	s1	High	a2	No	e1	Allow marshes to transgress into dry land	m1	2030	B.10	Run3-46
s1a2e1m12040	GRID Raster	Low	s1	High	a2	No	e1	Allow marshes to transgress into dry land	m1	2040	--	Run3-46
s1a2e1m12050	GRID Raster	Low	s1	High	a2	No	e1	Allow marshes to transgress into dry land	m1	2050	--	Run3-46
s1a2e1m12060	GRID Raster	Low	s1	High	a2	No	e1	Allow marshes to transgress into dry land	m1	2060	B.10	Run3-46
s1a2e1m12070	GRID Raster	Low	s1	High	a2	No	e1	Allow marshes to transgress into dry land	m1	2070	--	Run3-46
s1a2e1m12080	GRID Raster	Low	s1	High	a2	No	e1	Allow marshes to transgress into dry land	m1	2080	--	Run3-46
s1a2e1m12090	GRID Raster	Low	s1	High	a2	No	e1	Allow marshes to transgress into dry land	m1	2090	--	Run3-46
s1a2e1m12100	GRID Raster	Low	s1	High	a2	No	e1	Allow marshes to transgress into dry land	m1	2100	B.10	Run3-46
s1a2e1m22020	GRID Raster	Low	s1	High	a2	No	e1	Fortify developed dry land (excluding agriculture)	m2	2020	--	Run3-46
s1a2e1m22030	GRID Raster	Low	s1	High	a2	No	e1	Fortify developed dry land (excluding agriculture)	m2	2030	B.11	Run3-46
s1a2e1m22040	GRID Raster	Low	s1	High	a2	No	e1	Fortify developed dry land (excluding agriculture)	m2	2040	--	Run3-46
s1a2e1m22050	GRID Raster	Low	s1	High	a2	No	e1	Fortify developed dry land (excluding agriculture)	m2	2050	--	Run3-46
s1a2e1m22060	GRID Raster	Low	s1	High	a2	No	e1	Fortify developed dry land (excluding agriculture)	m2	2060	B.11	Run3-46
s1a2e1m22070	GRID Raster	Low	s1	High	a2	No	e1	Fortify developed dry land (excluding agriculture)	m2	2070	--	Run3-46
s1a2e1m22080	GRID Raster	Low	s1	High	a2	No	e1	Fortify developed dry land (excluding agriculture)	m2	2080	--	Run3-46
s1a2e1m22090	GRID Raster	Low	s1	High	a2	No	e1	Fortify developed dry land (excluding agriculture)	m2	2090	--	Run3-46
s1a2e1m22100	GRID Raster	Low	s1	High	a2	No	e1	Fortify developed dry land (excluding agriculture)	m2	2100	B.11	Run3-46
s1a2e1m32020	GRID Raster	Low	s1	High	a2	No	e1	Fortify developed dry land (including agriculture)	m3	2020	--	Run3-46b
s1a2e1m32030	GRID Raster	Low	s1	High	a2	No	e1	Fortify developed dry land (including agriculture)	m3	2030	B.12	Run3-46b
s1a2e1m32040	GRID Raster	Low	s1	High	a2	No	e1	Fortify developed dry land (including agriculture)	m3	2040	--	Run3-46b
s1a2e1m32050	GRID Raster	Low	s1	High	a2	No	e1	Fortify developed dry land (including agriculture)	m3	2050	--	Run3-46b
s1a2e1m32060	GRID Raster	Low	s1	High	a2	No	e1	Fortify developed dry land (including agriculture)	m3	2060	B.12	Run3-46b
s1a2e1m32070	GRID Raster	Low	s1	High	a2	No	e1	Fortify developed dry land (including agriculture)	m3	2070	--	Run3-46b
s1a2e1m32080	GRID Raster	Low	s1	High	a2	No	e1	Fortify developed dry land (including agriculture)	m3	2080	--	Run3-46b
s1a2e1m32090	GRID Raster	Low	s1	High	a2	No	e1	Fortify developed dry land (including agriculture)	m3	2090	--	Run3-46b
s1a2e1m32100	GRID Raster	Low	s1	High	a2	No	e1	Fortify developed dry land (including agriculture)	m3	2100	B.12	Run3-46b
s1a2e1m42020	GRID Raster	Low	s1	High	a2	No	e1	Fortify developed dry land (including agriculture and managed ponds)	m4	2020	--	Run3-46c
s1a2e1m42030	GRID Raster	Low	s1	High	a2	No	e1	Fortify developed dry land (including agriculture and managed ponds)	m4	2030	B.13	Run3-46c
s1a2e1m42040	GRID Raster	Low	s1	High	a2	No	e1	Fortify developed dry land (including agriculture and managed ponds)	m4	2040	--	Run3-46c
s1a2e1m42050	GRID Raster	Low	s1	High	a2	No	e1	Fortify developed dry land (including agriculture and managed ponds)	m4	2050	--	Run3-46c
s1a2e1m42060	GRID Raster	Low	s1	High	a2	No	e1	Fortify developed dry land (including agriculture and managed ponds)	m4	2060	B.13	Run3-46c
s1a2e1m42070	GRID Raster	Low	s1	High	a2	No	e1	Fortify developed dry land (including agriculture and managed ponds)	m4	2070	--	Run3-46c
s1a2e1m42080	GRID Raster	Low	s1	High	a2	No	e1	Fortify developed dry land (including agriculture and managed ponds)	m4	2080	--	Run3-46c
s1a2e1m42090	GRID Raster	Low	s1	High	a2	No	e1	Fortify developed dry land (including agriculture and managed ponds)	m4	2090	--	Run3-46c
s1a2e1m42100	GRID Raster	Low	s1	High	a2	No	e1	Fortify developed dry land (including agriculture and managed ponds)	m4	2100	B.13	Run3-46c

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		Scenarios								Planning Horizon	Figure	ESA Model Run
		Sea Level Rise		Accretion		Erosion of New Inlet		Management				
File Name	File Type	*Description*	*sym*	*Description*	*sym*	*Description*	*sym*	*Description*	*sym*	*Year*	*in Appendix B*	*#*
s1a2e2m12020	GRID Raster	Low	s1	High	a2	Yes	e2	Allow marshes to transgress into dry land	m1	2020	--	Run3-50
s1a2e2m12030	GRID Raster	Low	s1	High	a2	Yes	e2	Allow marshes to transgress into dry land	m1	2030	B.14	Run3-50
s1a2e2m12040	GRID Raster	Low	s1	High	a2	Yes	e2	Allow marshes to transgress into dry land	m1	2040	--	Run3-50
s1a2e2m12050	GRID Raster	Low	s1	High	a2	Yes	e2	Allow marshes to transgress into dry land	m1	2050	--	Run3-50
s1a2e2m12060	GRID Raster	Low	s1	High	a2	Yes	e2	Allow marshes to transgress into dry land	m1	2060	B.14	Run3-50
s1a2e2m12070	GRID Raster	Low	s1	High	a2	Yes	e2	Allow marshes to transgress into dry land	m1	2070	--	Run3-50
s1a2e2m12080	GRID Raster	Low	s1	High	a2	Yes	e2	Allow marshes to transgress into dry land	m1	2080	--	Run3-50
s1a2e2m12090	GRID Raster	Low	s1	High	a2	Yes	e2	Allow marshes to transgress into dry land	m1	2090	--	Run3-50
s1a2e2m12100	GRID Raster	Low	s1	High	a2	Yes	e2	Allow marshes to transgress into dry land	m1	2100	B.14	Run3-50
s1a2e2m22020	GRID Raster	Low	s1	High	a2	Yes	e2	Fortify developed dry land (excluding agriculture)	m2	2020	--	Run3-50
s1a2e2m22030	GRID Raster	Low	s1	High	a2	Yes	e2	Fortify developed dry land (excluding agriculture)	m2	2030	B.15	Run3-50
s1a2e2m22040	GRID Raster	Low	s1	High	a2	Yes	e2	Fortify developed dry land (excluding agriculture)	m2	2040	--	Run3-50
s1a2e2m22050	GRID Raster	Low	s1	High	a2	Yes	e2	Fortify developed dry land (excluding agriculture)	m2	2050	--	Run3-50
s1a2e2m22060	GRID Raster	Low	s1	High	a2	Yes	e2	Fortify developed dry land (excluding agriculture)	m2	2060	B.15	Run3-50
s1a2e2m22070	GRID Raster	Low	s1	High	a2	Yes	e2	Fortify developed dry land (excluding agriculture)	m2	2070	--	Run3-50
s1a2e2m22080	GRID Raster	Low	s1	High	a2	Yes	e2	Fortify developed dry land (excluding agriculture)	m2	2080	--	Run3-50
s1a2e2m22090	GRID Raster	Low	s1	High	a2	Yes	e2	Fortify developed dry land (excluding agriculture)	m2	2090	--	Run3-50
s1a2e2m22100	GRID Raster	Low	s1	High	a2	Yes	e2	Fortify developed dry land (excluding agriculture)	m2	2100	B.15	Run3-50
s1a2e2m32020	GRID Raster	Low	s1	High	a2	Yes	e2	Fortify developed dry land (including agriculture)	m3	2020	--	Run3-50b
s1a2e2m32030	GRID Raster	Low	s1	High	a2	Yes	e2	Fortify developed dry land (including agriculture)	m3	2030	B.16	Run3-50b
s1a2e2m32040	GRID Raster	Low	s1	High	a2	Yes	e2	Fortify developed dry land (including agriculture)	m3	2040	--	Run3-50b
s1a2e2m32050	GRID Raster	Low	s1	High	a2	Yes	e2	Fortify developed dry land (including agriculture)	m3	2050	--	Run3-50b
s1a2e2m32060	GRID Raster	Low	s1	High	a2	Yes	e2	Fortify developed dry land (including agriculture)	m3	2060	B.16	Run3-50b
s1a2e2m32070	GRID Raster	Low	s1	High	a2	Yes	e2	Fortify developed dry land (including agriculture)	m3	2070	--	Run3-50b
s1a2e2m32080	GRID Raster	Low	s1	High	a2	Yes	e2	Fortify developed dry land (including agriculture)	m3	2080	--	Run3-50b
s1a2e2m32090	GRID Raster	Low	s1	High	a2	Yes	e2	Fortify developed dry land (including agriculture)	m3	2090	--	Run3-50b
s1a2e2m32100	GRID Raster	Low	s1	High	a2	Yes	e2	Fortify developed dry land (including agriculture)	m3	2100	B.16	Run3-50b
s1a2e2m42020	GRID Raster	Low	s1	High	a2	Yes	e2	Fortify developed dry land (including agriculture and managed ponds)	m4	2020	--	Run3-50c
s1a2e2m42030	GRID Raster	Low	s1	High	a2	Yes	e2	Fortify developed dry land (including agriculture and managed ponds)	m4	2030	B.17	Run3-50c
s1a2e2m42040	GRID Raster	Low	s1	High	a2	Yes	e2	Fortify developed dry land (including agriculture and managed ponds)	m4	2040	--	Run3-50c
s1a2e2m42050	GRID Raster	Low	s1	High	a2	Yes	e2	Fortify developed dry land (including agriculture and managed ponds)	m4	2050	--	Run3-50c
s1a2e2m42060	GRID Raster	Low	s1	High	a2	Yes	e2	Fortify developed dry land (including agriculture and managed ponds)	m4	2060	B.17	Run3-50c
s1a2e2m42070	GRID Raster	Low	s1	High	a2	Yes	e2	Fortify developed dry land (including agriculture and managed ponds)	m4	2070	--	Run3-50c
s1a2e2m42080	GRID Raster	Low	s1	High	a2	Yes	e2	Fortify developed dry land (including agriculture and managed ponds)	m4	2080	--	Run3-50c
s1a2e2m42090	GRID Raster	Low	s1	High	a2	Yes	e2	Fortify developed dry land (including agriculture and managed ponds)	m4	2090	--	Run3-50c
s1a2e2m42100	GRID Raster	Low	s1	High	a2	Yes	e2	Fortify developed dry land (including agriculture and managed ponds)	m4	2100	B.17	Run3-50c

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		Scenarios											
		Sea Level Rise		Accretion		Erosion of New Inlet		Management		Planning Horizon	Figure	ESA Model Run
File Name	File Type	*Description*	*sym*	*Description*	*sym*	*Description*	*sym*	*Description*	*sym*	*Year*	*in Appendix B*	*#*
s3a1e1m12020	GRID Raster	High	s3	Low	a1	No	e1	Allow marshes to transgress into dry land	m1	2020	--	Run3-45
s3a1e1m12030	GRID Raster	High	s3	Low	a1	No	e1	Allow marshes to transgress into dry land	m1	2030	B.18	Run3-45
s3a1e1m12040	GRID Raster	High	s3	Low	a1	No	e1	Allow marshes to transgress into dry land	m1	2040	--	Run3-45
s3a1e1m12050	GRID Raster	High	s3	Low	a1	No	e1	Allow marshes to transgress into dry land	m1	2050	--	Run3-45
s3a1e1m12060	GRID Raster	High	s3	Low	a1	No	e1	Allow marshes to transgress into dry land	m1	2060	B.18	Run3-45
s3a1e1m12070	GRID Raster	High	s3	Low	a1	No	e1	Allow marshes to transgress into dry land	m1	2070	--	Run3-45
s3a1e1m12080	GRID Raster	High	s3	Low	a1	No	e1	Allow marshes to transgress into dry land	m1	2080	--	Run3-45
s3a1e1m12090	GRID Raster	High	s3	Low	a1	No	e1	Allow marshes to transgress into dry land	m1	2090	--	Run3-45
s3a1e1m12100	GRID Raster	High	s3	Low	a1	No	e1	Allow marshes to transgress into dry land	m1	2100	B.18	Run3-45
s3a1e1m22020	GRID Raster	High	s3	Low	a1	No	e1	Fortify developed dry land (excluding agriculture)	m2	2020	--	Run3-45
s3a1e1m22030	GRID Raster	High	s3	Low	a1	No	e1	Fortify developed dry land (excluding agriculture)	m2	2030	B.19	Run3-45
s3a1e1m22040	GRID Raster	High	s3	Low	a1	No	e1	Fortify developed dry land (excluding agriculture)	m2	2040	--	Run3-45
s3a1e1m22050	GRID Raster	High	s3	Low	a1	No	e1	Fortify developed dry land (excluding agriculture)	m2	2050	--	Run3-45
s3a1e1m22060	GRID Raster	High	s3	Low	a1	No	e1	Fortify developed dry land (excluding agriculture)	m2	2060	B.19	Run3-45
s3a1e1m22070	GRID Raster	High	s3	Low	a1	No	e1	Fortify developed dry land (excluding agriculture)	m2	2070	--	Run3-45
s3a1e1m22080	GRID Raster	High	s3	Low	a1	No	e1	Fortify developed dry land (excluding agriculture)	m2	2080	--	Run3-45
s3a1e1m22090	GRID Raster	High	s3	Low	a1	No	e1	Fortify developed dry land (excluding agriculture)	m2	2090	--	Run3-45
s3a1e1m22100	GRID Raster	High	s3	Low	a1	No	e1	Fortify developed dry land (excluding agriculture)	m2	2100	B.19	Run3-45
s3a1e1m32020	GRID Raster	High	s3	Low	a1	No	e1	Fortify developed dry land (including agriculture)	m3	2020	--	Run3-45b
s3a1e1m32030	GRID Raster	High	s3	Low	a1	No	e1	Fortify developed dry land (including agriculture)	m3	2030	B.20	Run3-45b
s3a1e1m32040	GRID Raster	High	s3	Low	a1	No	e1	Fortify developed dry land (including agriculture)	m3	2040	--	Run3-45b
s3a1e1m32050	GRID Raster	High	s3	Low	a1	No	e1	Fortify developed dry land (including agriculture)	m3	2050	--	Run3-45b
s3a1e1m32060	GRID Raster	High	s3	Low	a1	No	e1	Fortify developed dry land (including agriculture)	m3	2060	B.20	Run3-45b
s3a1e1m32070	GRID Raster	High	s3	Low	a1	No	e1	Fortify developed dry land (including agriculture)	m3	2070	--	Run3-45b
s3a1e1m32080	GRID Raster	High	s3	Low	a1	No	e1	Fortify developed dry land (including agriculture)	m3	2080	--	Run3-45b
s3a1e1m32090	GRID Raster	High	s3	Low	a1	No	e1	Fortify developed dry land (including agriculture)	m3	2090	--	Run3-45b
s3a1e1m32100	GRID Raster	High	s3	Low	a1	No	e1	Fortify developed dry land (including agriculture)	m3	2100	B.20	Run3-45b
s3a1e1m42020	GRID Raster	High	s3	Low	a1	No	e1	Fortify developed dry land (including agriculture and managed ponds)	m4	2020	--	Run3-45c
s3a1e1m42030	GRID Raster	High	s3	Low	a1	No	e1	Fortify developed dry land (including agriculture and managed ponds)	m4	2030	B.21	Run3-45c
s3a1e1m42040	GRID Raster	High	s3	Low	a1	No	e1	Fortify developed dry land (including agriculture and managed ponds)	m4	2040	--	Run3-45c
s3a1e1m42050	GRID Raster	High	s3	Low	a1	No	e1	Fortify developed dry land (including agriculture and managed ponds)	m4	2050	--	Run3-45c
s3a1e1m42060	GRID Raster	High	s3	Low	a1	No	e1	Fortify developed dry land (including agriculture and managed ponds)	m4	2060	B.21	Run3-45c
s3a1e1m42070	GRID Raster	High	s3	Low	a1	No	e1	Fortify developed dry land (including agriculture and managed ponds)	m4	2070	--	Run3-45c
s3a1e1m42080	GRID Raster	High	s3	Low	a1	No	e1	Fortify developed dry land (including agriculture and managed ponds)	m4	2080	--	Run3-45c
s3a1e1m42090	GRID Raster	High	s3	Low	a1	No	e1	Fortify developed dry land (including agriculture and managed ponds)	m4	2090	--	Run3-45c
s3a1e1m42100	GRID Raster	High	s3	Low	a1	No	e1	Fortify developed dry land (including agriculture and managed ponds)	m4	2100	B.21	Run3-45c

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		Scenarios								Planning Horizon	Figure	ESA Model Run
		Sea Level Rise		Accretion		Erosion of New Inlet		Management				
File Name	File Type	*Description*	*sym*	*Description*	*sym*	*Description*	*sym*	*Description*	*sym*	*Year*	*in Appendix B*	*#*
s3a1e2m12020	GRID Raster	High	s3	Low	a1	Yes	e2	Allow marshes to transgress into dry land	m1	2020	--	Run3-49
s3a1e2m12030	GRID Raster	High	s3	Low	a1	Yes	e2	Allow marshes to transgress into dry land	m1	2030	B.22	Run3-49
s3a1e2m12040	GRID Raster	High	s3	Low	a1	Yes	e2	Allow marshes to transgress into dry land	m1	2040	--	Run3-49
s3a1e2m12050	GRID Raster	High	s3	Low	a1	Yes	e2	Allow marshes to transgress into dry land	m1	2050	--	Run3-49
s3a1e2m12060	GRID Raster	High	s3	Low	a1	Yes	e2	Allow marshes to transgress into dry land	m1	2060	B.22	Run3-49
s3a1e2m12070	GRID Raster	High	s3	Low	a1	Yes	e2	Allow marshes to transgress into dry land	m1	2070	--	Run3-49
s3a1e2m12080	GRID Raster	High	s3	Low	a1	Yes	e2	Allow marshes to transgress into dry land	m1	2080	--	Run3-49
s3a1e2m12090	GRID Raster	High	s3	Low	a1	Yes	e2	Allow marshes to transgress into dry land	m1	2090	--	Run3-49
s3a1e2m12100	GRID Raster	High	s3	Low	a1	Yes	e2	Allow marshes to transgress into dry land	m1	2100	B.22	Run3-49
s3a1e2m22020	GRID Raster	High	s3	Low	a1	Yes	e2	Fortify developed dry land (excluding agriculture)	m2	2020	--	Run3-49
s3a1e2m22030	GRID Raster	High	s3	Low	a1	Yes	e2	Fortify developed dry land (excluding agriculture)	m2	2030	B.23	Run3-49
s3a1e2m22040	GRID Raster	High	s3	Low	a1	Yes	e2	Fortify developed dry land (excluding agriculture)	m2	2040	--	Run3-49
s3a1e2m22050	GRID Raster	High	s3	Low	a1	Yes	e2	Fortify developed dry land (excluding agriculture)	m2	2050	--	Run3-49
s3a1e2m22060	GRID Raster	High	s3	Low	a1	Yes	e2	Fortify developed dry land (excluding agriculture)	m2	2060	B.23	Run3-49
s3a1e2m22070	GRID Raster	High	s3	Low	a1	Yes	e2	Fortify developed dry land (excluding agriculture)	m2	2070	--	Run3-49
s3a1e2m22080	GRID Raster	High	s3	Low	a1	Yes	e2	Fortify developed dry land (excluding agriculture)	m2	2080	--	Run3-49
s3a1e2m22090	GRID Raster	High	s3	Low	a1	Yes	e2	Fortify developed dry land (excluding agriculture)	m2	2090	--	Run3-49
s3a1e2m22100	GRID Raster	High	s3	Low	a1	Yes	e2	Fortify developed dry land (excluding agriculture)	m2	2100	B.23	Run3-49
s3a1e2m32020	GRID Raster	High	s3	Low	a1	Yes	e2	Fortify developed dry land (including agriculture)	m3	2020	--	Run3-49b
s3a1e2m32030	GRID Raster	High	s3	Low	a1	Yes	e2	Fortify developed dry land (including agriculture)	m3	2030	B.24	Run3-49b
s3a1e2m32040	GRID Raster	High	s3	Low	a1	Yes	e2	Fortify developed dry land (including agriculture)	m3	2040	--	Run3-49b
s3a1e2m32050	GRID Raster	High	s3	Low	a1	Yes	e2	Fortify developed dry land (including agriculture)	m3	2050	--	Run3-49b
s3a1e2m32060	GRID Raster	High	s3	Low	a1	Yes	e2	Fortify developed dry land (including agriculture)	m3	2060	B.24	Run3-49b
s3a1e2m32070	GRID Raster	High	s3	Low	a1	Yes	e2	Fortify developed dry land (including agriculture)	m3	2070	--	Run3-49b
s3a1e2m32080	GRID Raster	High	s3	Low	a1	Yes	e2	Fortify developed dry land (including agriculture)	m3	2080	--	Run3-49b
s3a1e2m32090	GRID Raster	High	s3	Low	a1	Yes	e2	Fortify developed dry land (including agriculture)	m3	2090	--	Run3-49b
s3a1e2m32100	GRID Raster	High	s3	Low	a1	Yes	e2	Fortify developed dry land (including agriculture)	m3	2100	B.24	Run3-49b
s3a1e2m42020	GRID Raster	High	s3	Low	a1	Yes	e2	Fortify developed dry land (including agriculture and managed ponds)	m4	2020	--	Run3-49c
s3a1e2m42030	GRID Raster	High	s3	Low	a1	Yes	e2	Fortify developed dry land (including agriculture and managed ponds)	m4	2030	B.25	Run3-49c
s3a1e2m42040	GRID Raster	High	s3	Low	a1	Yes	e2	Fortify developed dry land (including agriculture and managed ponds)	m4	2040	--	Run3-49c
s3a1e2m42050	GRID Raster	High	s3	Low	a1	Yes	e2	Fortify developed dry land (including agriculture and managed ponds)	m4	2050	--	Run3-49c
s3a1e2m42060	GRID Raster	High	s3	Low	a1	Yes	e2	Fortify developed dry land (including agriculture and managed ponds)	m4	2060	B.25	Run3-49c
s3a1e2m42070	GRID Raster	High	s3	Low	a1	Yes	e2	Fortify developed dry land (including agriculture and managed ponds)	m4	2070	--	Run3-49c
s3a1e2m42080	GRID Raster	High	s3	Low	a1	Yes	e2	Fortify developed dry land (including agriculture and managed ponds)	m4	2080	--	Run3-49c
s3a1e2m42090	GRID Raster	High	s3	Low	a1	Yes	e2	Fortify developed dry land (including agriculture and managed ponds)	m4	2090	--	Run3-49c
s3a1e2m42100	GRID Raster	High	s3	Low	a1	Yes	e2	Fortify developed dry land (including agriculture and managed ponds)	m4	2100	B.25	Run3-49c

Appendix A. Table of SLAMM Deliverables

Note: The "allow erosion of new inlet" scenario is not recommended for display on the web map or for release to the public. The file names of these outputs are highlighted in ***red*** *. Please see section 6.3 of main report for explanation.*

		Scenarios								Planning Horizon	Figure	ESA Model Run
		Sea Level Rise		Accretion		Erosion of New Inlet		Management				
File Name	File Type	*Description*	*sym*	*Description*	*sym*	*Description*	*sym*	*Description*	*sym*	*Year*	*in Appendix B*	*#*
s3a2e1m12020	GRID Raster	High	s3	High	a2	No	e1	Allow marshes to transgress into dry land	m1	2020	--	Run3-44
s3a2e1m12030	GRID Raster	High	s3	High	a2	No	e1	Allow marshes to transgress into dry land	m1	2030	B.26	Run3-44
s3a2e1m12040	GRID Raster	High	s3	High	a2	No	e1	Allow marshes to transgress into dry land	m1	2040	--	Run3-44
s3a2e1m12050	GRID Raster	High	s3	High	a2	No	e1	Allow marshes to transgress into dry land	m1	2050	--	Run3-44
s3a2e1m12060	GRID Raster	High	s3	High	a2	No	e1	Allow marshes to transgress into dry land	m1	2060	B.26	Run3-44
s3a2e1m12070	GRID Raster	High	s3	High	a2	No	e1	Allow marshes to transgress into dry land	m1	2070	--	Run3-44
s3a2e1m12080	GRID Raster	High	s3	High	a2	No	e1	Allow marshes to transgress into dry land	m1	2080	--	Run3-44
s3a2e1m12090	GRID Raster	High	s3	High	a2	No	e1	Allow marshes to transgress into dry land	m1	2090	--	Run3-44
s3a2e1m12100	GRID Raster	High	s3	High	a2	No	e1	Allow marshes to transgress into dry land	m1	2100	B.26	Run3-44
s3a2e1m22020	GRID Raster	High	s3	High	a2	No	e1	Fortify developed dry land (excluding agriculture)	m2	2020	--	Run3-44
s3a2e1m22030	GRID Raster	High	s3	High	a2	No	e1	Fortify developed dry land (excluding agriculture)	m2	2030	B.27	Run3-44
s3a2e1m22040	GRID Raster	High	s3	High	a2	No	e1	Fortify developed dry land (excluding agriculture)	m2	2040	--	Run3-44
s3a2e1m22050	GRID Raster	High	s3	High	a2	No	e1	Fortify developed dry land (excluding agriculture)	m2	2050	--	Run3-44
s3a2e1m22060	GRID Raster	High	s3	High	a2	No	e1	Fortify developed dry land (excluding agriculture)	m2	2060	B.27	Run3-44
s3a2e1m22070	GRID Raster	High	s3	High	a2	No	e1	Fortify developed dry land (excluding agriculture)	m2	2070	--	Run3-44
s3a2e1m22080	GRID Raster	High	s3	High	a2	No	e1	Fortify developed dry land (excluding agriculture)	m2	2080	--	Run3-44
s3a2e1m22090	GRID Raster	High	s3	High	a2	No	e1	Fortify developed dry land (excluding agriculture)	m2	2090	--	Run3-44
s3a2e1m22100	GRID Raster	High	s3	High	a2	No	e1	Fortify developed dry land (excluding agriculture)	m2	2100	B.27	Run3-44
s3a2e1m32020	GRID Raster	High	s3	High	a2	No	e1	Fortify developed dry land (including agriculture)	m3	2020	--	Run3-44b
s3a2e1m32030	GRID Raster	High	s3	High	a2	No	e1	Fortify developed dry land (including agriculture)	m3	2030	B.28	Run3-44b
s3a2e1m32040	GRID Raster	High	s3	High	a2	No	e1	Fortify developed dry land (including agriculture)	m3	2040	--	Run3-44b
s3a2e1m32050	GRID Raster	High	s3	High	a2	No	e1	Fortify developed dry land (including agriculture)	m3	2050	--	Run3-44b
s3a2e1m32060	GRID Raster	High	s3	High	a2	No	e1	Fortify developed dry land (including agriculture)	m3	2060	B.28	Run3-44b
s3a2e1m32070	GRID Raster	High	s3	High	a2	No	e1	Fortify developed dry land (including agriculture)	m3	2070	--	Run3-44b
s3a2e1m32080	GRID Raster	High	s3	High	a2	No	e1	Fortify developed dry land (including agriculture)	m3	2080	--	Run3-44b
s3a2e1m32090	GRID Raster	High	s3	High	a2	No	e1	Fortify developed dry land (including agriculture)	m3	2090	--	Run3-44b
s3a2e1m32100	GRID Raster	High	s3	High	a2	No	e1	Fortify developed dry land (including agriculture)	m3	2100	B.28	Run3-44b
s3a2e1m42020	GRID Raster	High	s3	High	a2	No	e1	Fortify developed dry land (including agriculture and managed ponds)	m4	2020	--	Run3-44c
s3a2e1m42030	GRID Raster	High	s3	High	a2	No	e1	Fortify developed dry land (including agriculture and managed ponds)	m4	2030	B.29	Run3-44c
s3a2e1m42040	GRID Raster	High	s3	High	a2	No	e1	Fortify developed dry land (including agriculture and managed ponds)	m4	2040	--	Run3-44c
s3a2e1m42050	GRID Raster	High	s3	High	a2	No	e1	Fortify developed dry land (including agriculture and managed ponds)	m4	2050	--	Run3-44c
s3a2e1m42060	GRID Raster	High	s3	High	a2	No	e1	Fortify developed dry land (including agriculture and managed ponds)	m4	2060	B.29	Run3-44c
s3a2e1m42070	GRID Raster	High	s3	High	a2	No	e1	Fortify developed dry land (including agriculture and managed ponds)	m4	2070	--	Run3-44c
s3a2e1m42080	GRID Raster	High	s3	High	a2	No	e1	Fortify developed dry land (including agriculture and managed ponds)	m4	2080	--	Run3-44c
s3a2e1m42090	GRID Raster	High	s3	High	a2	No	e1	Fortify developed dry land (including agriculture and managed ponds)	m4	2090	--	Run3-44c
s3a2e1m42100	GRID Raster	High	s3	High	a2	No	e1	Fortify developed dry land (including agriculture and managed ponds)	m4	2100	B.29	Run3-44c

Appendix A. Table of SLAMM Deliverables

Note: The "allow erosion of new inlet" scenario is not recommended for display on the web map or for release to the public. The file names of these outputs are highlighted in ***red*** *. Please see section 6.3 of main report for explanation.*

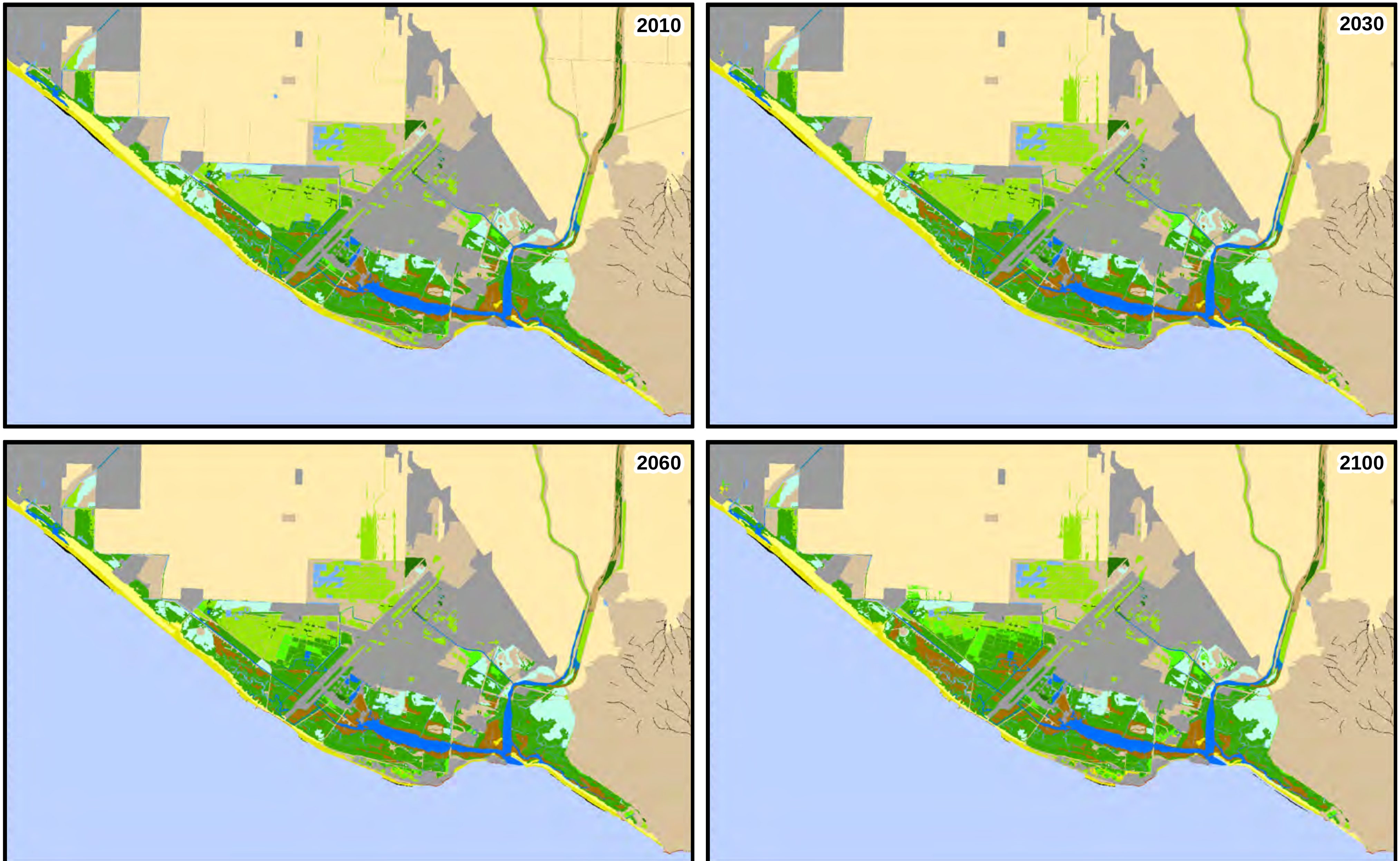
		Scenarios								Planning Horizon	Figure	ESA Model Run
		Sea Level Rise		Accretion		Erosion of New Inlet		Management				
File Name	File Type	*Description*	*sym*	*Description*	*sym*	*Description*	*sym*	*Description*	*sym*	*Year*	*in Appendix B*	*#*
s3a2e2m12020	GRID Raster	High	s3	High	a2	Yes	e2	Allow marshes to transgress into dry land	m1	2020	--	Run3-48
s3a2e2m12030	GRID Raster	High	s3	High	a2	Yes	e2	Allow marshes to transgress into dry land	m1	2030	B.30	Run3-48
s3a2e2m12040	GRID Raster	High	s3	High	a2	Yes	e2	Allow marshes to transgress into dry land	m1	2040	--	Run3-48
s3a2e2m12050	GRID Raster	High	s3	High	a2	Yes	e2	Allow marshes to transgress into dry land	m1	2050	--	Run3-48
s3a2e2m12060	GRID Raster	High	s3	High	a2	Yes	e2	Allow marshes to transgress into dry land	m1	2060	B.30	Run3-48
s3a2e2m12070	GRID Raster	High	s3	High	a2	Yes	e2	Allow marshes to transgress into dry land	m1	2070	--	Run3-48
s3a2e2m12080	GRID Raster	High	s3	High	a2	Yes	e2	Allow marshes to transgress into dry land	m1	2080	--	Run3-48
s3a2e2m12090	GRID Raster	High	s3	High	a2	Yes	e2	Allow marshes to transgress into dry land	m1	2090	--	Run3-48
s3a2e2m12100	GRID Raster	High	s3	High	a2	Yes	e2	Allow marshes to transgress into dry land	m1	2100	B.30	Run3-48
s3a2e2m22020	GRID Raster	High	s3	High	a2	Yes	e2	Fortify developed dry land (excluding agriculture)	m2	2020	--	Run3-48
s3a2e2m22030	GRID Raster	High	s3	High	a2	Yes	e2	Fortify developed dry land (excluding agriculture)	m2	2030	B.31	Run3-48
s3a2e2m22040	GRID Raster	High	s3	High	a2	Yes	e2	Fortify developed dry land (excluding agriculture)	m2	2040	--	Run3-48
s3a2e2m22050	GRID Raster	High	s3	High	a2	Yes	e2	Fortify developed dry land (excluding agriculture)	m2	2050	--	Run3-48
s3a2e2m22060	GRID Raster	High	s3	High	a2	Yes	e2	Fortify developed dry land (excluding agriculture)	m2	2060	B.31	Run3-48
s3a2e2m22070	GRID Raster	High	s3	High	a2	Yes	e2	Fortify developed dry land (excluding agriculture)	m2	2070	--	Run3-48
s3a2e2m22080	GRID Raster	High	s3	High	a2	Yes	e2	Fortify developed dry land (excluding agriculture)	m2	2080	--	Run3-48
s3a2e2m22090	GRID Raster	High	s3	High	a2	Yes	e2	Fortify developed dry land (excluding agriculture)	m2	2090	--	Run3-48
s3a2e2m22100	GRID Raster	High	s3	High	a2	Yes	e2	Fortify developed dry land (excluding agriculture)	m2	2100	B.31	Run3-48
s3a2e2m32020	GRID Raster	High	s3	High	a2	Yes	e2	Fortify developed dry land (including agriculture)	m3	2020	--	Run3-48b
s3a2e2m32030	GRID Raster	High	s3	High	a2	Yes	e2	Fortify developed dry land (including agriculture)	m3	2030	B.32	Run3-48b
s3a2e2m32040	GRID Raster	High	s3	High	a2	Yes	e2	Fortify developed dry land (including agriculture)	m3	2040	--	Run3-48b
s3a2e2m32050	GRID Raster	High	s3	High	a2	Yes	e2	Fortify developed dry land (including agriculture)	m3	2050	--	Run3-48b
s3a2e2m32060	GRID Raster	High	s3	High	a2	Yes	e2	Fortify developed dry land (including agriculture)	m3	2060	B.32	Run3-48b
s3a2e2m32070	GRID Raster	High	s3	High	a2	Yes	e2	Fortify developed dry land (including agriculture)	m3	2070	--	Run3-48b
s3a2e2m32080	GRID Raster	High	s3	High	a2	Yes	e2	Fortify developed dry land (including agriculture)	m3	2080	--	Run3-48b
s3a2e2m32090	GRID Raster	High	s3	High	a2	Yes	e2	Fortify developed dry land (including agriculture)	m3	2090	--	Run3-48b
s3a2e2m32100	GRID Raster	High	s3	High	a2	Yes	e2	Fortify developed dry land (including agriculture)	m3	2100	B.32	Run3-48b
s3a2e2m42020	GRID Raster	High	s3	High	a2	Yes	e2	Fortify developed dry land (including agriculture and managed ponds)	m4	2020	--	Run3-48c
s3a2e2m42030	GRID Raster	High	s3	High	a2	Yes	e2	Fortify developed dry land (including agriculture and managed ponds)	m4	2030	B.33	Run3-48c
s3a2e2m42040	GRID Raster	High	s3	High	a2	Yes	e2	Fortify developed dry land (including agriculture and managed ponds)	m4	2040	--	Run3-48c
s3a2e2m42050	GRID Raster	High	s3	High	a2	Yes	e2	Fortify developed dry land (including agriculture and managed ponds)	m4	2050	--	Run3-48c
s3a2e2m42060	GRID Raster	High	s3	High	a2	Yes	e2	Fortify developed dry land (including agriculture and managed ponds)	m4	2060	B.33	Run3-48c
s3a2e2m42070	GRID Raster	High	s3	High	a2	Yes	e2	Fortify developed dry land (including agriculture and managed ponds)	m4	2070	--	Run3-48c
s3a2e2m42080	GRID Raster	High	s3	High	a2	Yes	e2	Fortify developed dry land (including agriculture and managed ponds)	m4	2080	--	Run3-48c
s3a2e2m42090	GRID Raster	High	s3	High	a2	Yes	e2	Fortify developed dry land (including agriculture and managed ponds)	m4	2090	--	Run3-48c
s3a2e2m42100	GRID Raster	High	s3	High	a2	Yes	e2	Fortify developed dry land (including agriculture and managed ponds)	m4	2100	B.33	Run3-48c

Appendix B

SLAMM Results for all Scenarios

Habitat Type

- Blank (No Data)
- Developed Uplands
- Undeveloped Uplands
- Freshwater Wetland with Trees/Shrubs/Riparian Forest
- Freshwater Marsh
- Tidal Marsh
- Tidal Estuarine Wetland with Trees/Shrubs
- Emergent Salt Marsh
- Estuarine Beach
- Mud Flat
- Coastal Strand
- Rocky Intertidal
- Open Water
- Riverine Tidal
- Open Water Subtidal
- Tidal Channel
- Open Ocean
- Rarely Flooded Salt Marsh / Salt Pans
- Arroyo / Gravel / Shore
- Tidal Wetland with Trees/Shrubs
- Dunes
- Agriculture



Please see Figure B.1 for legend.
Scenario: s1a1e1m1 (Run 3-47)

12/15/2013

N

0 1 2 Miles

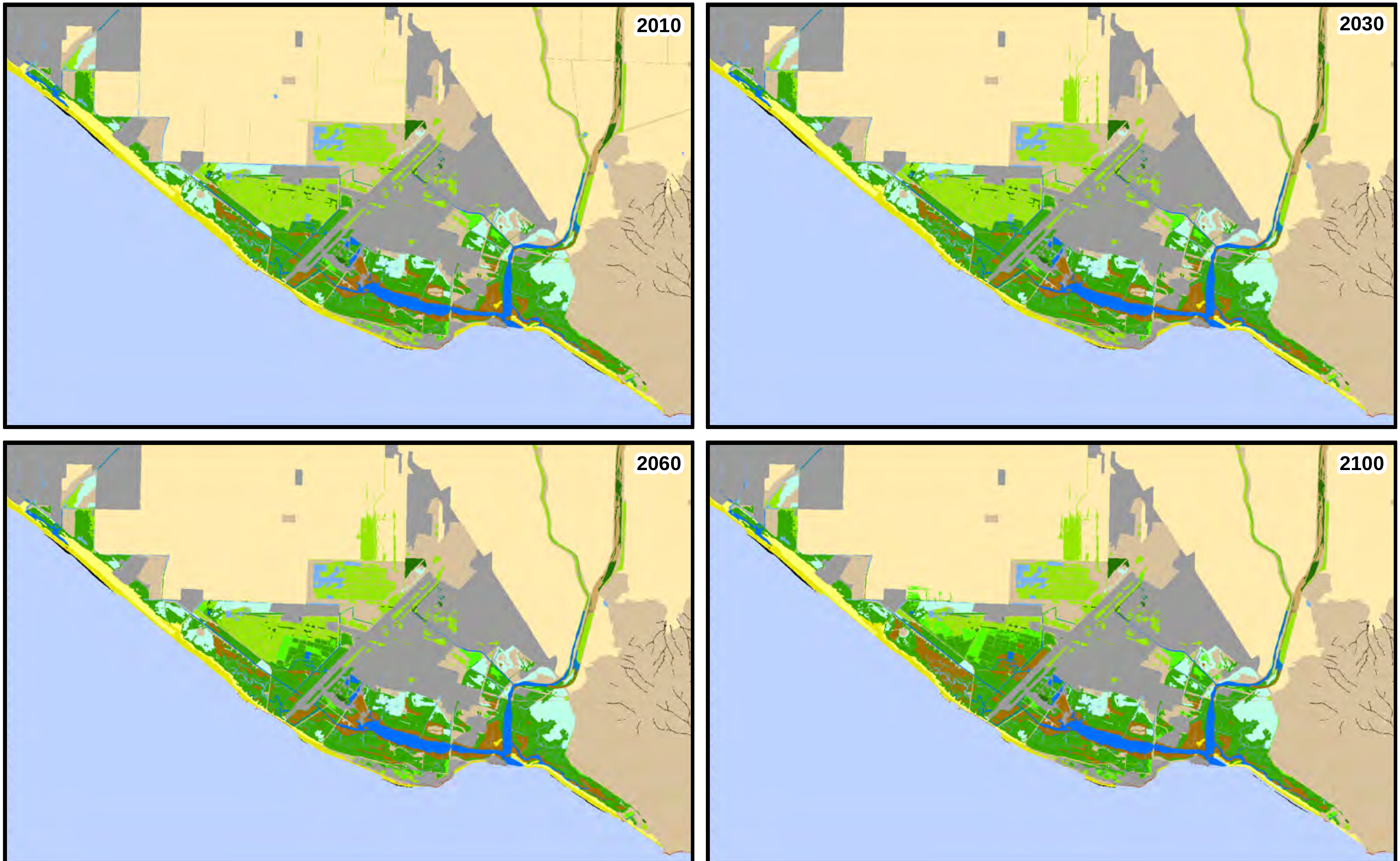
figure ***B.2***

Ventura County Climate Change Vulnerability Study

Results: Low SLR, Low Accretion, No Erosion of New Inlet, Allow Marshes to Transgress

ESA PWA Ref# - D211452

ESA PWA



Please see Figure B.1 for legend.
Scenario: s1a1e1m2 (Run 3-47)

12/15/2013

N

0 1 2 Miles

*figure **B.3***

Ventura County Climate Change Vulnerability Study

Results: Low SLR, Low Accretion, No Erosion of New Inlet, Fortify Dev. Dry Land (excl. Ag)

ESA PWA Ref# - D211452

Please see Figure B.1 for legend.
Scenario: s1a1e1m3 (Run 3-47b)

12/15/2013

N

0 1 2
Miles

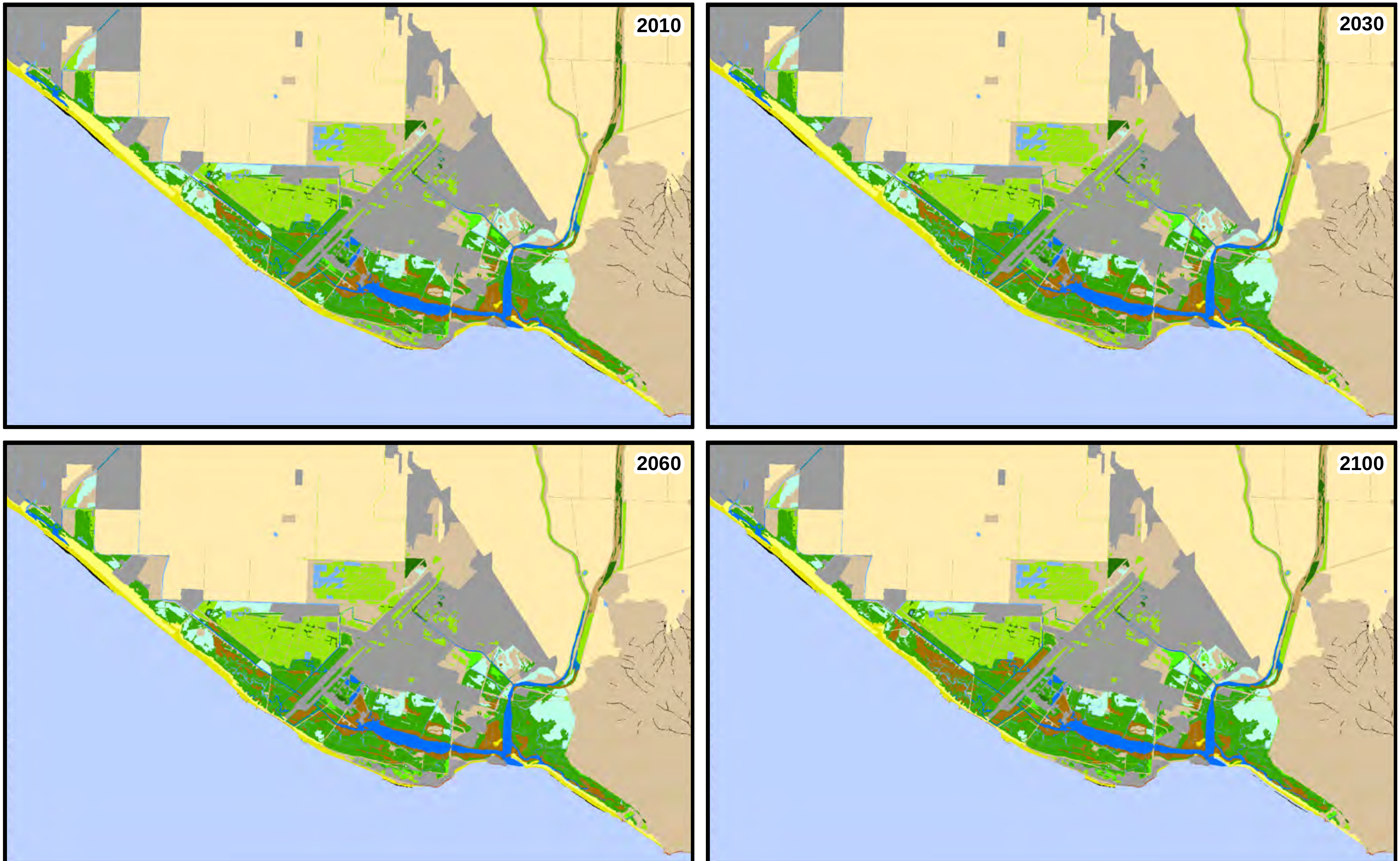
figure ***B.4***

Ventura County Climate Change Vulnerability Study

Results: Low SLR, Low Accretion, No Erosion of New Inlet, Fortify Dev. Dry Land (incl. Ag.)

ESA PWA Ref# - D211452

ESA PWA



Please see Figure B.1 for legend.
Scenario: s1a1e1m4 (Run 3-47c)

12/15/2013

N

0 1 2
Miles

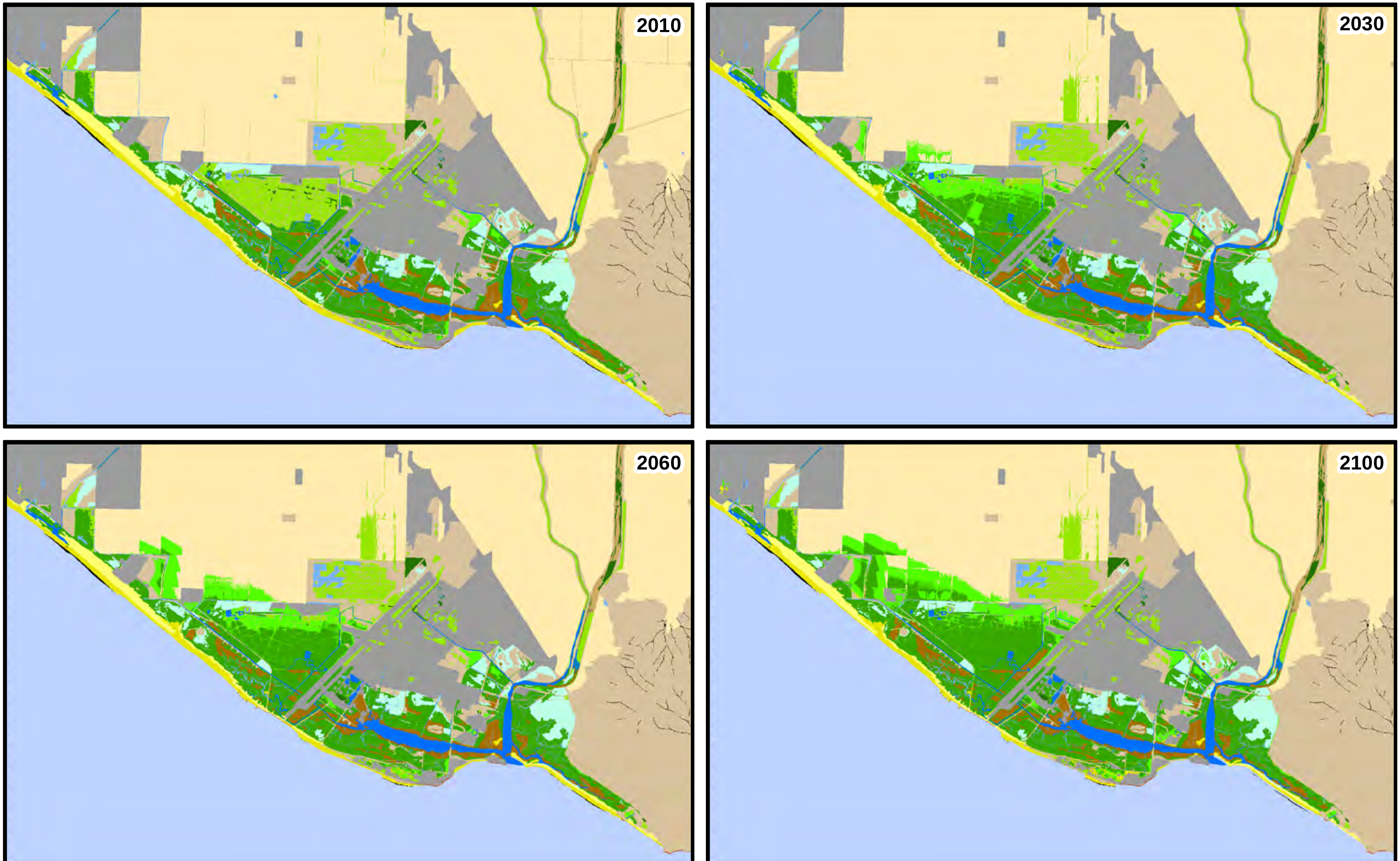
figure ***B.5***

Ventura County Climate Change Vulnerability Study

Results: Low SLR, Low Accretion, No Erosion of New Inlet, Fortify Dev. Dry Land (incl. Ag. + Ponds)

ESA PWA Ref# - D211452

ESA PWA



Please see Figure B.1 for legend.
Scenario: s1a1e2m1 (Run 3-51)

12/15/2013

N

0 1 2 Miles

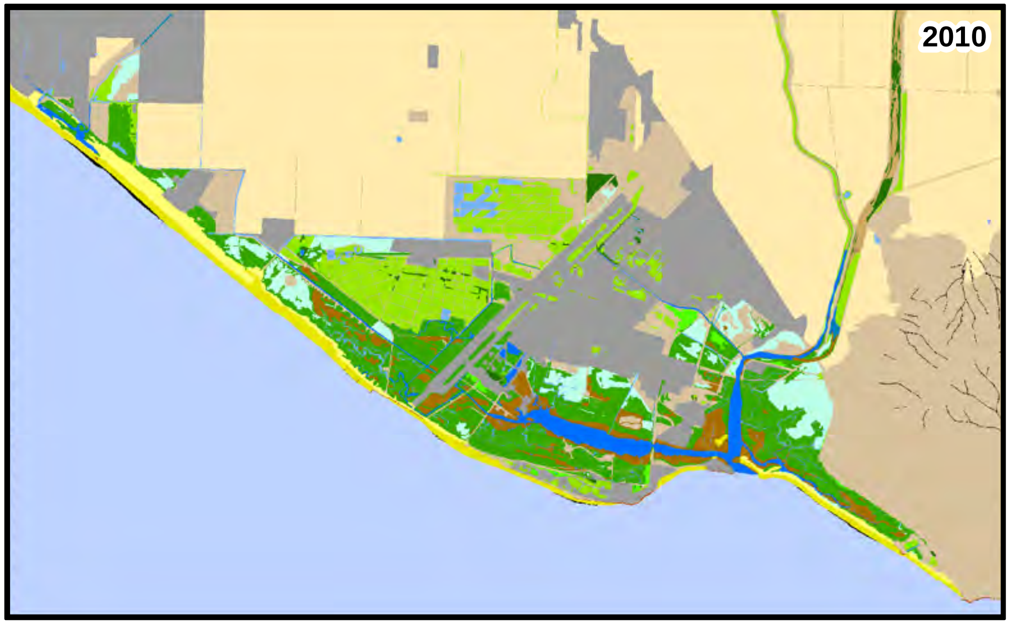
figure ***B.6***

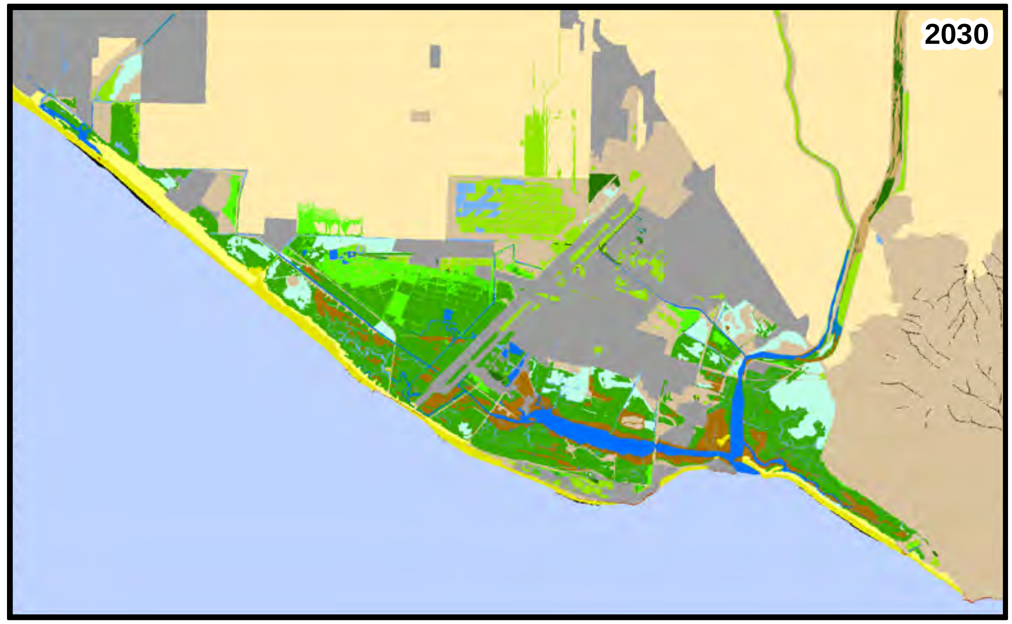
Ventura County Climate Change Vulnerability Study

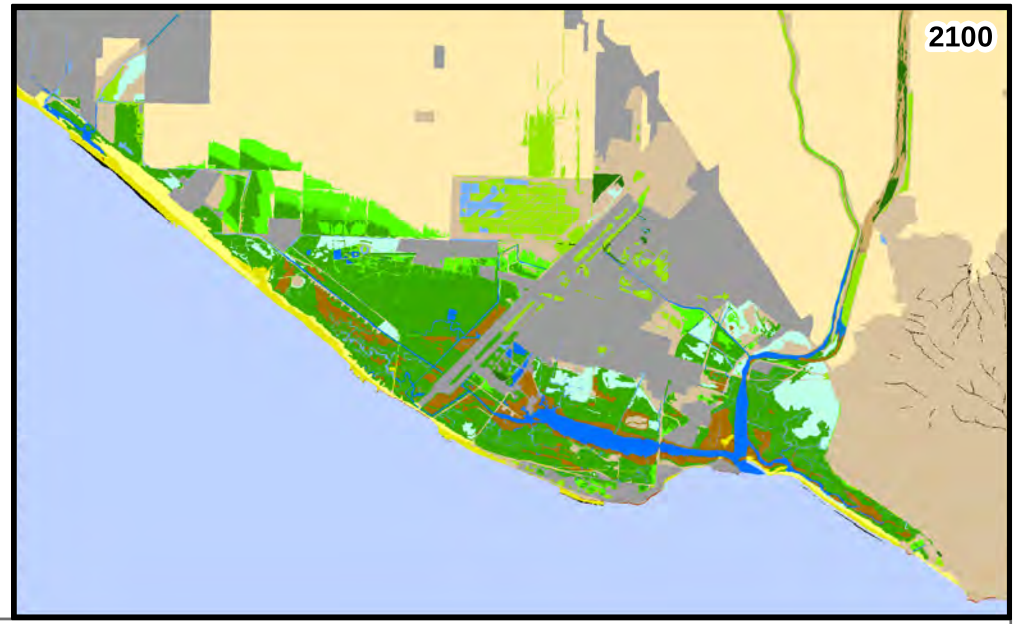
Results: Low SLR, Low Accretion, Erosion of New Inlet, Allow Marshes to Transgress

ESA PWA Ref# - D211452

ESA PWA







Please see Figure B.1 for legend.
Scenario: s1a1e2m2 (Run 3-51)

12/15/2013

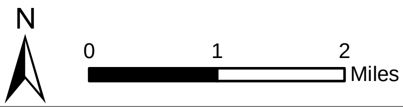


figure ***B.7***

Ventura County Climate Change Vulnerability Study

Results: Low SLR, Low Accretion, Erosion of New Inlet, Fortify Dev. Dry Land (excl. Ag.)

ESA PWA Ref# - D211452

ESA PWA

Please see Figure B.1 for legend.
Scenario: s1a1e2m3 (Run 3-51b)

12/15/2013

N

0 1 2
Miles

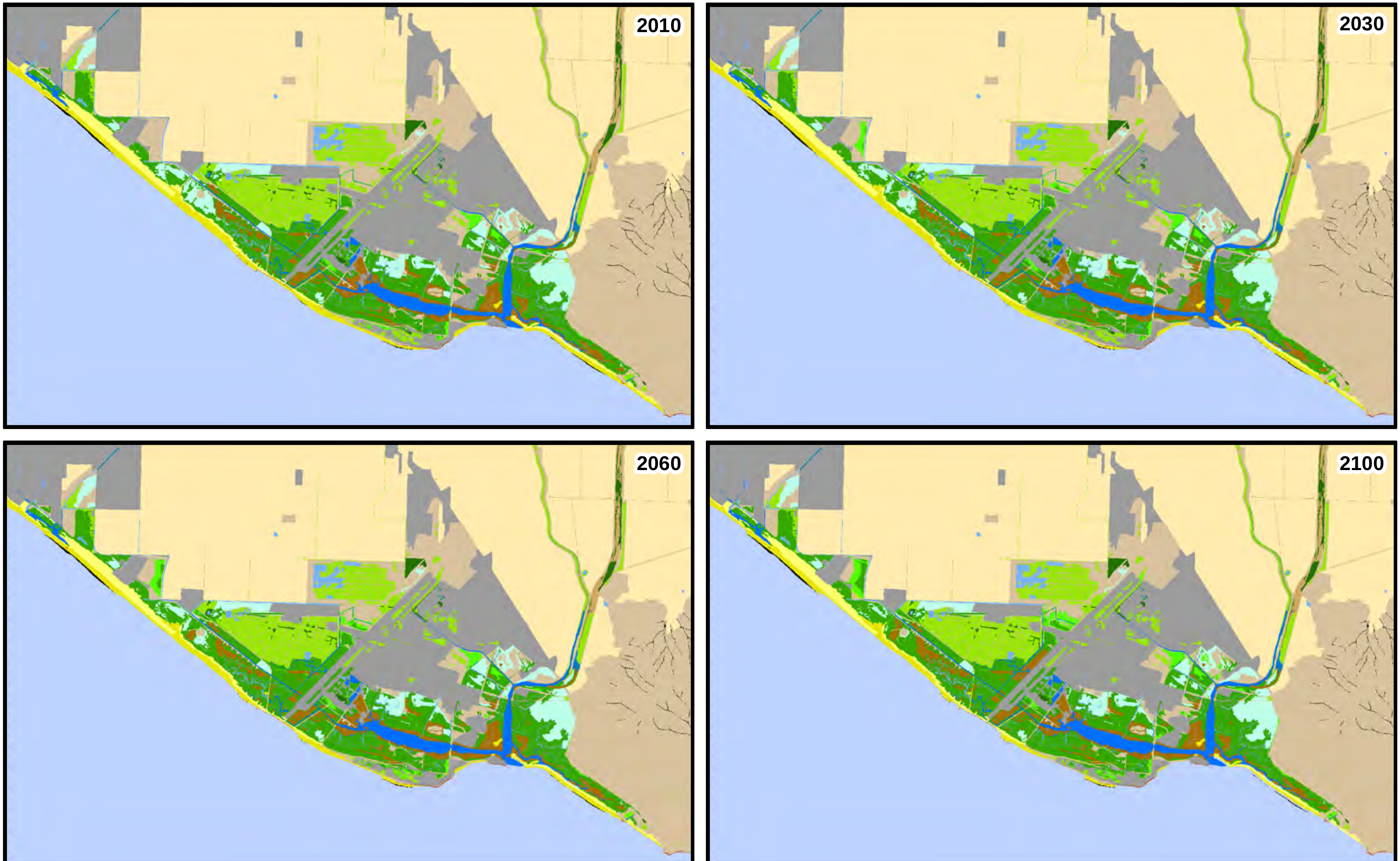
figure ***B.8***

Ventura County Climate Change Vulnerability Study

Results: Low SLR, Low Accretion, Erosion of New Inlet, Fortify Dev. Dry Land (incl. Ag.)

ESA PWA Ref# - D211452

ESA PWA



Please see Figure B.1 for legend.
Scenario: s1a1e2m4 (Run 3-51c)

12/15/2013

N

0 1 2 Miles

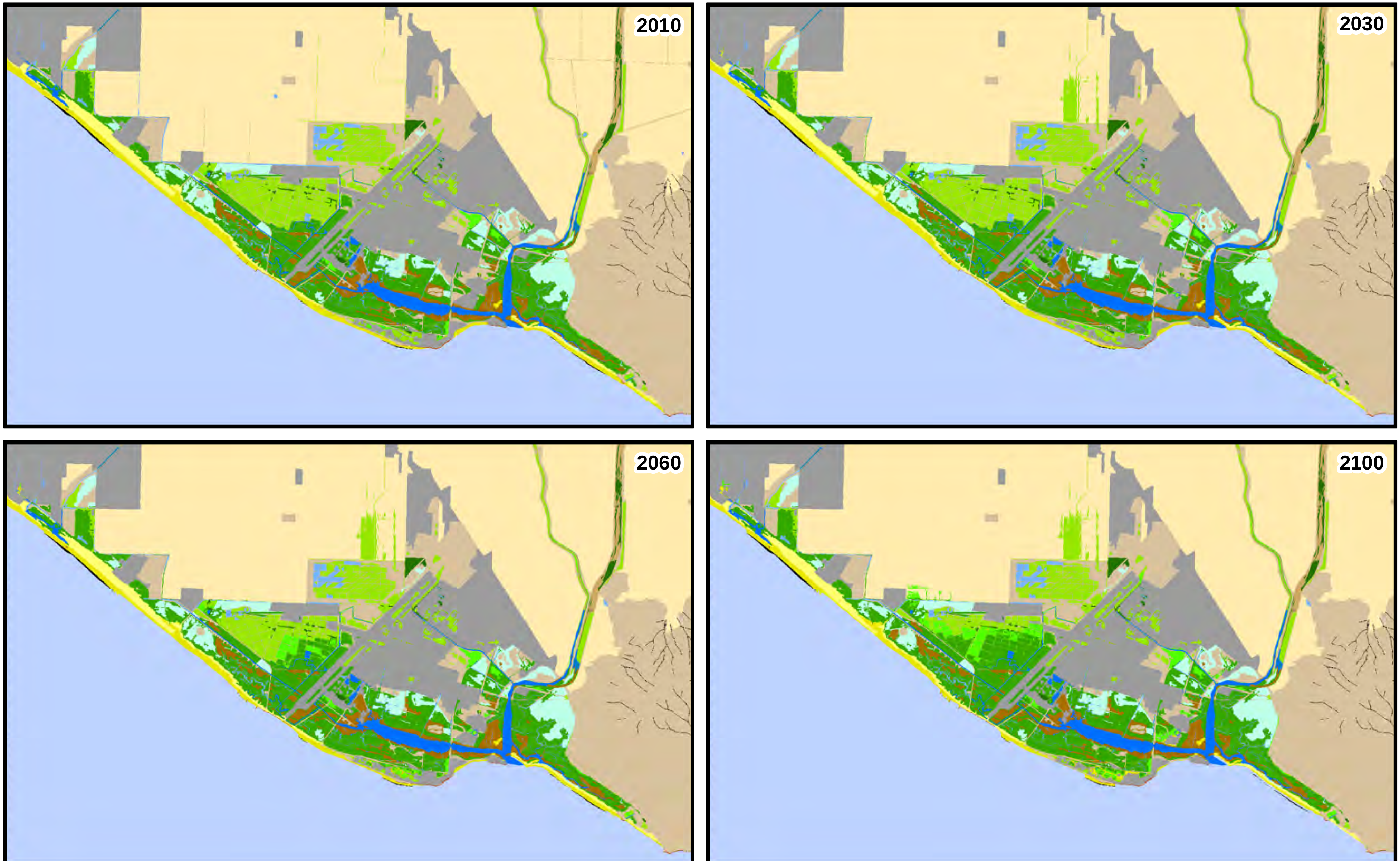
*figure **B.9***

Ventura County Climate Change Vulnerability Study

Results: Low SLR, Low Accretion, Erosion of New Inlet, Fortify Dev. Dry Land (incl. Ag. + Ponds)

ESA PWA Ref# - D211452

ESA PWA



Please see Figure B.1 for legend.
Scenario: s1a2e1m1 (Run 3-46)

12/15/2013

N

0 1 2 Miles

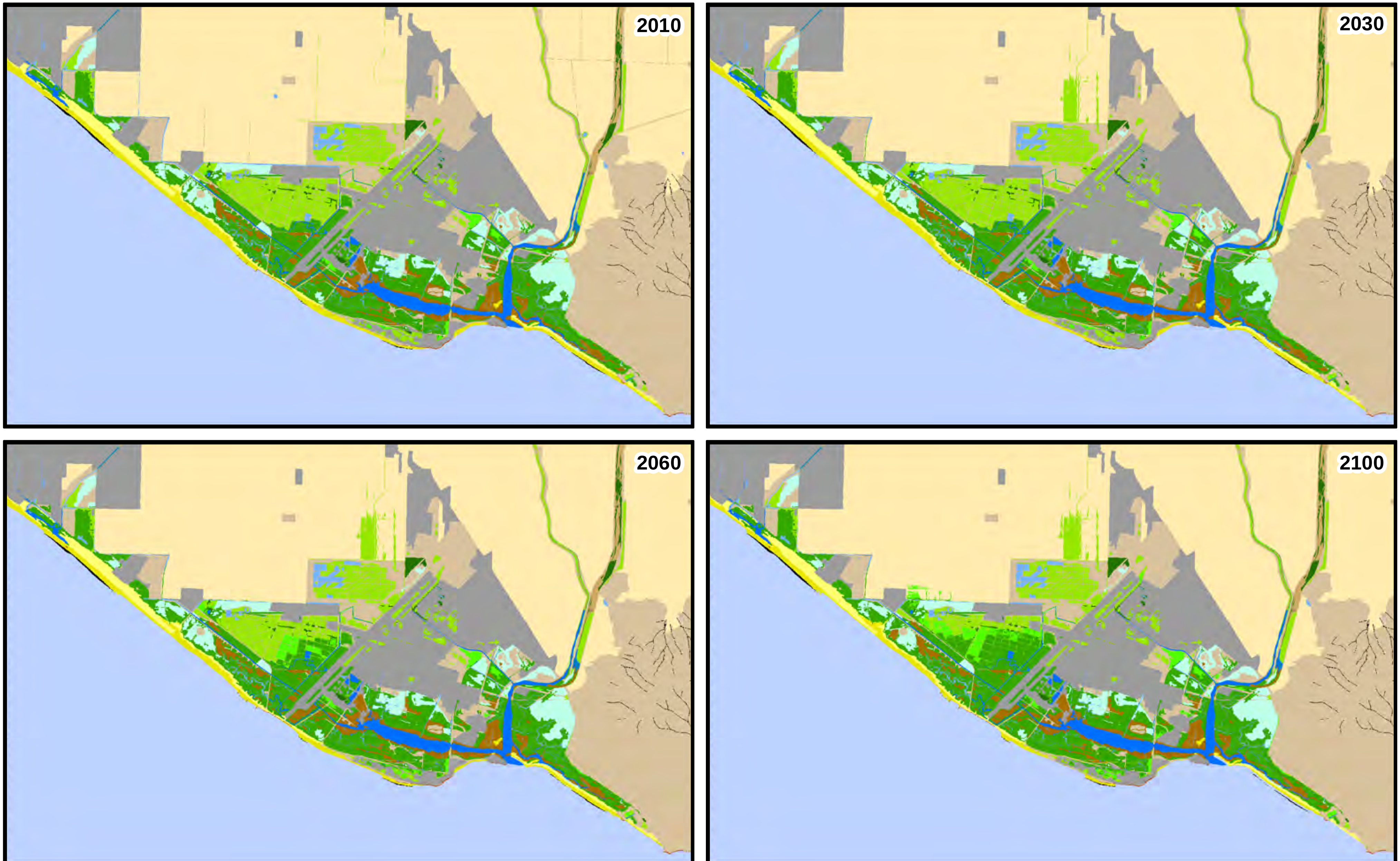
*figure **B.10***

Ventura County Climate Change Vulnerability Study

Results: Low SLR, High Accretion, No Erosion of New Inlet, Allow Marshes to Transgress

ESA PWA Ref# - D211452

ESA PWA



Please see Figure B.1 for legend.
Scenario: s1a2e1m2 (Run 3-46)

12/15/2013

N

0 1 2 Miles

figure ***B.11***

Ventura County Climate Change Vulnerability Study

Results: Low SLR, High Accretion, No Erosion of New Inlet, Fortify Dev. Dry Land (excl. Ag.)

ESA PWA Ref# - D211452

ESA PWA

Please see Figure B.1 for legend.
Scenario: s1a2e1m3 (Run 3-46b)

12/15/2013

N

0 1 2 Miles

figure ***B.12***

Ventura County Climate Change Vulnerability Study

Results: Low SLR, High Accretion, No Erosion of New Inlet, Fortify Dev. Dry Land (incl. Ag.)

ESA PWA Ref# - D211452

ESA PWA

Please see Figure B.1 for legend.
Scenario: s1a2e1m4 (Run 3-46c)

12/15/2013

N

0 1 2 Miles

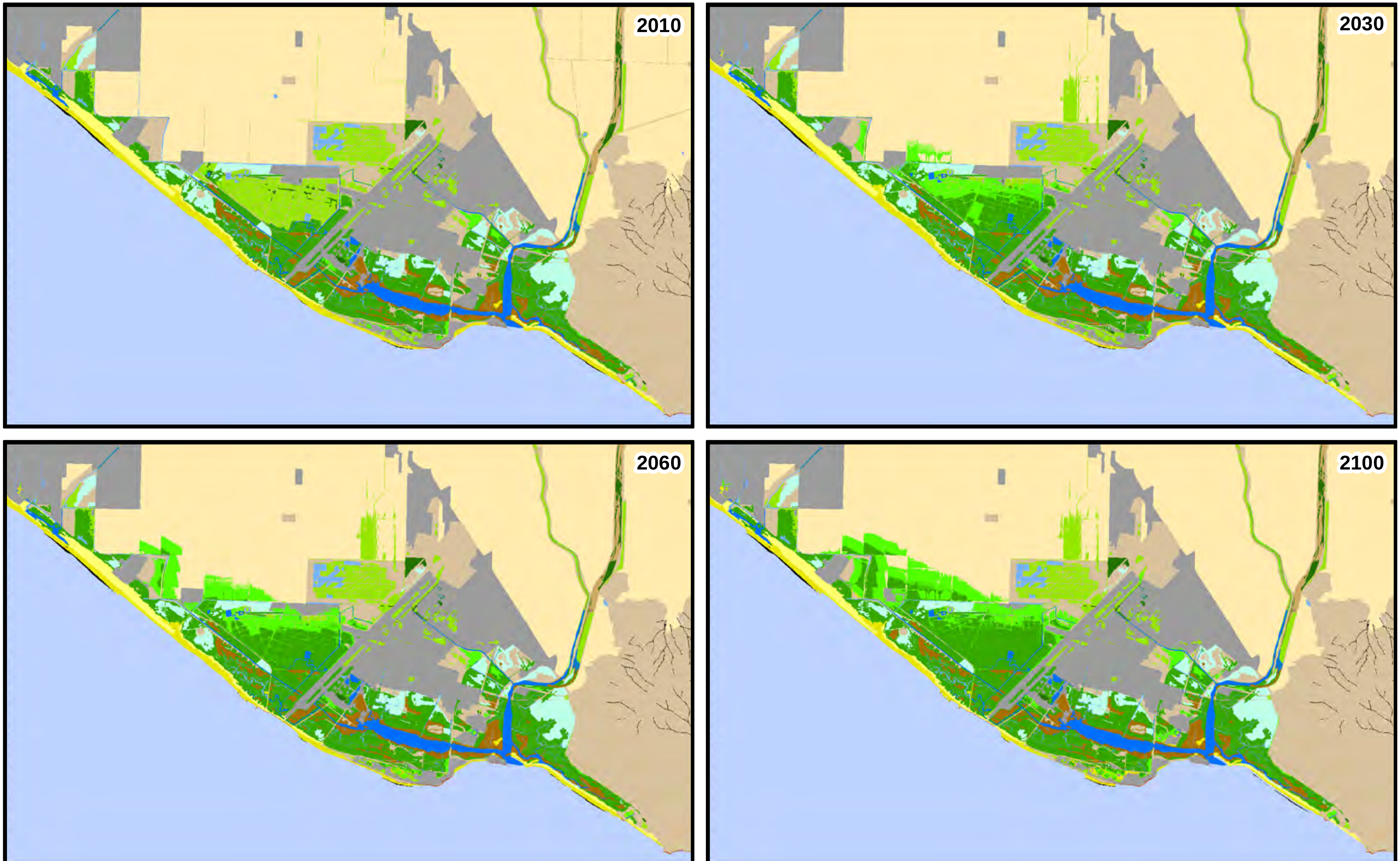
*figure **B.13***

Ventura County Climate Change Vulnerability Study

Results: Low SLR, High Accretion, No Erosion of New Inlet, Fortify Dev. Dry Land (incl. Ag. + Ponds)

ESA PWA Ref# - D211452

ESA PWA



Please see Figure B.1 for legend.
Scenario: s1a2e2m1 (Run 3-50)

12/15/2013

N

0 1 2 Miles

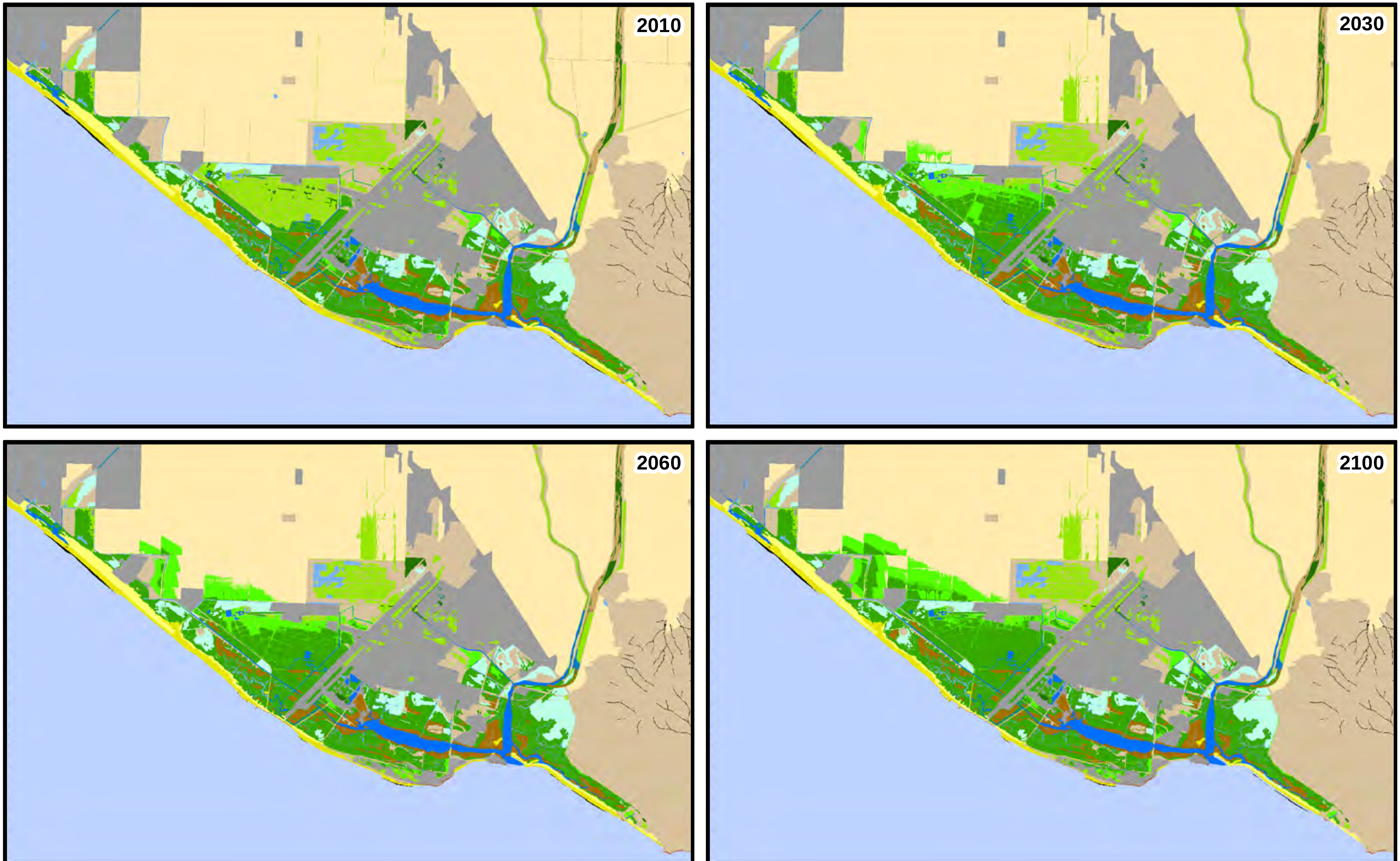
*figure **B.14***

Ventura County Climate Change Vulnerability Study

Results: Low SLR, High Accretion, Erosion of New Inlet, Allow Marshes to Transgress

ESA PWA Ref# - D211452

ESA PWA



Please see Figure B.1 for legend.
Scenario: s1a2e2m2 (Run 3-50)

12/15/2013

N

0 1 2 Miles

figure ***B.15***

Ventura County Climate Change Vulnerability Study

Results: Low SLR, High Accretion, Erosion of New Inlet, Fortify Dev. Dry Land (excl. Ag.)

ESA PWA Ref# - D211452

ESA PWA

Please see Figure B.1 for legend.
Scenario: s1a2e2m3 (Run 3-50b)

12/15/2013

N

0 1 2
Miles

*figure **B.16***

Ventura County Climate Change Vulnerability Study

Results: Low SLR, High Accretion, Erosion of New Inlet, Fortify Dev. Dry Land (incl. Ag.)

ESA PWA Ref# - D211452

ESA PWA

Please see Figure B.1 for legend.
Scenario: s1a2e2m4 (Run 3-50c)

12/15/2013

N

0 1 2 Miles

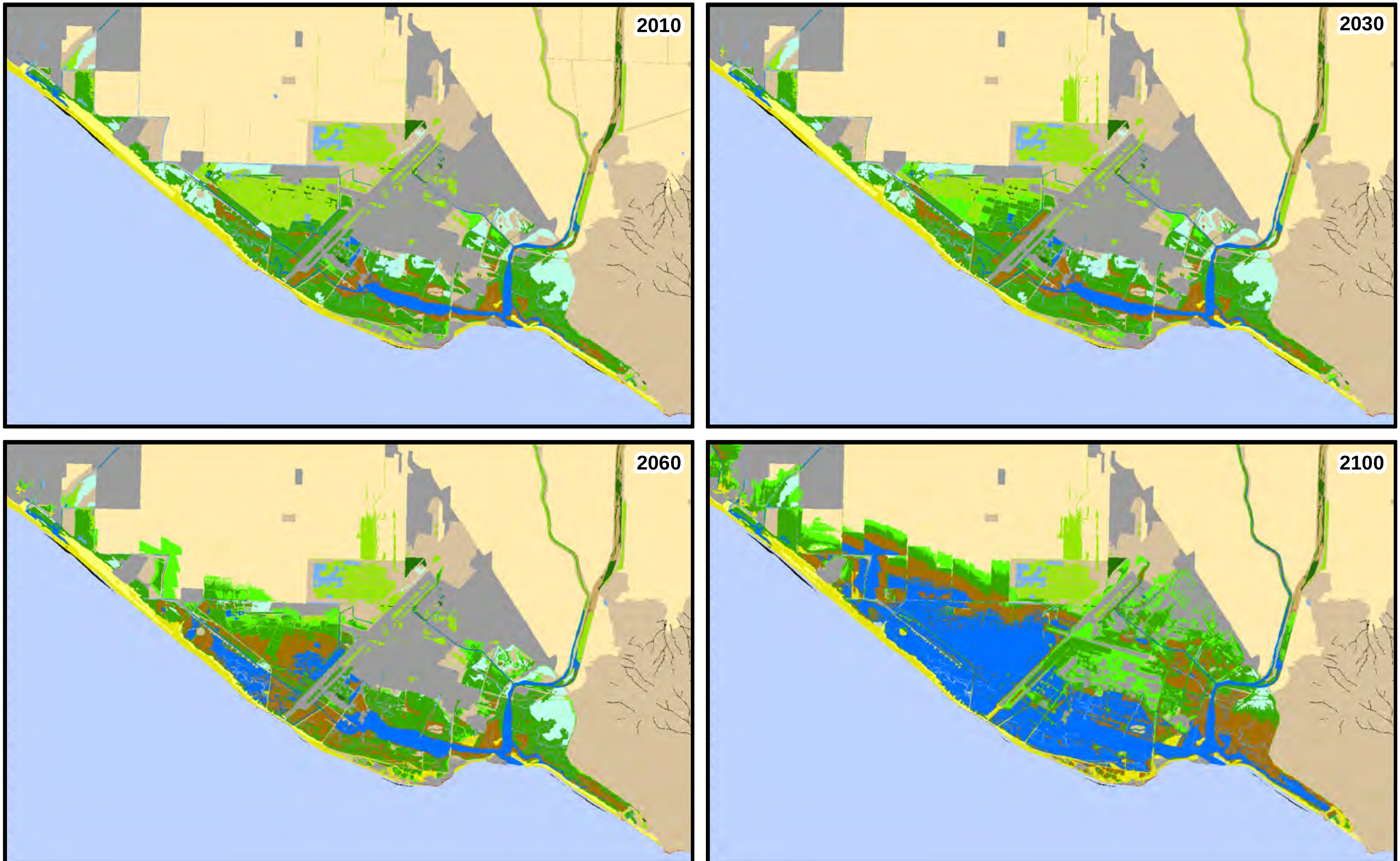
*figure **B.17***

Ventura County Climate Change Vulnerability Study

Results: Low SLR, High Accretion, Erosion of New Inlet, Fortify Dev. Dry Land (incl. Ag. + Ponds)

ESA PWA Ref# - D211452

ESA PWA



Please see Figure B.1 for legend.
Scenario: s3a1e1m1 (Run 3-45)

12/15/2013

N

0 1 2 Miles

*figure **B.18***

Ventura County Climate Change Vulnerability Study

Results: High SLR, Low Accretion, No Erosion of New Inlet, Allow Marshes to Transgress

ESA PWA Ref# - D211452

ESA PWA

Please see Figure B.1 for legend.
Scenario: s3a1e1m2 (Run 3-45)

12/15/2013

N

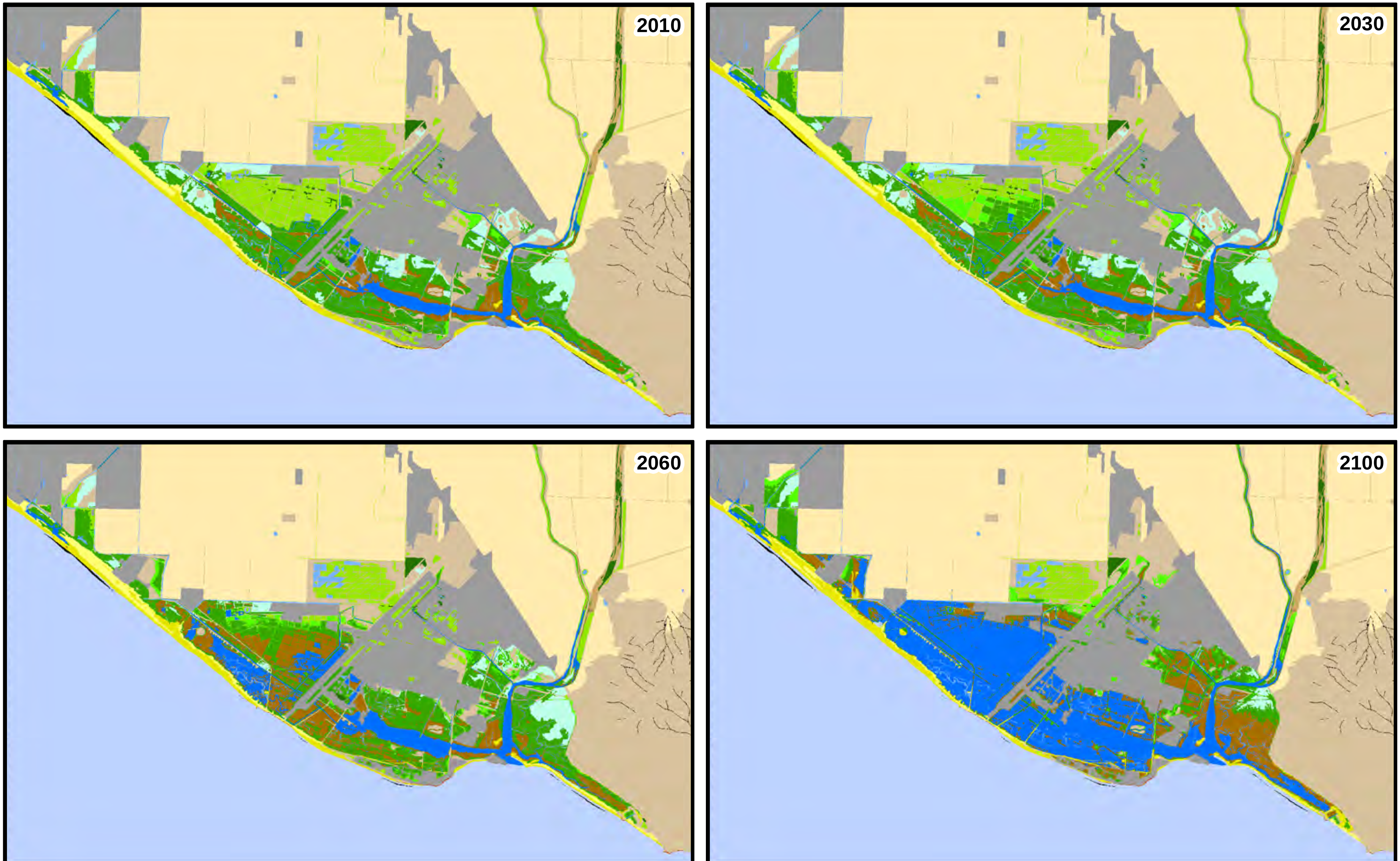
0 1 2 Miles

figure ***B.19***

Ventura County Climate Change Vulnerability Study

Results: High SLR, Low Accretion, No Erosion of New Inlet, Fortify Dev. Dry Land (excl. Ag.)

ESA PWA Ref# - D211452



Please see Figure B.1 for legend.
Scenario: s3a1e1m3 (Run 3-45b)

12/15/2013

N

0 1 2 Miles

figure ***B.20***

Ventura County Climate Change Vulnerability Study

Results: High SLR, Low Accretion, No Erosion of New Inlet, Fortify Dev. Dry Land (incl. Ag.)

ESA PWA Ref# - D211452

ESA PWA

Please see Figure B.1 for legend.
Scenario: s3a1e1m4 (Run 3-45c)

12/15/2013

N

0 1 2 Miles

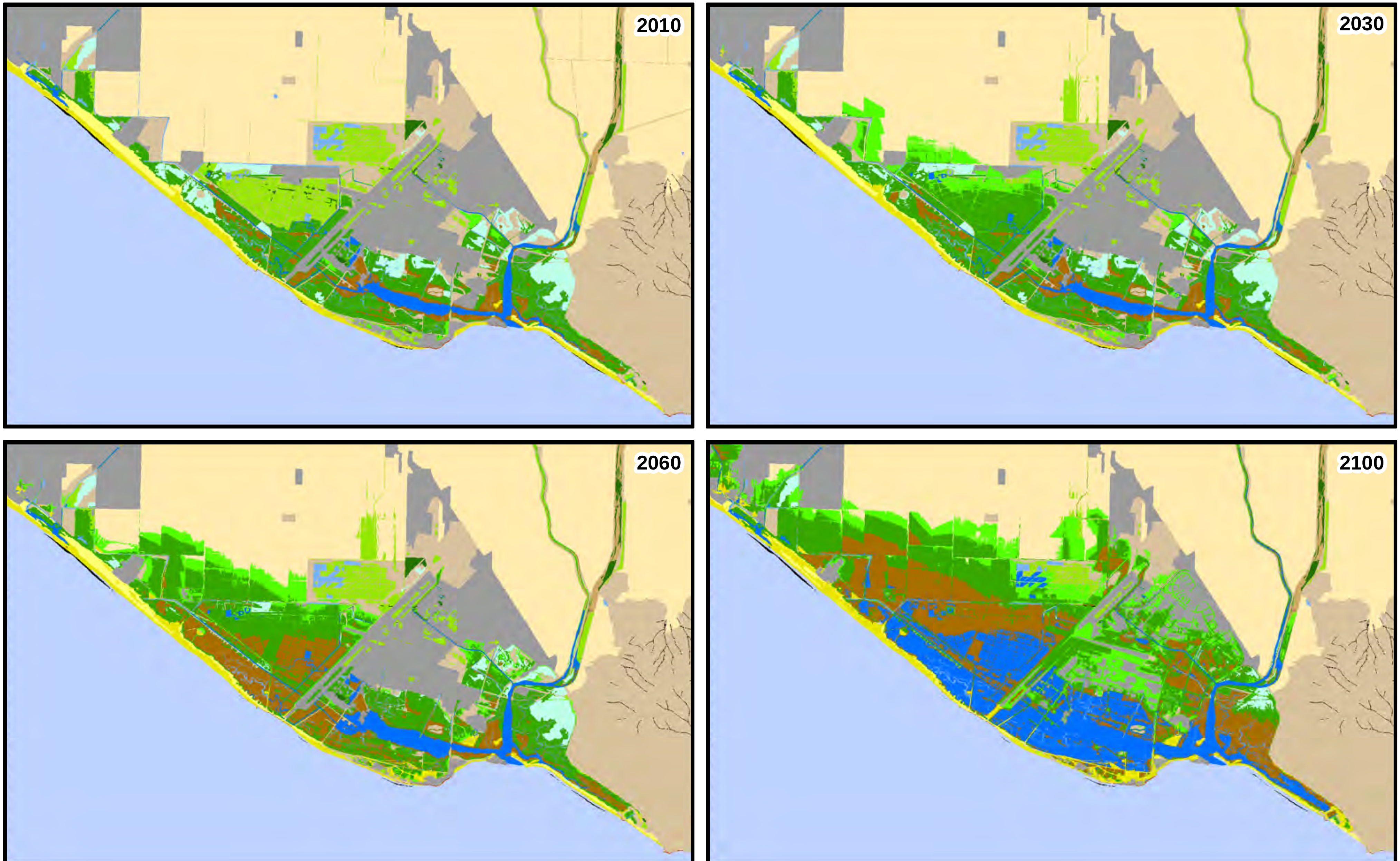
figure ***B.21***

Ventura County Climate Change Vulnerability Study

Results: High SLR, Low Accretion, No Erosion of New Inlet, Fortify Dev. Dry Land (incl. Ag. + Ponds)

ESA PWA Ref# - D211452

ESA PWA



Please see Figure B.1 for legend.
Scenario: s3a1e2m1 (Run 3-49)

12/15/2013

N

0 1 2 Miles

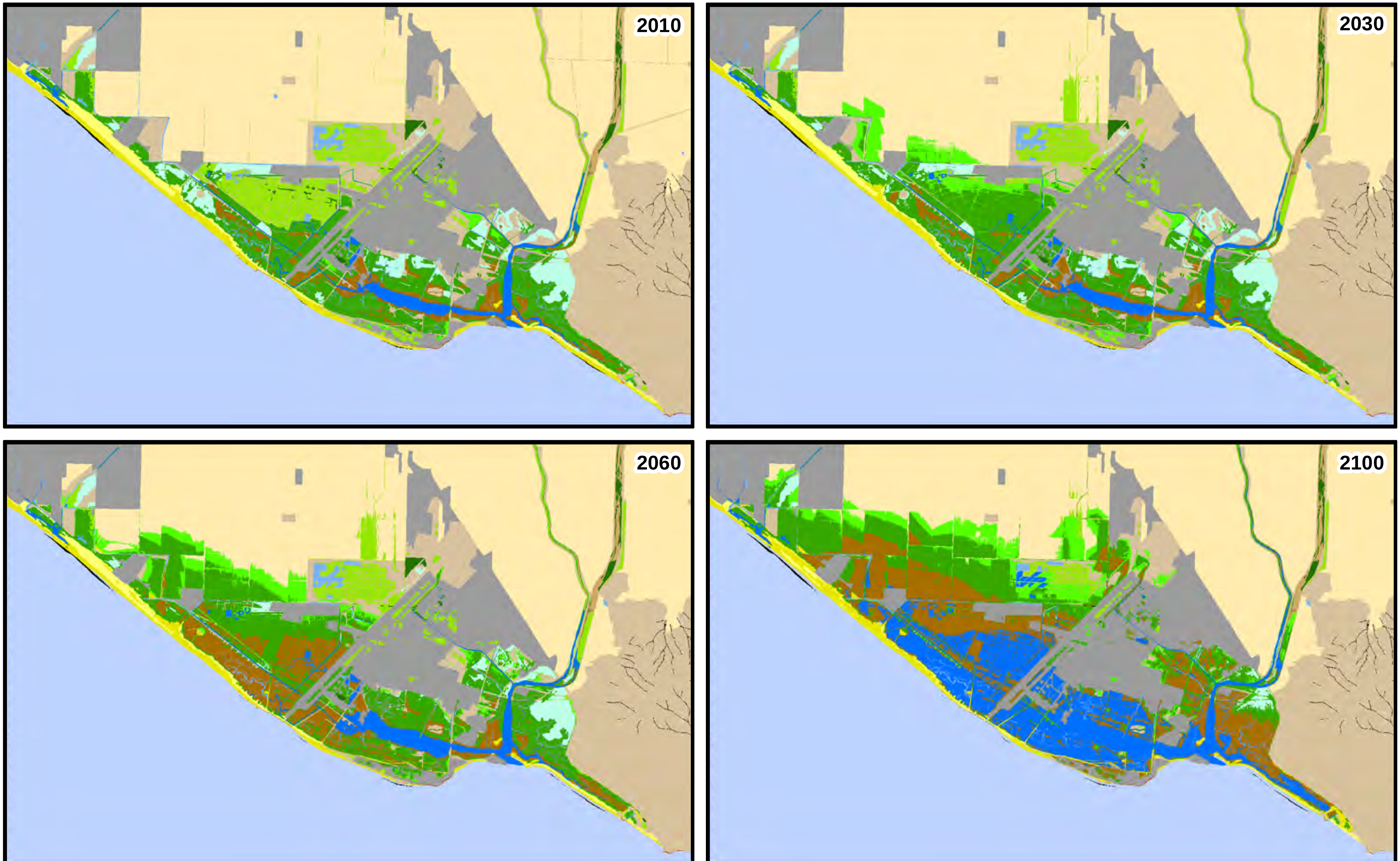
figure ***B.22***

Ventura County Climate Change Vulnerability Study

Results: High SLR, Low Accretion, Erosion of New Inlet, Allow Marshes to Transgress

ESA PWA Ref# - D211452

ESA PWA



Please see Figure B.1 for legend.
Scenario: s3a1e2m2 (Run 3-49)

12/15/2013

N

0 1 2 Miles

figure ***B.23***

Ventura County Climate Change Vulnerability Study

Results: High SLR, Low Accretion, Erosion of New Inlet, Fortify Dev. Dry Land (excl. Ag.)

ESA PWA Ref# - D211452

ESA PWA

Please see Figure B.1 for legend.
Scenario: s3a1e2m3 (Run 3-49b)

12/15/2013

N

0 1 2 Miles

*figure **B.24***

Ventura County Climate Change Vulnerability Study

Results: High SLR, Low Accretion, Erosion of New Inlet, Fortify Dev. Dry Land (incl. Ag.)

ESA PWA Ref# - D211452

ESA PWA

Please see Figure B.1 for legend.
Scenario: s3a1e2m4 (Run 3-49c)

12/15/2013

N

0 1 2 Miles

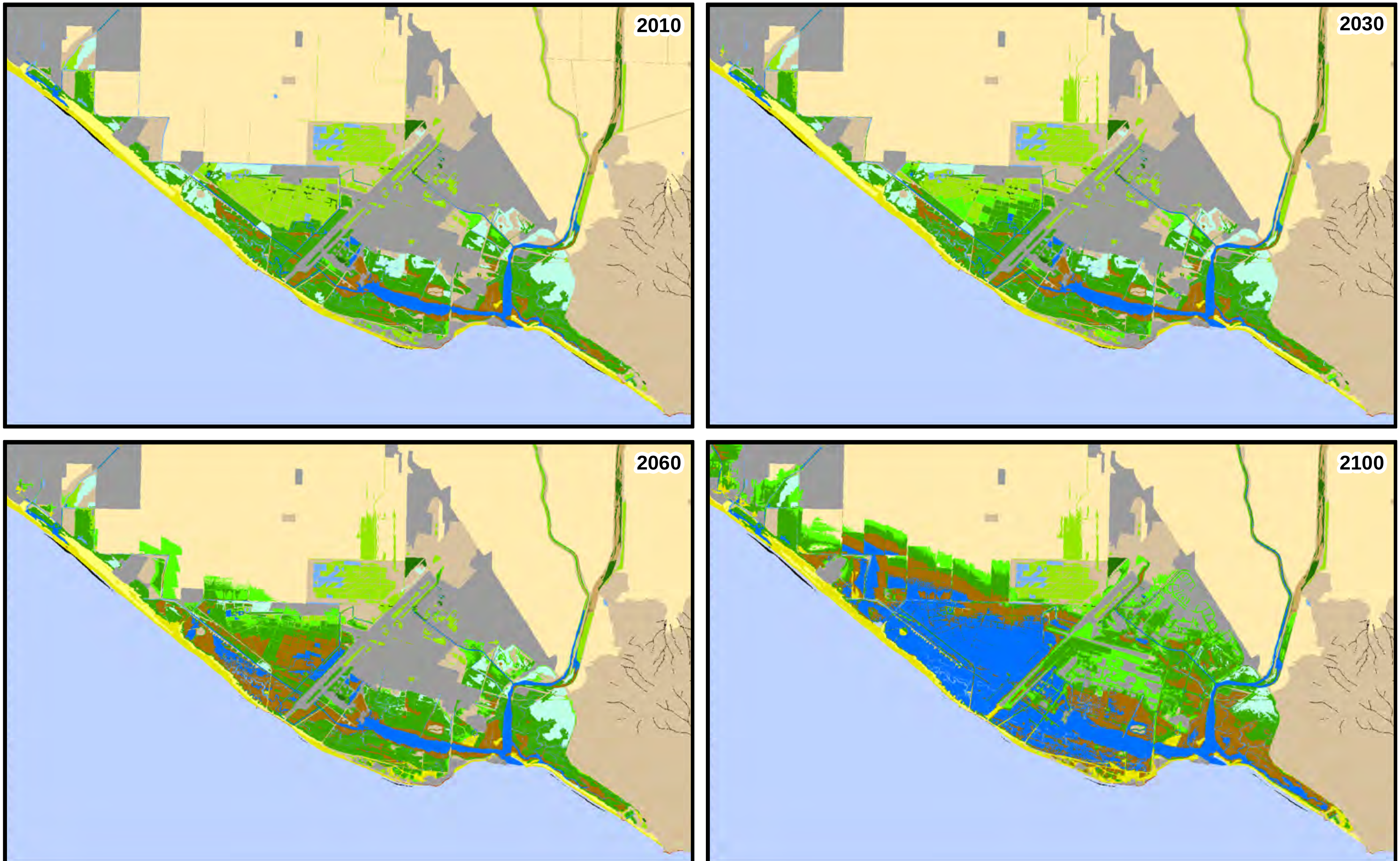
*figure **B.25***

Ventura County Climate Change Vulnerability Study

Results: High SLR, Low Accretion, Erosion of New Inlet, Fortify Dev. Dry Land (incl. Ag. + Ponds)

ESA PWA Ref# - D211452

ESA PWA



Please see Figure B.1 for legend.
Scenario: s3a2e1m1 (Run 3-44)

12/15/2013

N

0 1 2 Miles

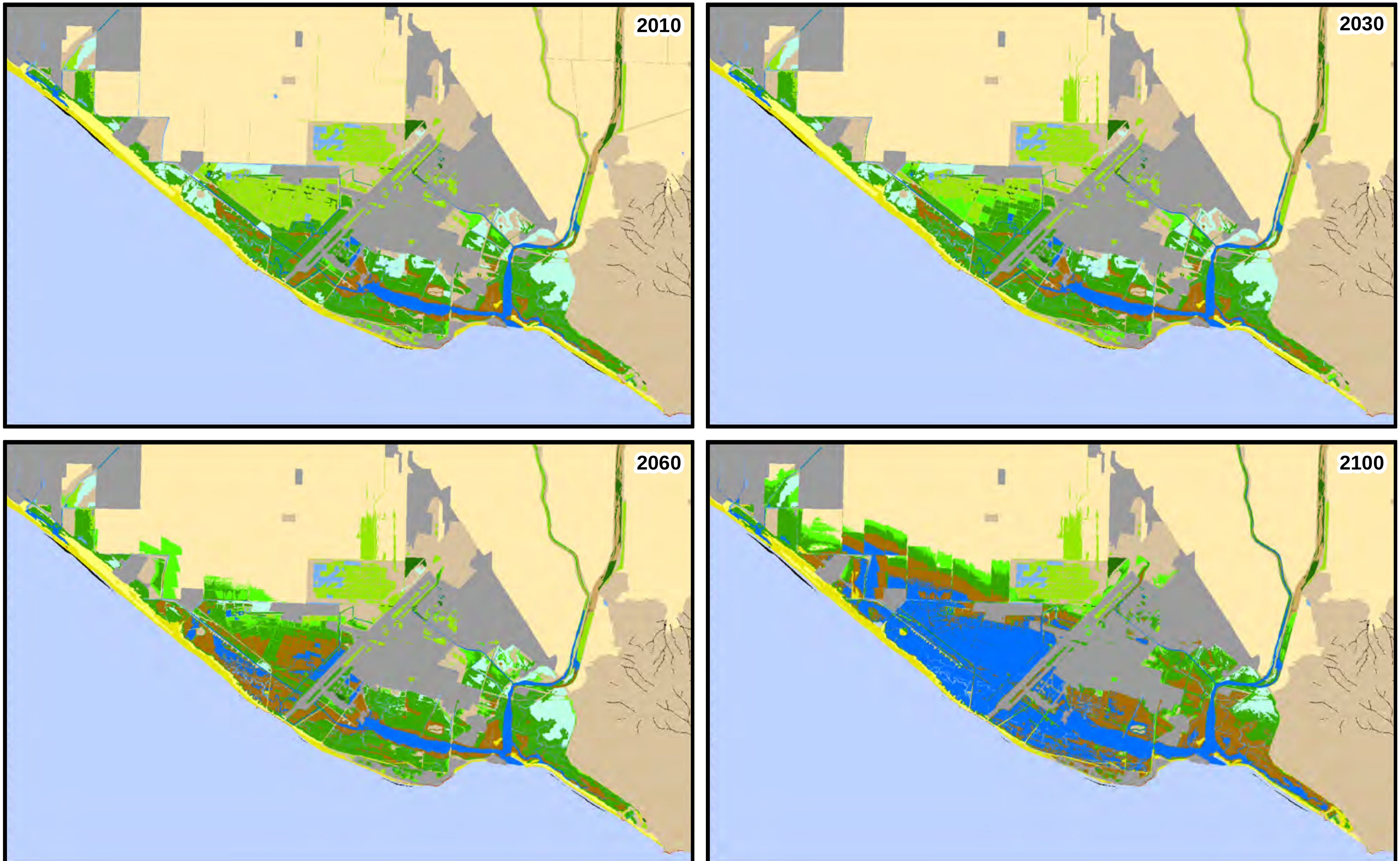
*figure **B.26***

Ventura County Climate Change Vulnerability Study

Results: High SLR, High Accretion, No Erosion of New Inlet, Allow Marshes to Transgress

ESA PWA Ref# - D211452

ESA PWA



Please see Figure B.1 for legend.
Scenario: s3a2e1m2 (Run 3-44)

12/15/2013

N

0 1 2 Miles

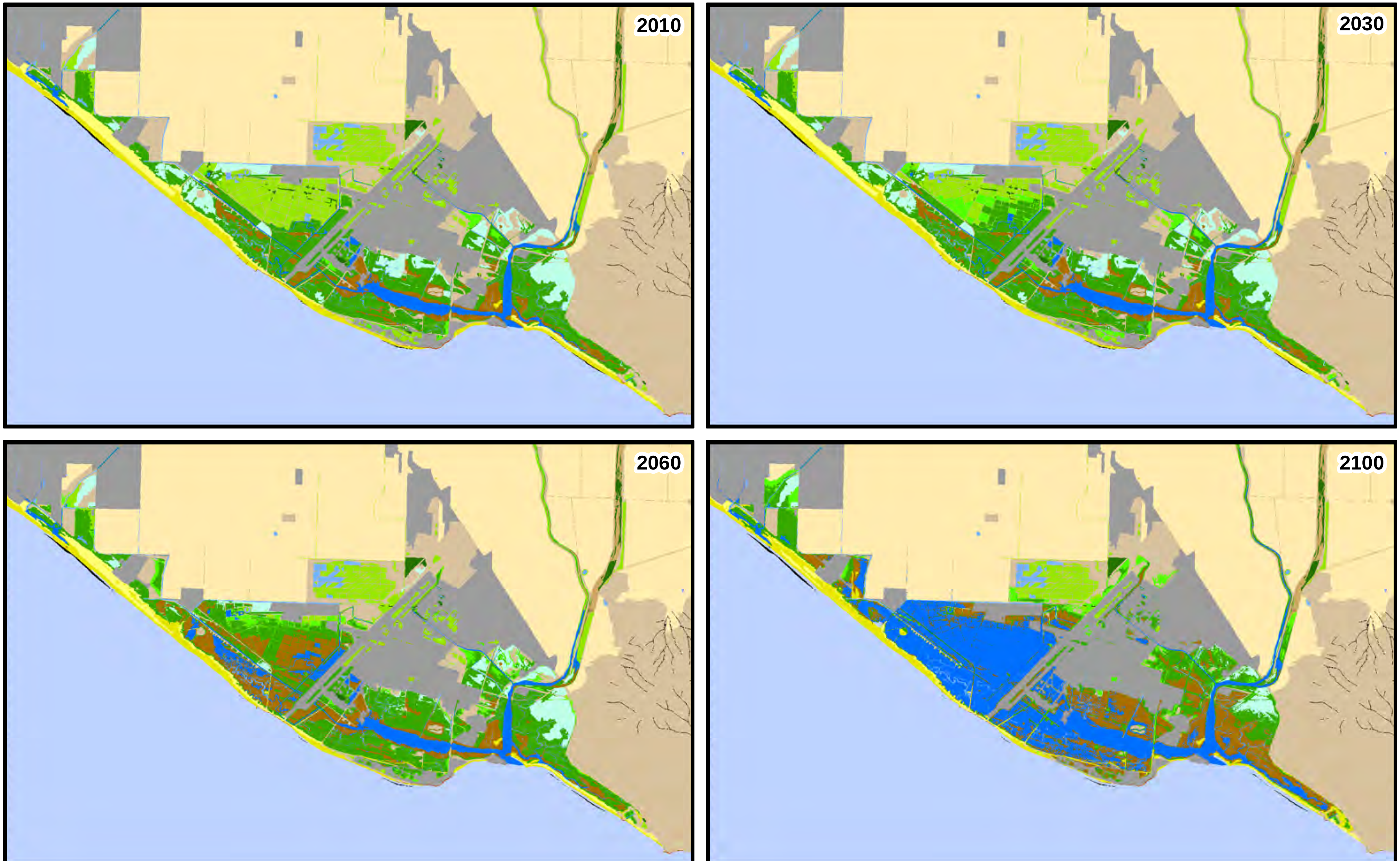
*figure **B.27***

Ventura County Climate Change Vulnerability Study

Results: High SLR, High Accretion, No Erosion of New Inlet, Fortify Dev. Dry Land (excl. Ag.)

ESA PWA Ref# - D211452

ESA PWA



Please see Figure B.1 for legend.
Scenario: s3a2e1m3 (Run 3-44b)

12/15/2013

N

0 1 2 Miles

figure ***B.28***

Ventura County Climate Change Vulnerability Study

Results: High SLR, High Accretion, No Erosion of New Inlet, Fortify Dev. Dry Land (incl. Ag.)

ESA PWA Ref# - D211452

ESA PWA

Please see Figure B.1 for legend.
Scenario: s3a2e1m4 (Run 3-44c)

12/15/2013

N

0 1 2 Miles

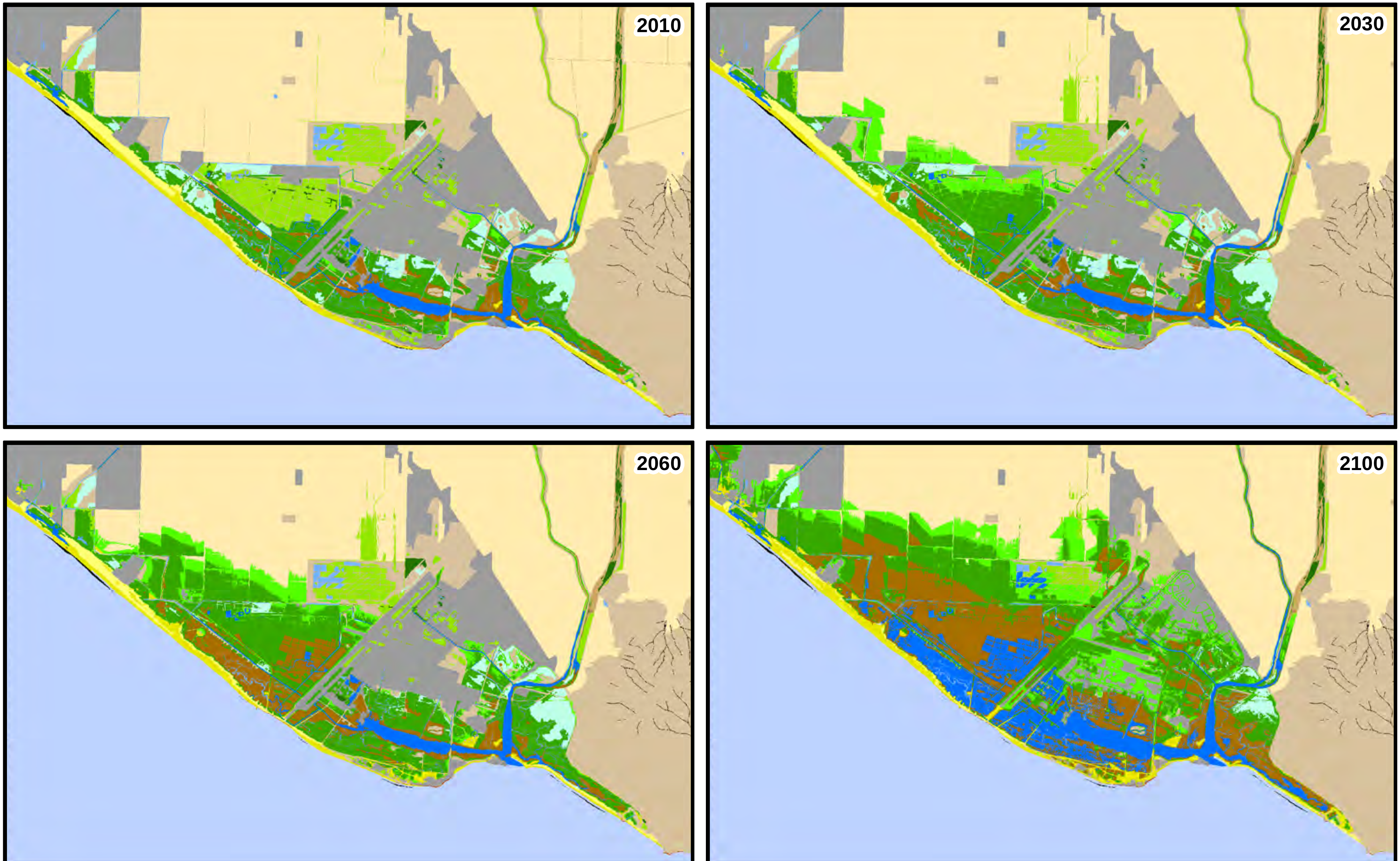
*figure **B.29***

Ventura County Climate Change Vulnerability Study

Results: High SLR, High Accretion, No Erosion of New Inlet, Fortify Dev. Dry Land (incl. Ag. + Ponds)

ESA PWA Ref# - D211452

ESA PWA



Please see Figure B.1 for legend.
Scenario: s3a2e2m1 (Run 3-48)

12/15/2013

N

0 1 2 Miles

figure ***B.30***

Ventura County Climate Change Vulnerability Study

Results: High SLR, High Accretion, Erosion of New Inlet, Allow Marshes to Transgress

ESA PWA Ref# - D211452

ESA PWA

Please see Figure B.1 for legend.
Scenario: s3a2e2m2 (Run 3-48)

12/15/2013

N

0 1 2 Miles

figure ***B.31***

Ventura County Climate Change Vulnerability Study

Results: High SLR, High Accretion, Erosion of New Inlet, Fortify Dev. Dry Land (excl. Ag.)

ESA PWA Ref# - D211452

ESA PWA

Please see Figure B.1 for legend.
Scenario: s3a2e2m3 (Run 3-48b)

12/15/2013

N

0 1 2 Miles

figure ***B.32***

Ventura County Climate Change Vulnerability Study

Results: High SLR, High Accretion, Erosion of New Inlet, Fortify Dev. Dry Land (incl. Ag.)

ESA PWA Ref# - D211452

ESA PWA

Please see Figure B.1 for legend.
Scenario: s3a2e2m4 (Run 3-48c)

12/15/2013

N

0 1 2 Miles

figure ***B.33***

Ventura County Climate Change Vulnerability Study

Results: High SLR, High Accretion, Erosion of New Inlet, Fortify Dev. Dry Land (incl. Ag. + Ponds)

ESA PWA Ref# - D211452

ESA PWA