

Memorandum

To: Monica Melkesian, Build Inc

From: Leslie Lazarotti
 lazarotti@wra-ca.com
 Ext. 1300

Cc:

Subject: Sea Level Rise – Constraints and Opportunities for India Basin

Date: July 8, 2015

The impetus for this study is to identify how sea level rise may impact current conditions along the India Basin shoreline, from 700 Innes to Heron’s Head Park, in the City and County of San Francisco. Existing conditions are compared to estimates based on currently accepted models of sea level rise elevations for the year 2100, which range from a low of 18 inches to a high of 65 inches (NRC 2012). The results of this study help quantify the net change in available tidal marsh habitats without any actions by humans, as well as identify areas that may be suitable for tidal marsh restoration. This information will be useful for planning purposes when identifying areas to target tidal marsh restoration efforts, site future public access/recreational improvements, and development.

Habitat areas presented in this study are estimated based on ground-based elevation ranges of tidal marsh vegetation in the immediate area and applied to topographic data generated from high-resolution LIDAR data (USGS 2010). For estimating future tidal marsh habitats the previous data is used in conjunction with estimates of future sea level rise elevations for the San Francisco Bay (NRC 2012). This study does not consider potential effects of climate change beyond sea level rise, such as changes in storm activity, sedimentation/erosion, temperature, or salinity, which may also influence habitat formation. This study also takes into account City of San Francisco guidance for incorporating sea level rise into capital planning.

Results

Tidal Marsh Habitat

Estimated areas of water, mudflat, low marsh, high marsh, transition zone, and upland for current conditions, current conditions plus 18 inches of sea level rise, and current conditions plus 65 inches of sea level rise (assuming no modifications to land elevations by humans) are presented in Table 1 and Figures 1 – 3.

Table. 1. Habitat Areas Under Current Conditions and Estimates of Sea Level Rise

Habitat	Current Conditions MSL = 3.2’ NAVD (acres)	Plus 18 inches MSL = 4.7’ NAVD (acres)	Plus 65 inches MSL = 8.6’ NAVD (acres)
Water	42.15	45.71	60.62
Mudflat	1.75	4.79	1.78
Low Marsh (cordgrass)	3.00	4.92	1.74
High Marsh (pickleweed)	7.39	2.01	2.39

Transition Zone	4.31	1.17	12.08
Upland	72.46	72.46	52.45

With increased water elevations, existing mudflat and tidal marsh will become open water and existing areas of tidal marsh vegetation may migrate inland to colonize suitable higher elevations. Broad, gentle slopes can best support this inland migration of tidal vegetation with rising water levels. However, without modifying the landscape to create suitable elevations for tidal marsh habitats there will be a considerable reduction of low and high marsh habitats throughout India Basin. Loss of tidal marsh would reduce available habitat for sensitive wildlife species. Inland areas would also lose the protection from rising sea levels and extreme storm events provided by a tidal marsh buffer along the shoreline, and more areas would require hard infrastructure for protection.

However, there are several areas along the shoreline of India Basin with high potential for tidal marsh restoration. These areas are generally relatively low-elevation uplands or transitional zones that are adjacent to current tidal marsh or mudflat habitat. Figure 4 highlights areas where 1 to 2 feet of excavation would create elevations suitable to support tidal marsh vegetation under present conditions. Heron’s Head Park, India Basin Shoreline Park, and the shoreline of 700 and 900 Innes all contain areas of relatively low-elevation uplands with gentle slopes that are suitable for tidal marsh establishment under rising sea levels.

Public Access

Public access is currently present throughout Heron’s Head Park, around the perimeter of the former PG&E Hunter’s Point Power Plant, and at India Basin Shoreline Park. Future public access should be planned in areas mapped as uplands in Figure 3 (current conditions plus 65 inches) to avoid future inundation and to avoid areas with the greatest potential for tidal marsh restoration.

City Of San Francisco Sea Level Rise Guidance

The City of San Francisco provides a framework for considering sea level rise within the capital planning process for the City of San Francisco. The framework includes four key steps for assessing and adapting to sea level rise in capital planning: (1) sea level rise science review; (2) vulnerability assessment; (3) risk assessment; and (4) adaptation planning. The City requires that all planned capital improvement projects with a cost of at least \$5 million and located within a designated Sea Level Rise Vulnerability Zone complete the City’s Sea Level Rise Checklist to guide the City’s evaluation of the project. The checklist involves an assessment of project vulnerabilities under a range of future scenarios (between 6 to 66 inches of sea level rise, both with and without the effects of the 100-year storm event).

While the checklist is intended to analyze a proposed project, it can also be used as a planning tool to analyze existing conditions, understand key vulnerabilities and opportunities of a site, and inform where to place various project components. Figure 5 shows the location of Mean Higher High Water (MHHW) under current conditions and six future sea level rise scenarios identified in the City’s Sea Level Rise Checklist.

Sources

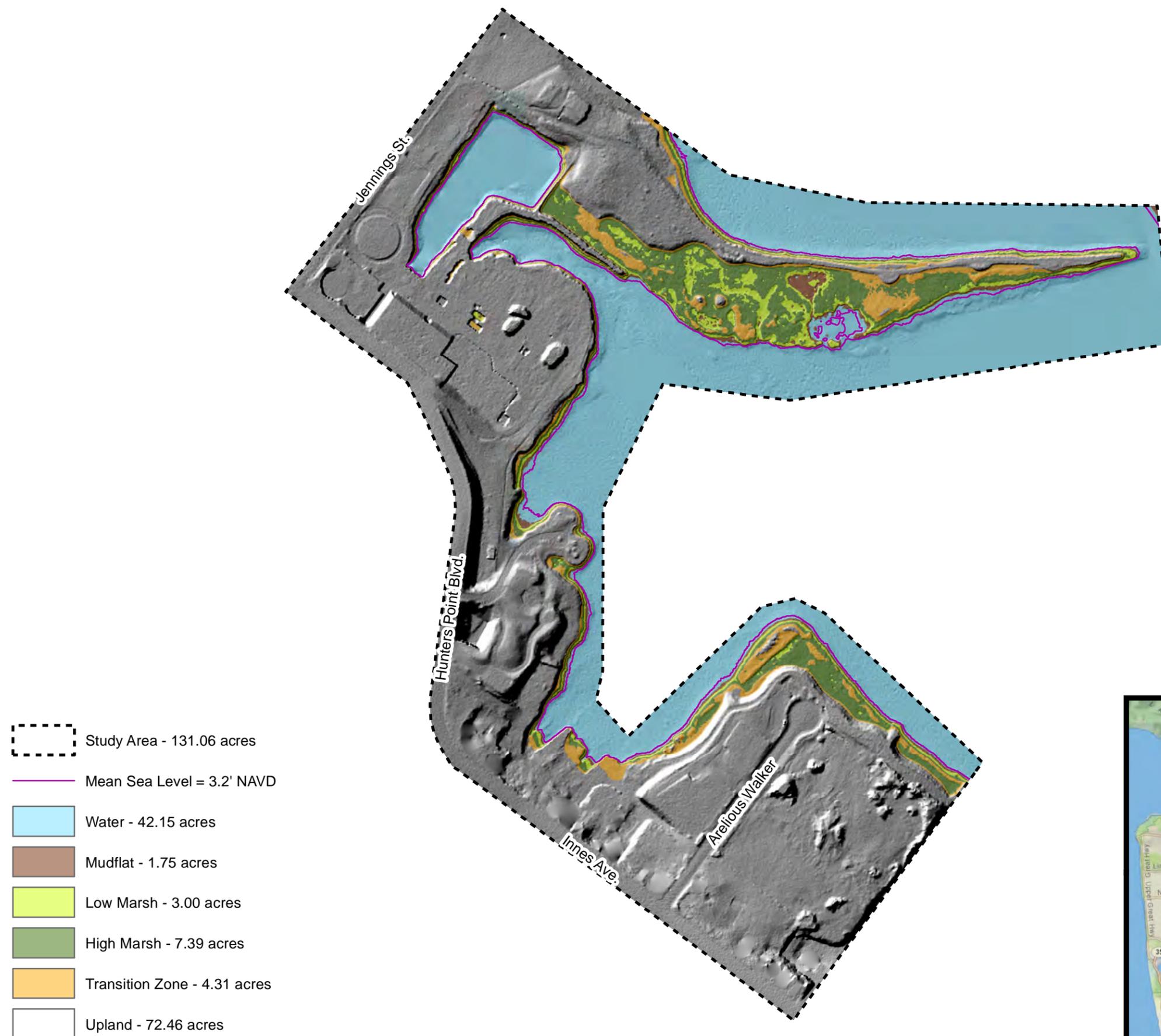
City of San Francisco. 2014. *Guidance for Incorporating Sea Level Rise into Capital Planning In San Francisco: Assessing Vulnerability and Risk to Support Adaptation*. September 22, 2014.

[NRC] National Research Council, 2012. *Sea-Level Rise for the Coasts of California, Oregon, and Washington: Past Present and Future*.

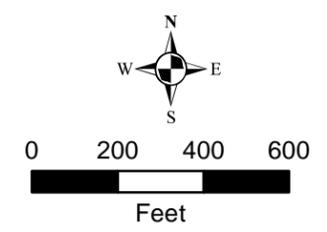
[USGS]. U.S. Geological Survey. 2010. LIDAR Data for the San Francisco Coast.

India Basin
Sea Level Rise Analysis
San Francisco, California

Figure 1.
Tidal Marsh Habitat
by Elevation for 2010



-  Study Area - 131.06 acres
-  Mean Sea Level = 3.2' NAVD
-  Water - 42.15 acres
-  Mudflat - 1.75 acres
-  Low Marsh - 3.00 acres
-  High Marsh - 7.39 acres
-  Transition Zone - 4.31 acres
-  Upland - 72.46 acres



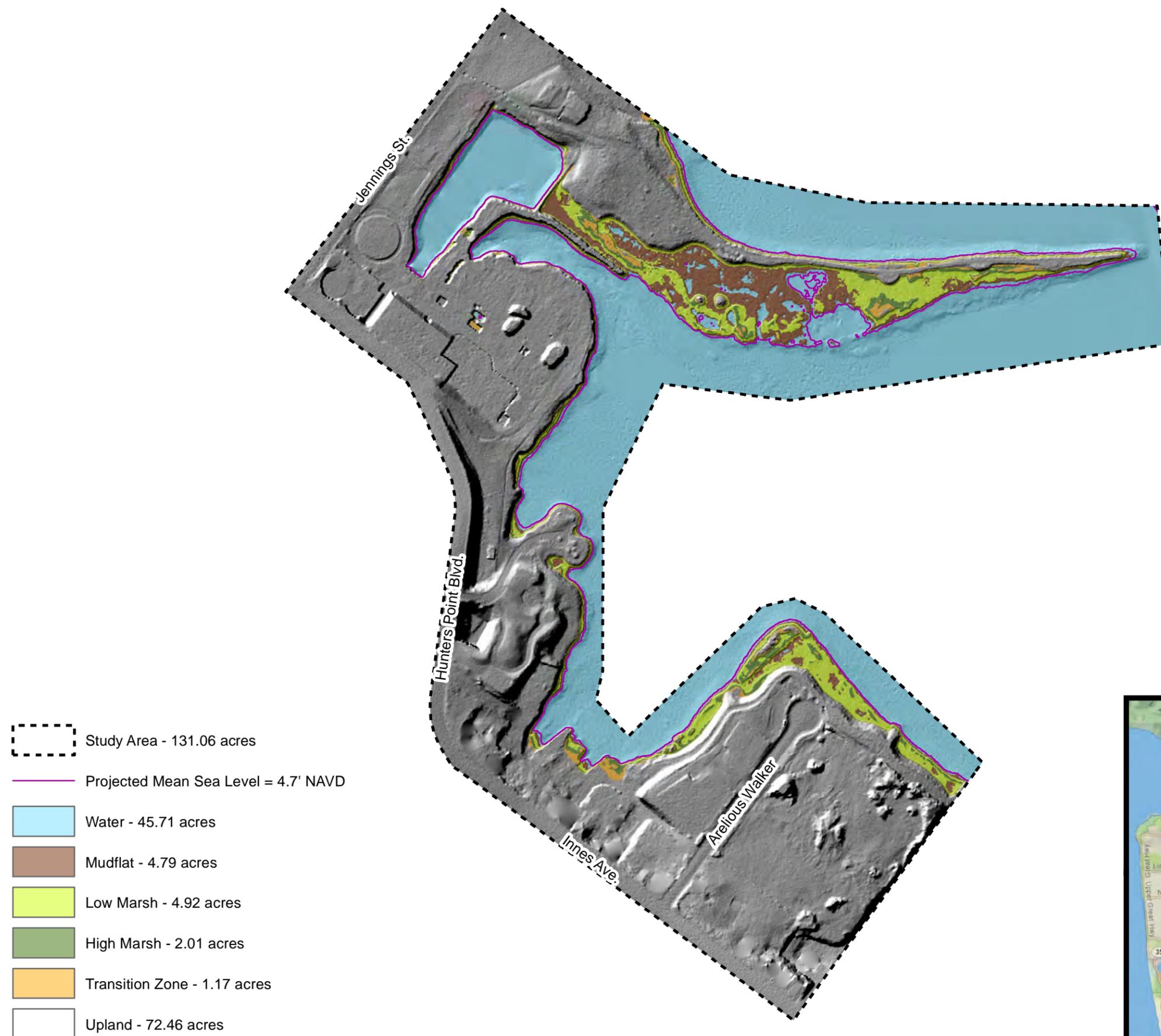
Map Prepared Date: 7/2/2015
Map Prepared By: dchan
Base Source: San Francisco City/County
Data Source(s): WRA

India Basin
Sea Level Rise Analysis
San Francisco, California

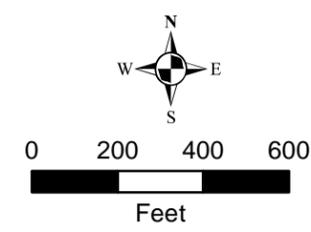
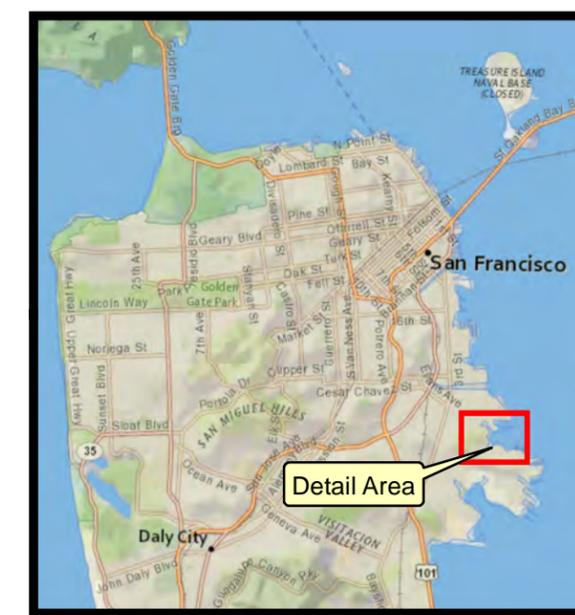
Figure 2.

Projected Tidal Marsh
Habitat by Elevation for
Year 2100

(Based on Current Mean
Sea Level + 18")



-  Study Area - 131.06 acres
-  Projected Mean Sea Level = 4.7' NAVD
-  Water - 45.71 acres
-  Mudflat - 4.79 acres
-  Low Marsh - 4.92 acres
-  High Marsh - 2.01 acres
-  Transition Zone - 1.17 acres
-  Upland - 72.46 acres



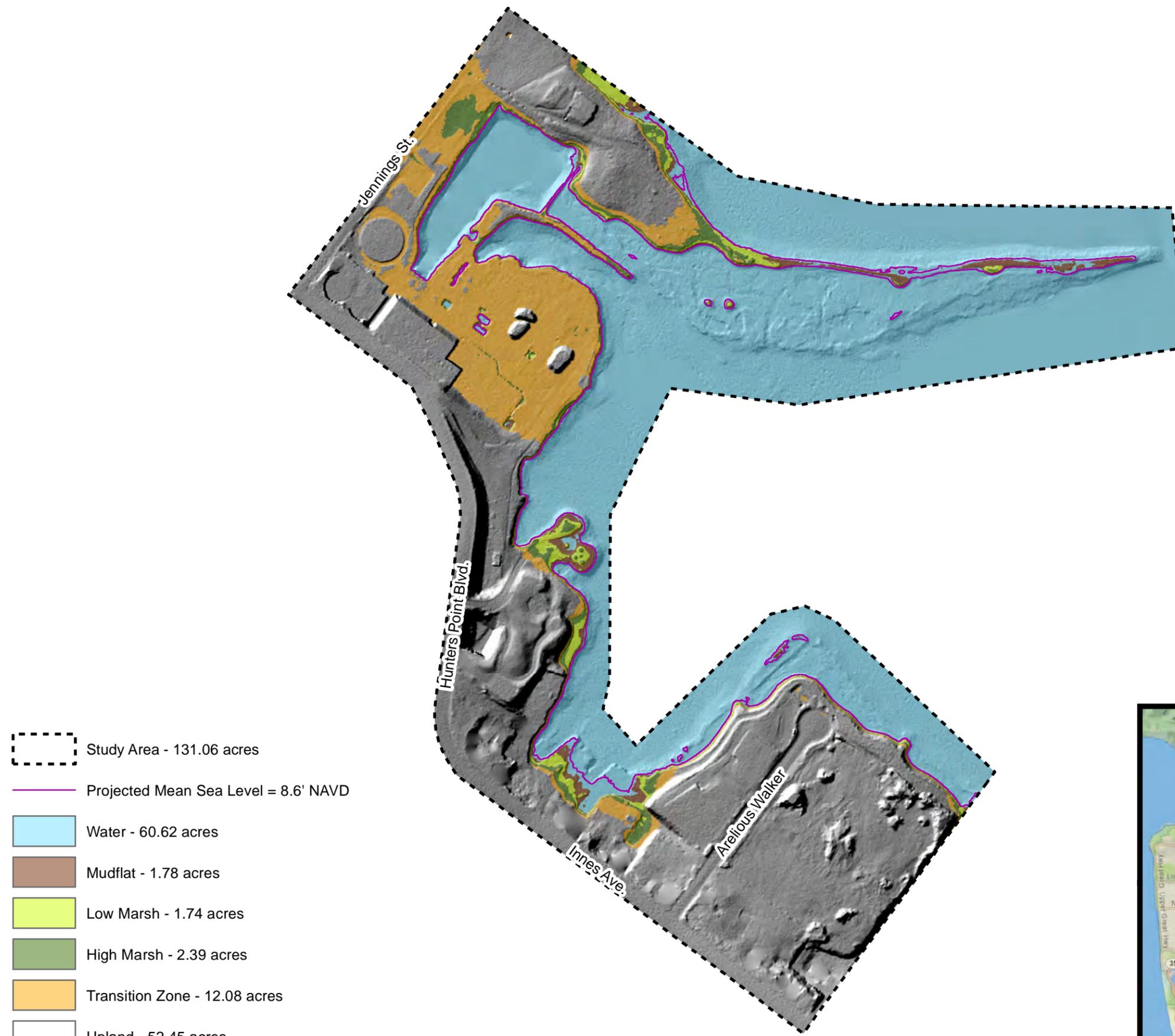
Map Prepared Date: 7/2/2015
Map Prepared By: dchan
Base Source: San Francisco City/County
Data Source(s): WRA

India Basin
Sea Level Rise Analysis
San Francisco, California

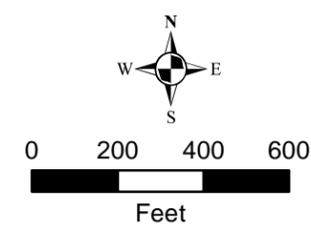
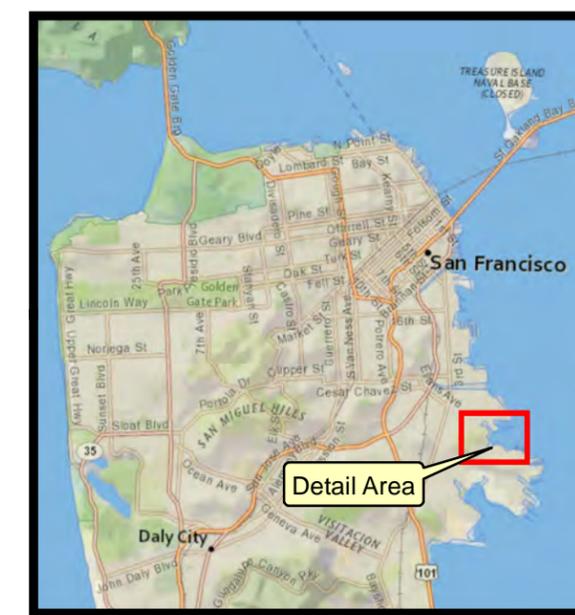
Figure 3.

Projected Tidal Marsh
Habitat by Elevation for
Year 2100

(Based on Current Mean
Sea Level + 65")

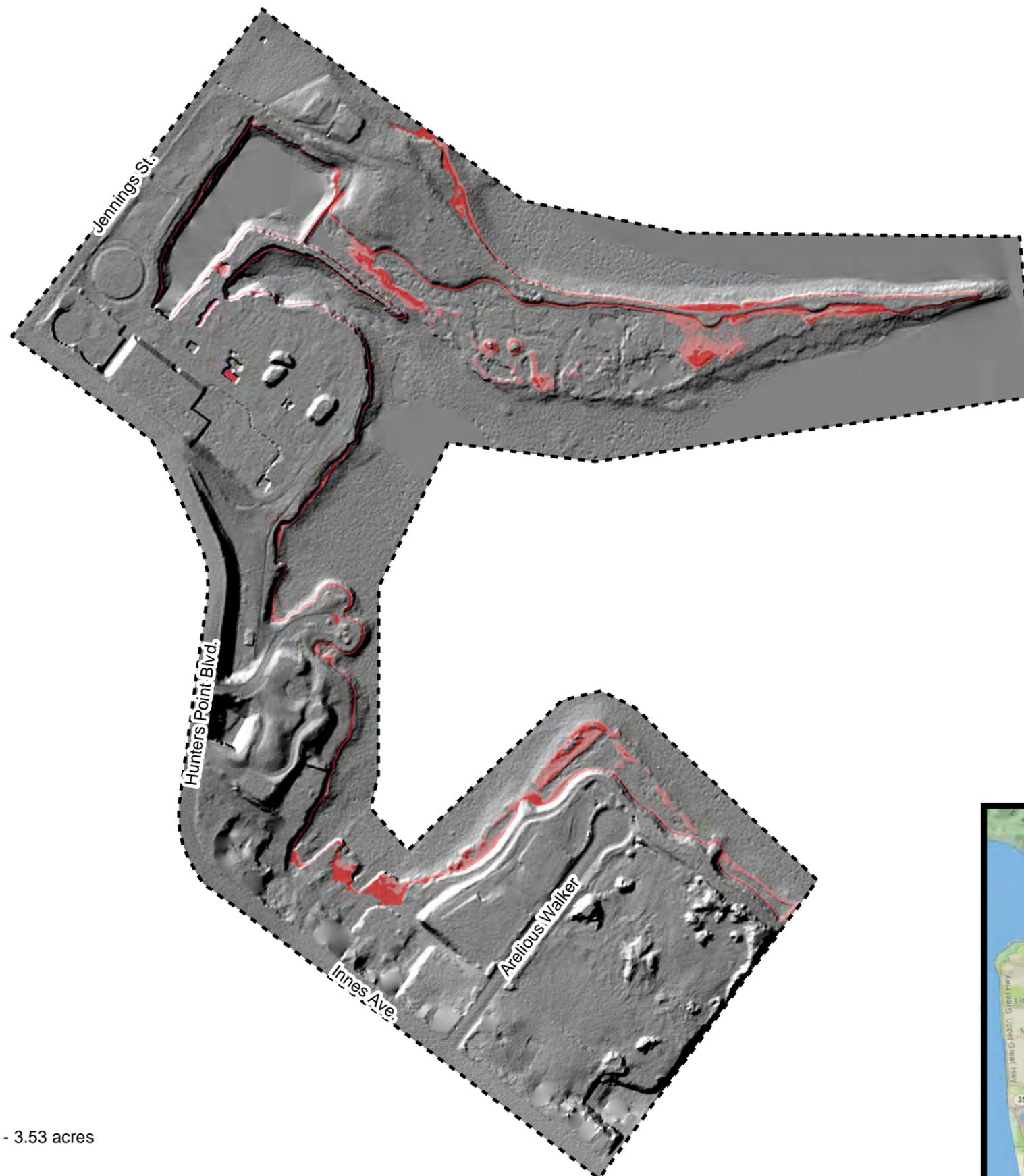


-  Study Area - 131.06 acres
-  Projected Mean Sea Level = 8.6' NAVD
-  Water - 60.62 acres
-  Mudflat - 1.78 acres
-  Low Marsh - 1.74 acres
-  High Marsh - 2.39 acres
-  Transition Zone - 12.08 acres
-  Upland - 52.45 acres

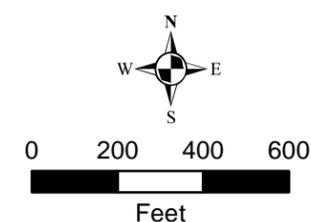
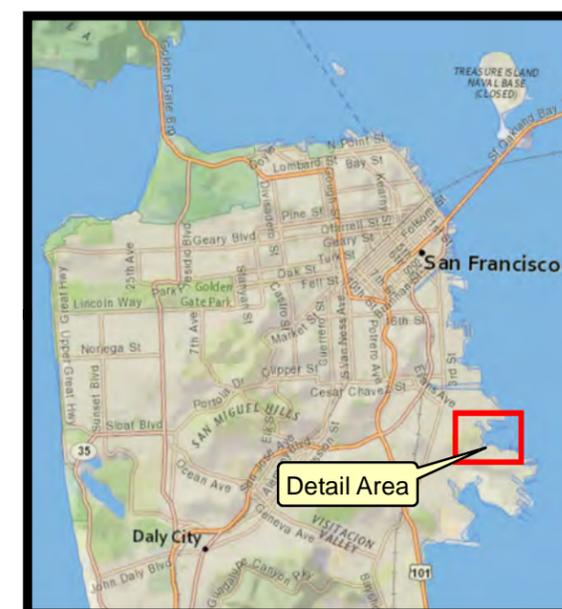


Map Prepared Date: 7/2/2015
Map Prepared By: dchan
Base Source: San Francisco City/County
Data Source(s): WRA

India Basin
Sea Level Rise Analysis
San Francisco, California



-  Study Area - 131.06 acres
-  1' above existing pickleweed - 3.53 acres
-  2' above existing pickleweed - 6.92 acres

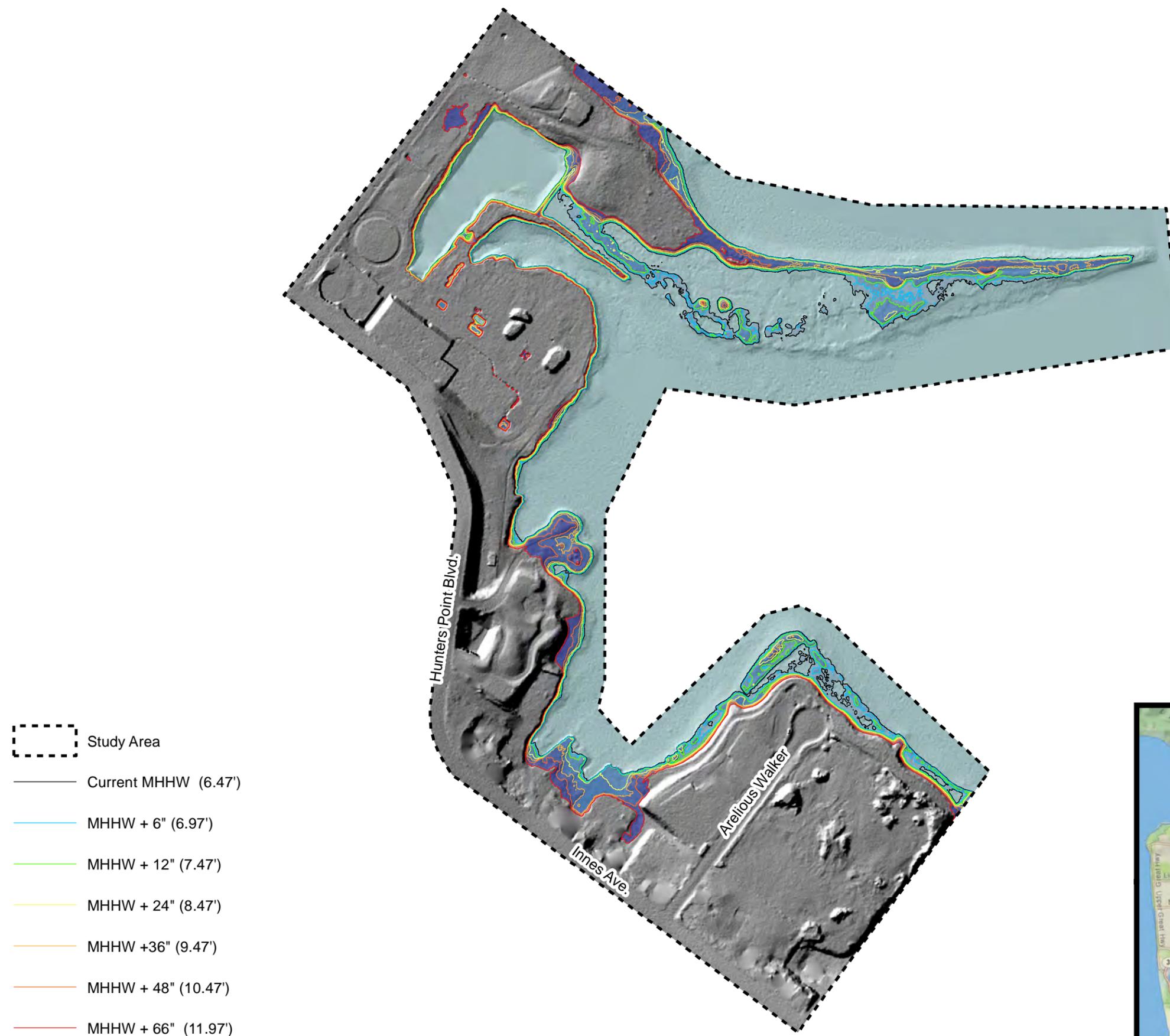


Map Prepared Date: 7/6/2015
Map Prepared By: dchan
Base Source: San Francisco City/County
Data Source(s): WRA

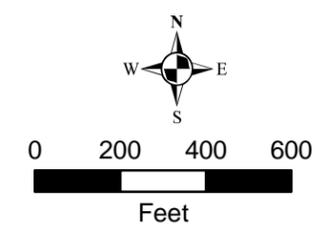
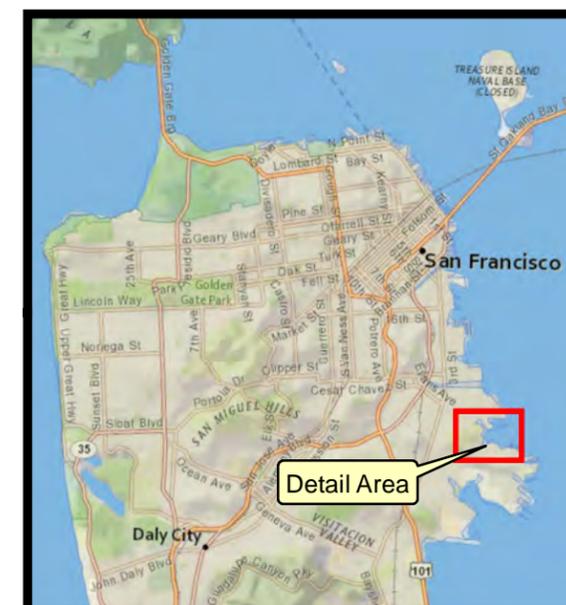
Figure 4.
Potential
Locations for
Tidal Marsh
Creation Based
on Proximity to
Existing Tidal
Marsh
Elevations.

India Basin
Sea Level Rise Analysis
San Francisco, California

Figure 5.
Projected Sea Level
Rise by Elevation



-  Study Area
-  Current MHHW (6.47')
-  MHHW + 6" (6.97')
-  MHHW + 12" (7.47')
-  MHHW + 24" (8.47')
-  MHHW + 36" (9.47')
-  MHHW + 48" (10.47')
-  MHHW + 66" (11.97')



Map Prepared Date: 7/2/2015
 Map Prepared By: dchan
 Base Source: San Francisco City/County
 Data Source(s): WRA