Appendix E

Colma Marsh

Introduction

Colma Creek Public Shore contains Colma marsh (hereafter Colma) and is located in south San Francisco Bay just north of San Francisco International Airport. It is fed by Colma Creek which has its headwaters at San Bruno Mountain. Colma owned and maintained by the Port of San Francisco in San Mateo County. Colma provides important habitat for migratory shorebirds and the federally-endangered California clapper rail (*Rallus longirostris obsoletus*).

This study focused on 24.6 ha of marsh. Beginning In 2006, a herbicide treatment was applied to the marsh in an attempt to control the invasive *Spartina densiflora* and the *S. densiflora* x *S. foliosa* hybrid. As a result from this treatment vegetation at Colma was extremely sparse, therefore vegetation surveys were not conducted. Elevation surveys were done in 2010 using an RTK GPS and to monitor tidal inundation a water level logger was deployed in 2010.

Results

Elevation surveys

A total of 537 elevation measurements were taken at Colma (Fig. E-1). The elevation range 0.38 - 2.31 m with a mean of 1.38 m (NAVD88). Over half (67%) of the survey points fell within 1.01-1.61 m, with a 0.6 m range. Colma is the lowest marsh surveyed in this study with 87% of the elevation points taken located below mean high water (MHW; Fig E-2). A 3-m resolution elevation model was developed in ArcGIS 9.3 (ESRI, Redlands, CA) Spatial Analyst using the Kriging method (Fig.

3). This baseline elevation model was used as the initial elevation in the WARMER sea-level rise (SLR) model.

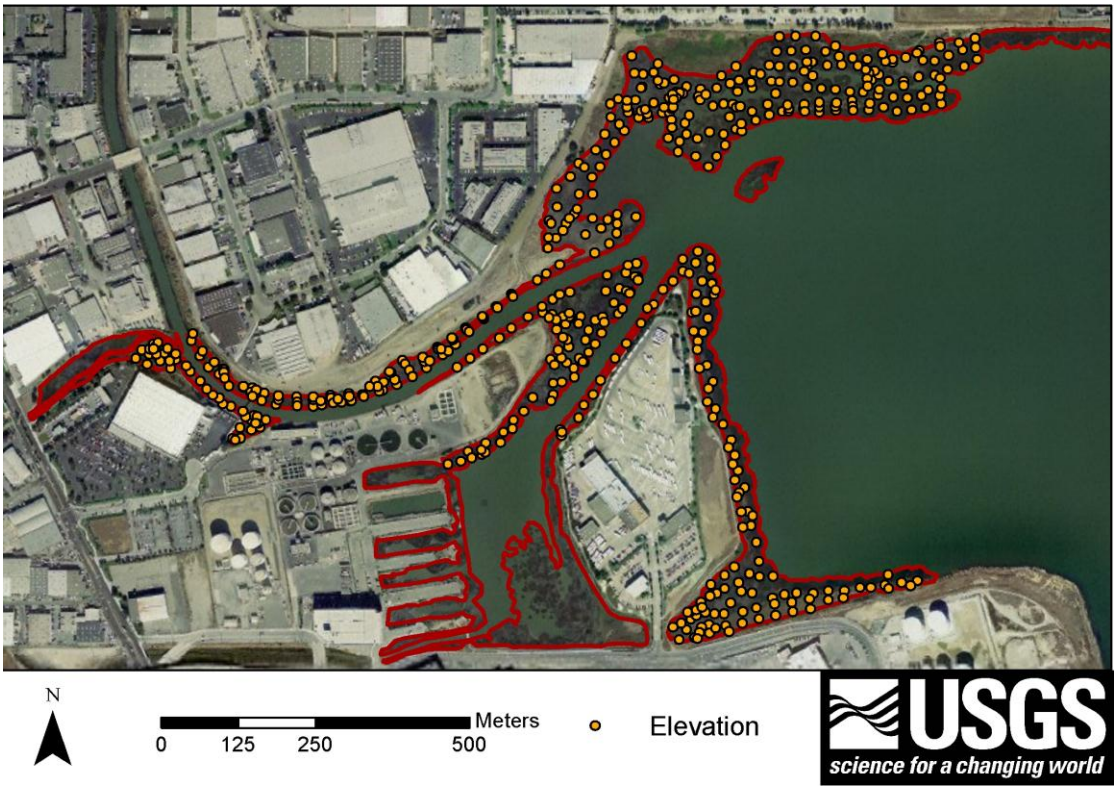

Figure E-1. Colma marsh with elevation survey points taken in 2010.

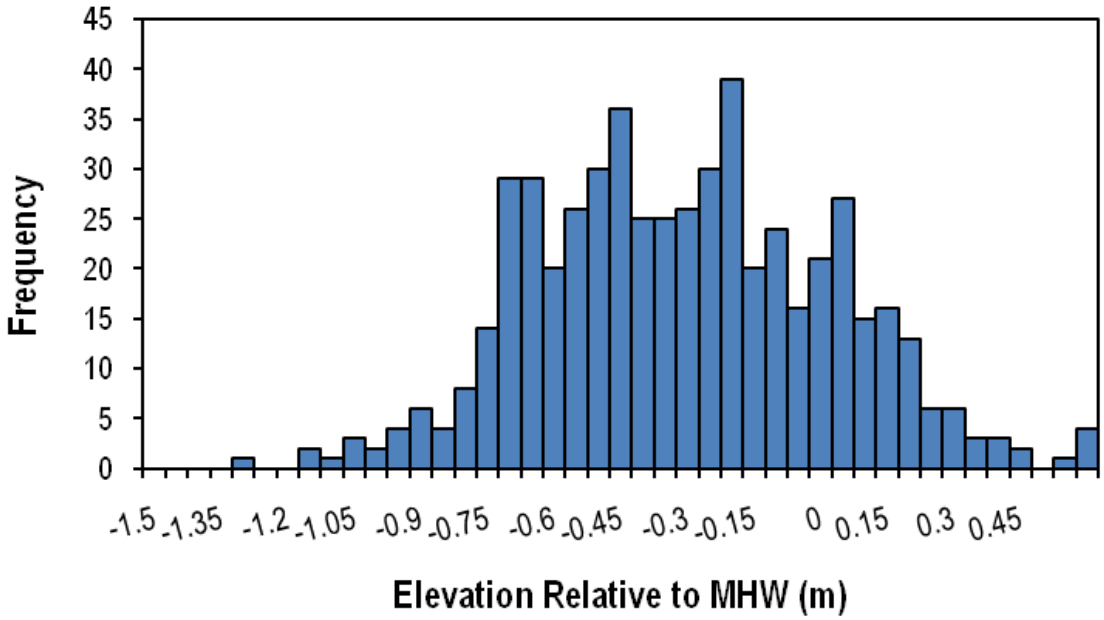

Figure E-2. Distribution of elevation relative to local mean high water (MHW) at Colma.

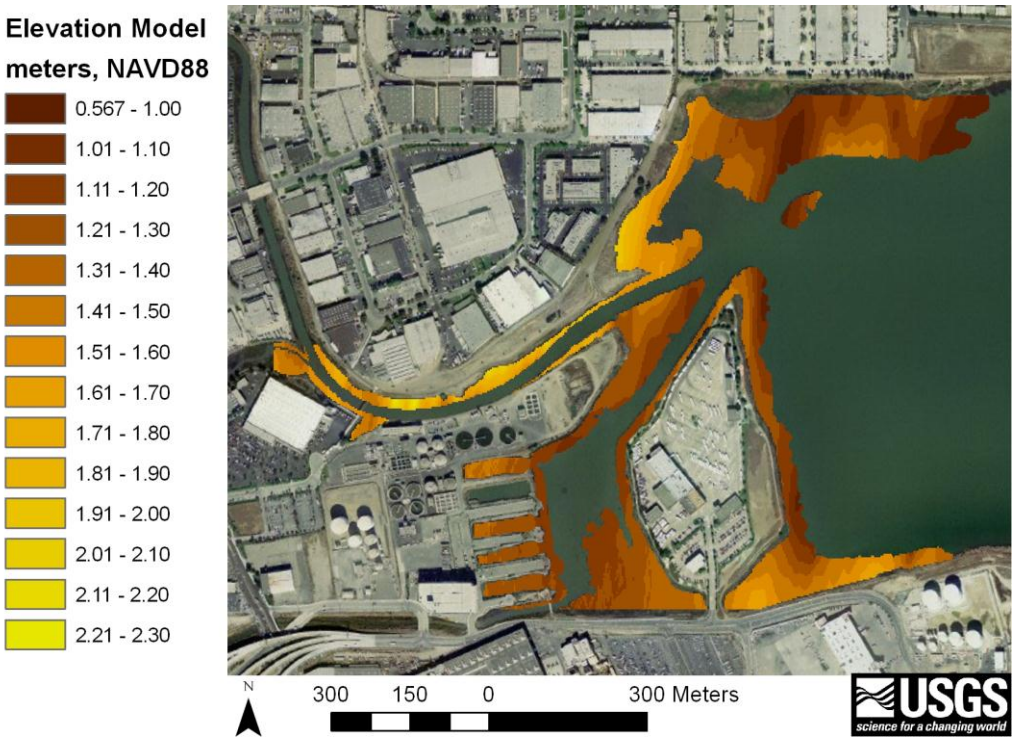

Figure E-3. Elevation model (3-m resolution) developed from ground RTK GPS elevation data.

Water level monitoring

Site-specific water level was monitored at Colma in 2010. Water level was measured using one logger deployed in a second order channel. We found MHW at 1.77 m and mean higher high water (MHHW) at 1.97 m for the site (NAVD88). Water levels throughout the year were recorded to evaluate seasonal patterns in tides. The marsh platform (defined as mean marsh elevation) was inundated most often from January 2010 through February 2010 (Fig. E-5). Those recorded above average water levels due to several record-breaking storms that brought low air pressure and substantial rainfall, resulting in higher-than-predicted tides. The cumulative rainfall in January 2010 was above average throughout the San Francisco bay area and daily rainfall records were broken in some locations (NOAA). This resulted in longer inundation periods of the marsh platform.

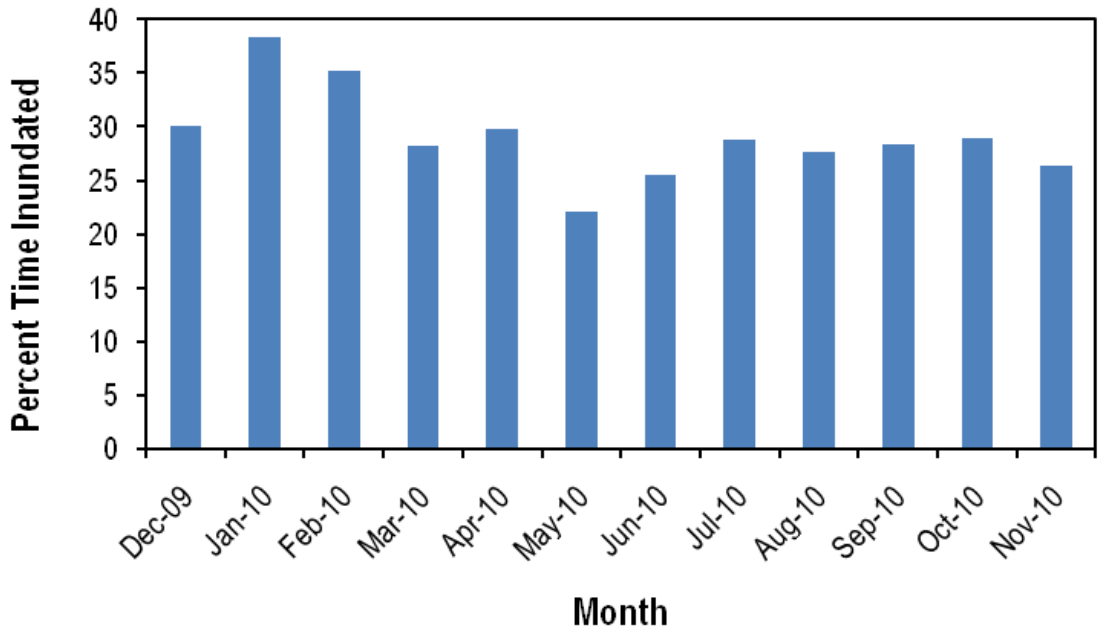

Figure E-5. Percent of time Colma was inundated monthly. Based on the mean elevation of the marsh platform.

Marsh elevation modeling

WARMER results indicate that Colma will keep pace with local SLR through this century (Fig. E-5 – E-6). Initial elevation is below MHW and is projected to increase slightly to 2060 (+ XX m SLR), and begins to decline (Fig. E.6). Colma does not reach MHW elevations throughout the century. WARMER projects that elevation relative to MSL peaks at ~2050, at which time the SLR curve goes exponential and the marsh begins subsiding elevation (Fig. E-6).

Vegetation data from the other 11 sites were categorized as mudflat, low, mid, high marsh, or upland transition plant communities (Table 4) and used to interpret the WARMER SLR results (Figs. D-8 – D-9). Upland transition (> 1.0 m MSL), is characterized by coyote bush (*Baccharis pilularis*). High marsh (0.7 – 1.0 m MSL), is characterized by *Frankenia salina* and *Jaumea carnosa*, while mid marsh (0.45 – 0.7 m MSL), is dominated by *Sarcocornia pacifica.* Low marsh

(0.2 – 0.45 m MSL), is characterized by *Spartina spp.* or *Scirpus spp.* in brackish areas. Mudflat habitat (< 0.2 m MSL), is unvegetated or sparsely covered with *Spartina spp.*

Assuming that high sediment deposition occurs, Colma is projected to transition from a mudflat to mid marsh plant community by 2030 (Figs. E-7 – E-8). By 2100, Colma is projected to be comprised primarily of low marsh. The high suspended sediment concentrations which occur in south San Francisco Bay may allow Colma to maintain elevation relative to SLR. However, the absence of established vegetation due to the herbicide treatment could result in erosion and loss of the sediment trapping ability. As a result of the chemical treatment, Colma currently functions as a mudflat.

The WARMER model parameters for Colma were extrapolated using sediment core data near Laumeister marsh, thus predictions should be interpreted with caution as local sedimentation processes are likely very different between these marshes. To improve results, local site-specific sediment core data could be collected, along with suspended sediment concentrations to characterize sediment deposition potential.

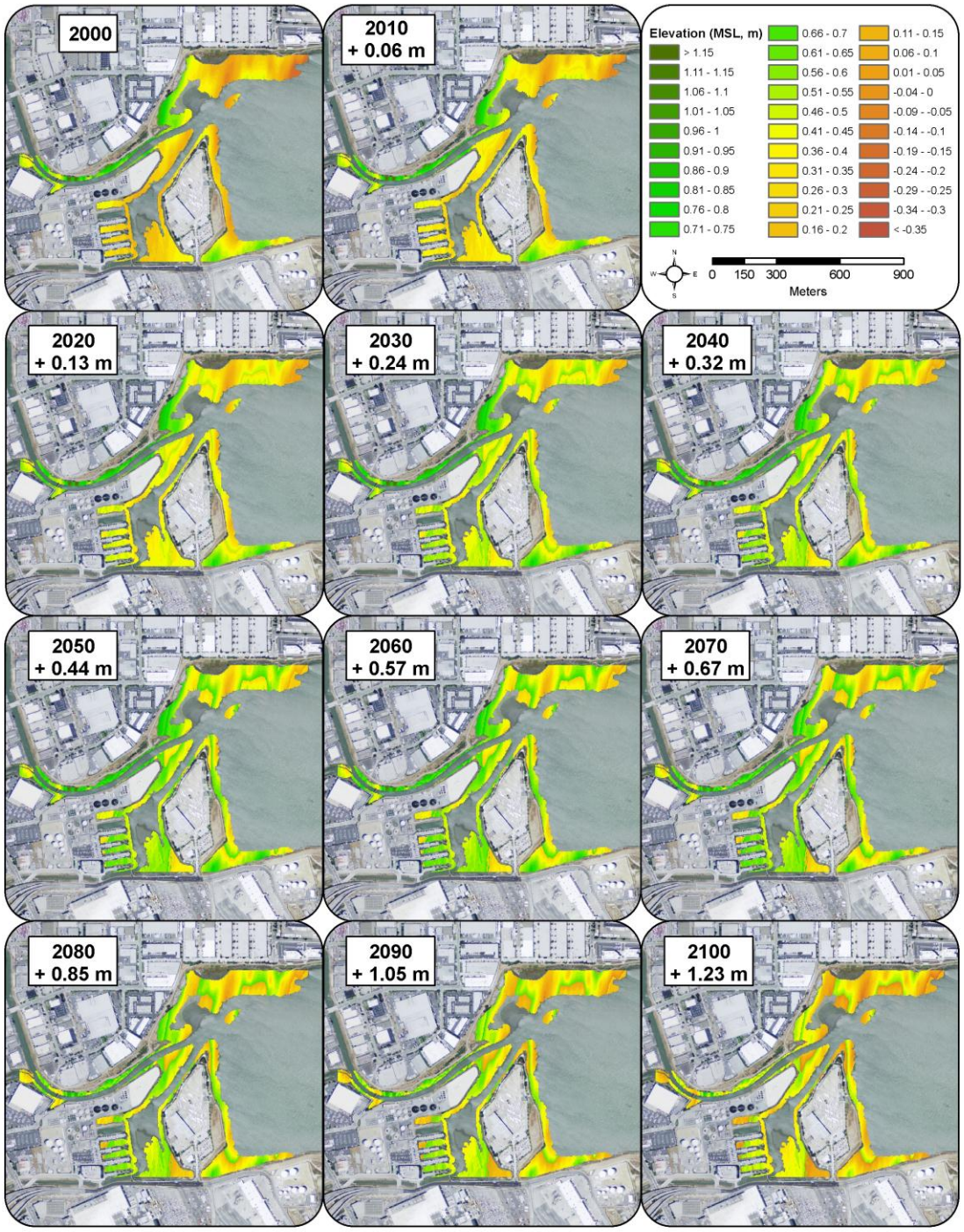

Figure E-5. WARMER results for Colma. WARMER accounts for changes in relative seal-level, subsidence, inorganic sediment accumulation, above/below ground organic matter productivity, compaction, and decay. Non-linear sea-level rise projections for California were used (Cayan *et al.* 2009).

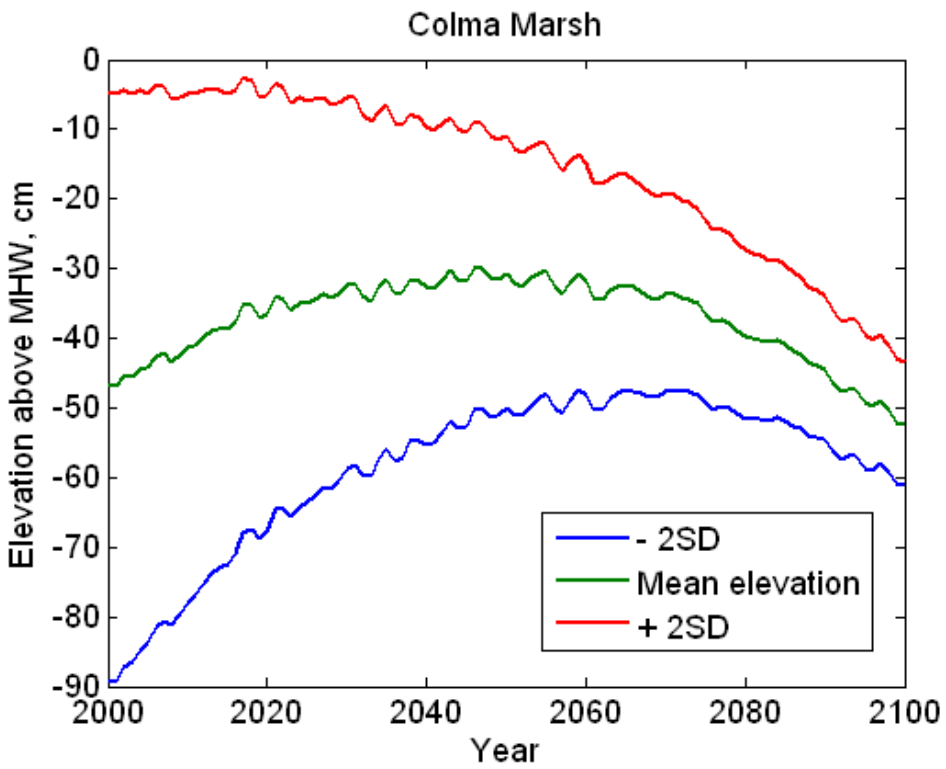

Figure E-6. WARMER scenarios for marsh elevation change at Colma. Elevation above MHW is plotted versus model year with two standard deviations (SD).

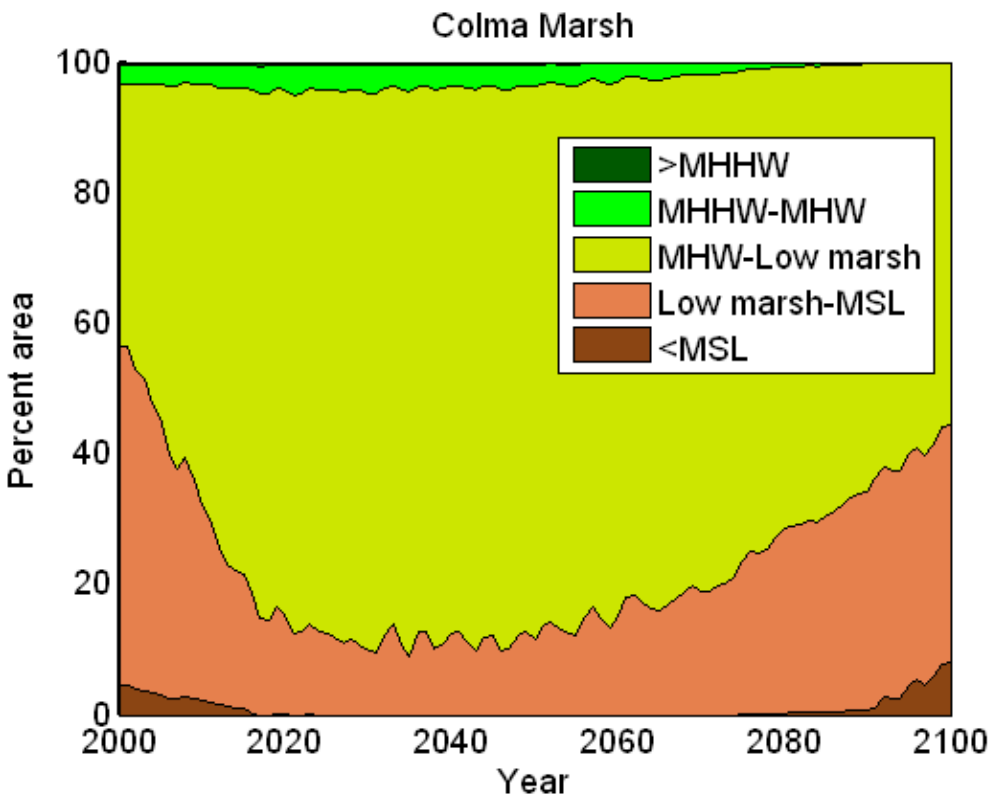

Figure E-7. Area of Colma within a given tidal range for the duration of the simulation period.

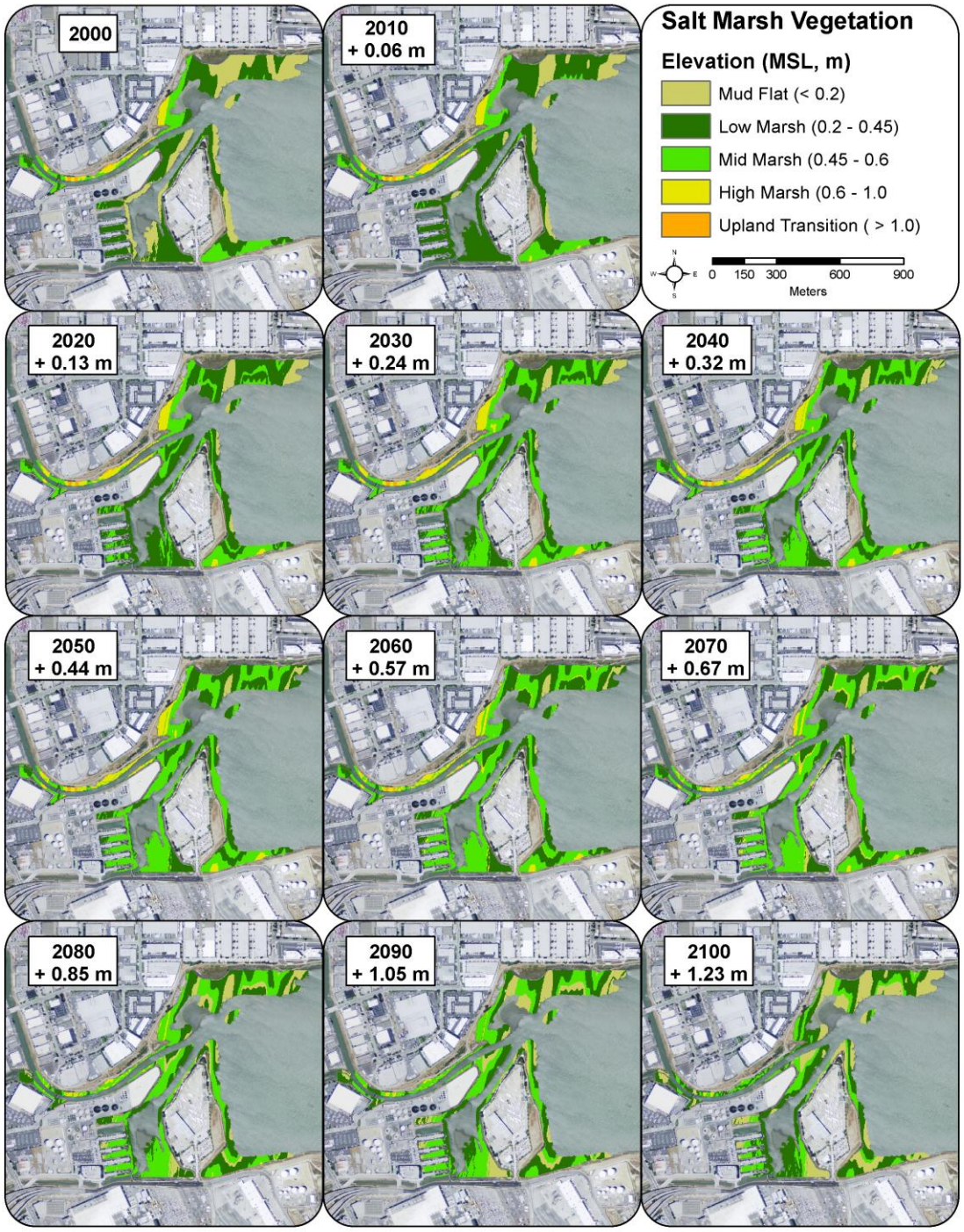

Figure E-8. Colma WARMER results in terms of plant communities which were determined from vegetation data. Upland transition (> 1.0 m MSL) is characterized by coyote bush (*Baccharis pilularis*). High marsh (0.7 – 1.0 m MSL) is characterized by *Frankenia salina* and *Jaumea carnosa*, while mid marsh (0.45 – 0.7 m MSL) is dominated by *Sarcocornia pacifica.* Low marsh (0.2 – 0.45 m MSL) is characterized by *Spartina spp.* or *Scirpus spp.* in brackish areas. Mudflat habitat (< 0.2 m MSL) is unvegetated or sparsely covered with *Spartina spp.*