

Appendix D: Sea Level Rise Inundation Maps

Prepared by

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Overview | This set of sea level rise maps integrates GIS information on facilities, roads, and other park features for the subset of parks that staff chose to view during regional workshops with agency staff. The maps show areas potentially affected by +1 foot and +2 feet of sea level rise relative to the ordinary high tide (the Mean High High Water mark, or MHHW). A storm surge value of +3 feet is also mapped. This storm surge level is the approximate value of the observed 1% annual probability water level (i.e., the 100-year storm tide) for the Puget Sound region and outer Washington coast, excluding Toke Point, and relative to MHHW (Zervas 2005; see also, NOAA Extreme Water Levels⁹¹). Surge at individual locations will vary slightly from this value; the value for Toke Point is considerably higher: +5.7 feet (Zervas 2005). Research does not project any change in maximum storm surge at this time, however higher sea level will increase the potential for damage by storm surge by allowing surge to reach further inland.

The +1 and +2 foot sea level rise values shown on the maps are proximate to or within the current range of sea level rise projected for Washington by 2050 (mean of +6 in. with a range of -1 to +19 in.) and 2100 (mean of +24 in. with a range of +4 to +56 in.) (NRC 2012). A third representation of potential sea level rise risk is found by combining the value of the mean increase in sea level rise for 2100 (+2 feet) with the +3 feet storm surge level. This combined value (+5 feet, or +60 inches) illustrates areas that could be permanently inundated by the current upper estimate for sea level rise in 2100 (+56 inches).

It is important to remember that while the maps are useful for showing areas that are likely to be permanently inundated or affected by higher surge, the maps are not able to capture the dynamic effects of coastal erosion and bluff sloughing. These processes can influence how sea level rise affects a park by changing the shape of a coastline over time and altering sediment movement in the nearshore. This also means that the size of the projected inundation/storm surge zones should not be the sole determinant for interpreting how sea level rise affects parks. This is particularly true in the Puget Sound region, where many beaches are narrow and backed by coastal bluffs.

The maps for individual parks were created using just two data sources: Washington State Parks GIS data and NOAA Sea Level Rise data.

The Parks GIS data consists of 6 geodatasets available at <http://biz.parks.wa.gov/gis/>:

1. Accommodation Features,
2. Boundaries,
3. Facility Inventory,
4. Roadways,
5. Trails, and
6. Walkways

Boundaries, Trails, and Walkways were mapped as provided. Roadways were mapped in three categories, park, campground, and public roads. The Facility Inventory was also mapped in three categories: Historic, > 1000 square feet, and < 1000 square feet. The Accommodation Features dataset contains a wide variety of types of features. All of the structures in the Facility Inventory were also in the Accommodation Features, so these were screened out of the Accommodation Features so they would not be mapped twice. Also, minor features such as picnic tables and fire rings were screened out and

⁹¹ Available at: <https://tidesandcurrents.noaa.gov/est/>

not mapped. About half of the remaining Accommodation Features are parking, so these were mapped with a 'P' symbol. The rest of the Accommodation Features were grouped together and mapped as a point feature.

Data Source

The Sea Level Rise data was downloaded from the NOAA Office for Coastal Management (<https://coast.noaa.gov/digitalcoast/tools/slr.html>). The website has extensive documentation as to how the data were developed. In summary, their goals were to:

- Use best publically available and accessible elevation data
- Map literature-supported levels of sea level rise
- Map sea level rise on top of mean higher high water (MHHW)
- Incorporate local and regional tidal variation of MHHW for each area
- Evaluate inundation for hydrological connectivity

Unfortunately, either the elevation data or the determination of MHHW for the Washington state outer coast was flawed, such that the mapping results for the parks in the beach zone were incorrect. Also, NOAA did not map the northern portion of the San Juan Islands, so that we cannot provide sea level rise maps for the parks on Patos, Sucia, Stuart, Matia and Clark Islands. These issues has been reported to NOAA and will hopefully be addressed in a future revision of their dataset.

A handful of park maps contain data from a third source, the National Hydrography Dataset, where there are lakes or wetlands in the park (e.g., Deception Pass).

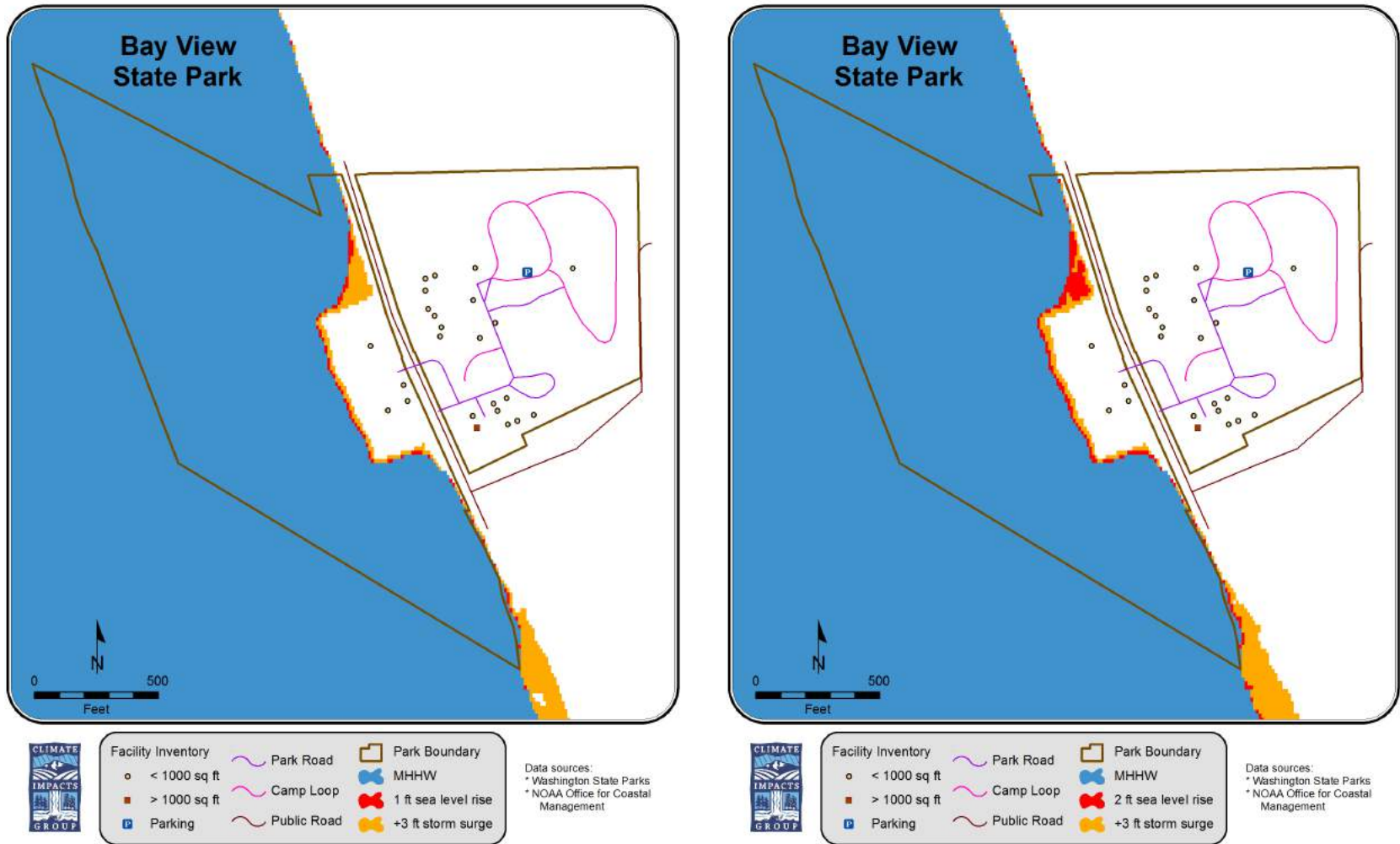


Figure 1. Sea level rise maps for *Bay View State Park*. The +1 and +2 foot sea level rise values shown on the maps are proximate to or within the current range of sea level rise projected for Washington for 2050 (mean of +6 in. with a range of -1 to +19 in.) and 2100 (mean of +24 in. with a range of +4 to +56 in.) (NRC 2012). A 1% annual probability storm surge value of +3 feet is also mapped. The maps do not capture the dynamic effects of coastal erosion and bluff sloughing, which can affect the reach of inundation zones over time. Figure source: R. Norheim, UW Climate Impacts Group.

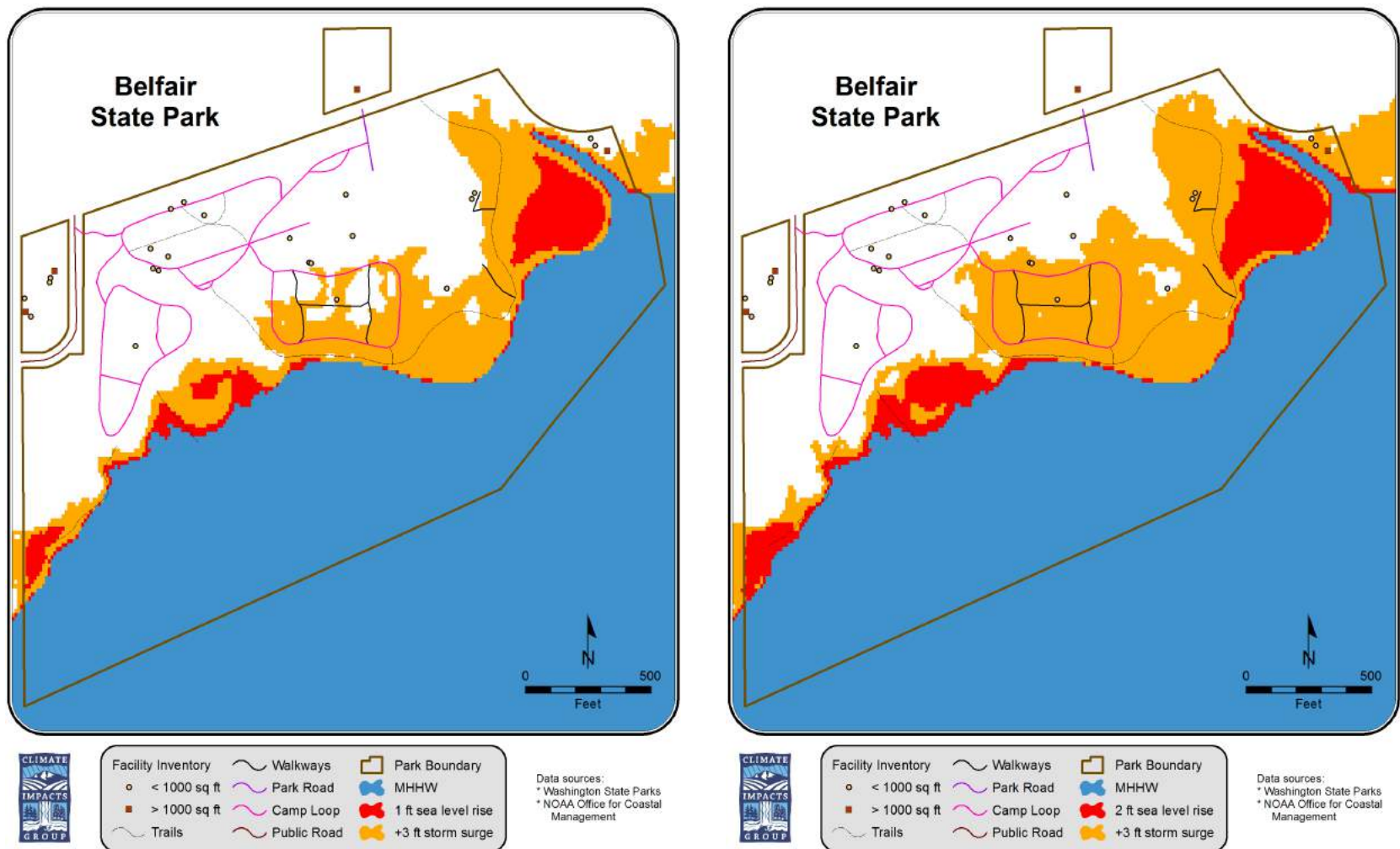


Figure 2. Sea level rise maps for *Belfair State Park*. The +1 and +2 foot sea level rise values shown on the maps are proximate to or within the current range of sea level rise projected for Washington for 2050 (mean of +6 in. with a range of -1 to +19 in.) and 2100 (mean of +24 in. with a range of +4 to +56 in.) (NRC 2012). A 1% annual probability storm surge value of +3 feet is also mapped. The maps do not capture the dynamic effects of coastal erosion and bluff sloughing, which can affect the reach of inundation zones over time. Figure source: R. Norheim, UW Climate Impacts Group.

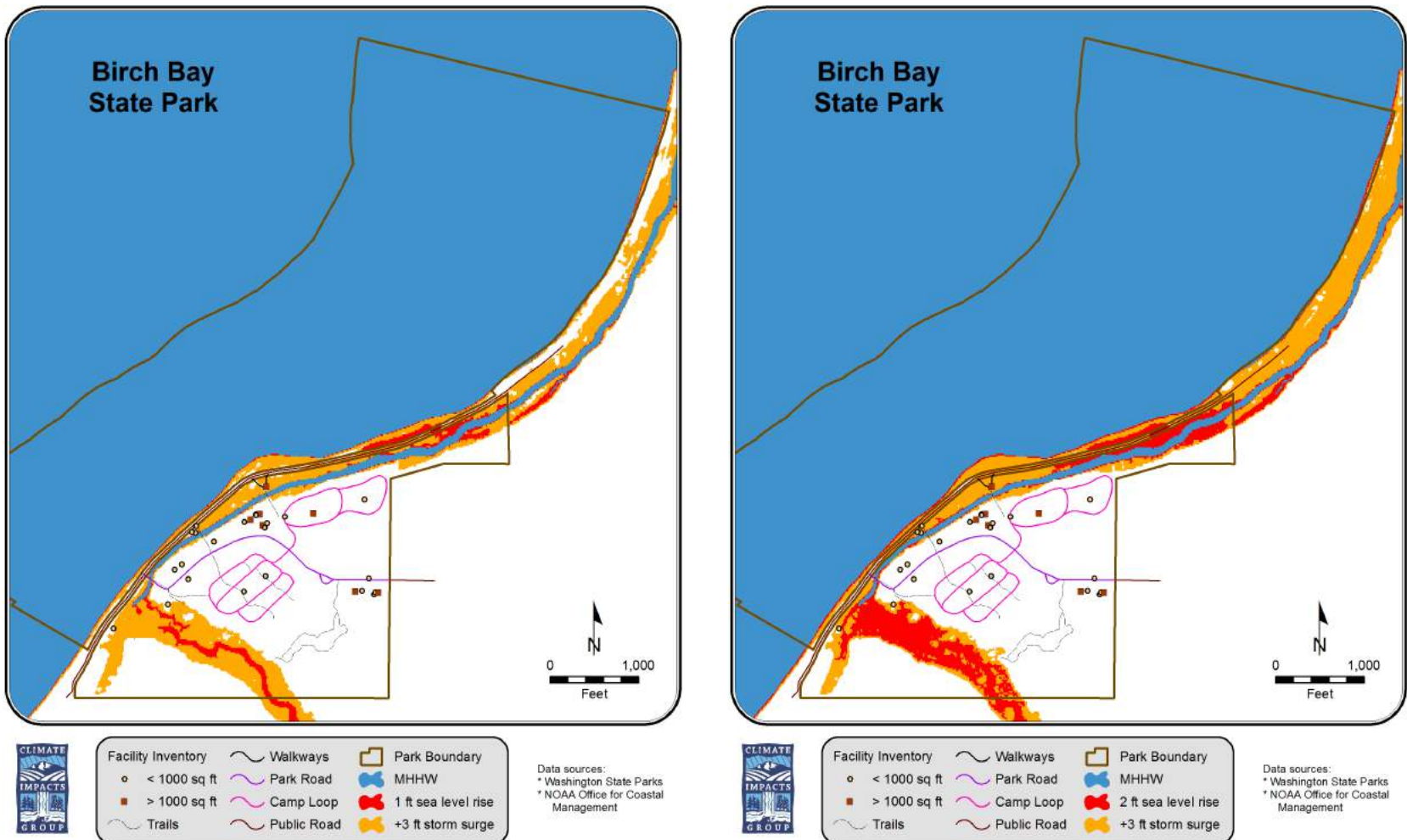


Figure 3. Sea level rise maps for *Birch Bay State Park*. The +1 and +2 foot sea level rise values shown on the maps are proximate to or within the current range of sea level rise projected for Washington for 2050 (mean of +6 in. with a range of -1 to +19 in.) and 2100 (mean of +24 in. with a range of +4 to +56 in.) (NRC 2012). A 1% annual probability storm surge value of +3 feet is also mapped. The maps do not capture the dynamic effects of coastal erosion and bluff sloughing, which can affect the reach of inundation zones over time. Figure source: R. Norheim, UW Climate Impacts Group.

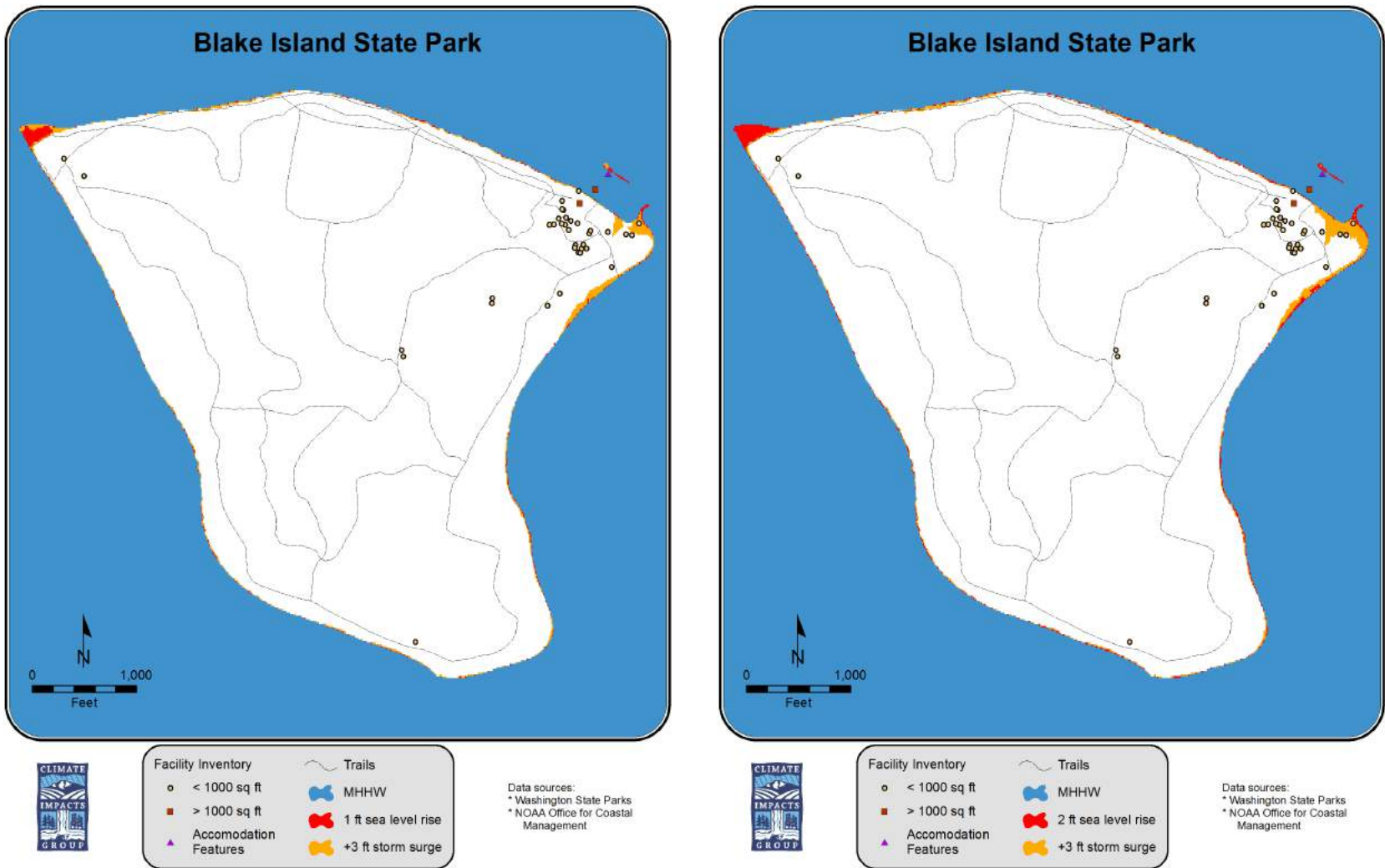


Figure 4. Sea level rise maps for *Blake Island State Park*. The +1 and +2 foot sea level rise values shown on the maps are proximate to or within the current range of sea level rise projected for Washington for 2050 (mean of +6 in. with a range of -1 to +19 in.) and 2100 (mean of +24 in. with a range of +4 to +56 in.) (NRC 2012). A 1% annual probability storm surge value of +3 feet is also mapped. The maps do not capture the dynamic effects of coastal erosion and bluff sloughing, which can affect the reach of inundation zones over time. Figure source: R. Norheim, UW Climate Impacts Group.

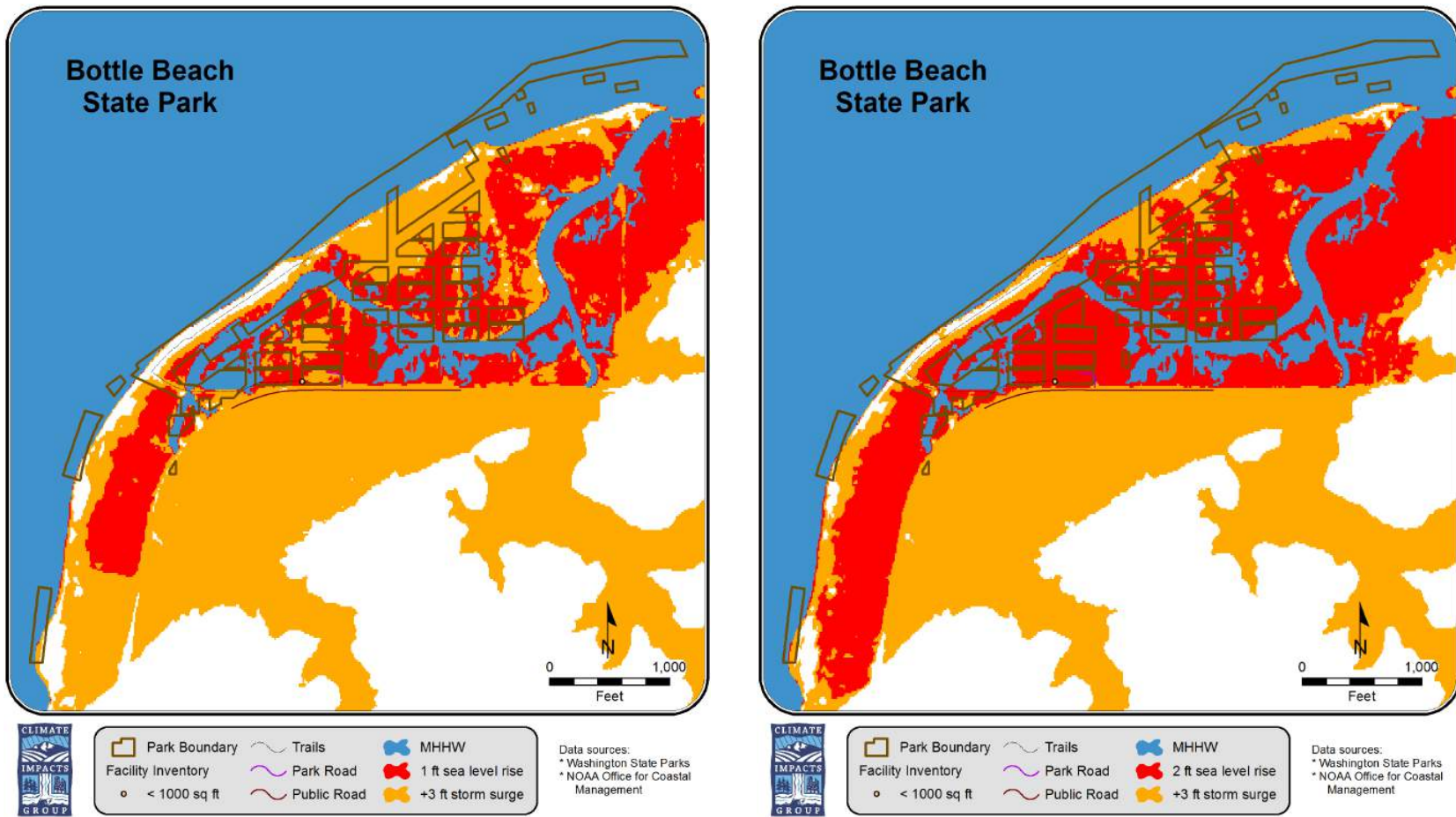


Figure 5. Sea level rise maps for *Bottle Beach State Park*. The +1 and +2 foot sea level rise values shown on the maps are proximate to or within the current range of sea level rise projected for Washington for 2050 (mean of +6 in. with a range of -1 to +19 in.) and 2100 (mean of +24 in. with a range of +4 to +56 in.) (NRC 2012). A 1% annual probability storm surge value of +3 feet is also mapped. The maps do not capture the dynamic effects of coastal erosion and bluff sloughing, which can affect the reach of inundation zones over time. Figure source: R. Norheim, UW Climate Impacts Group.

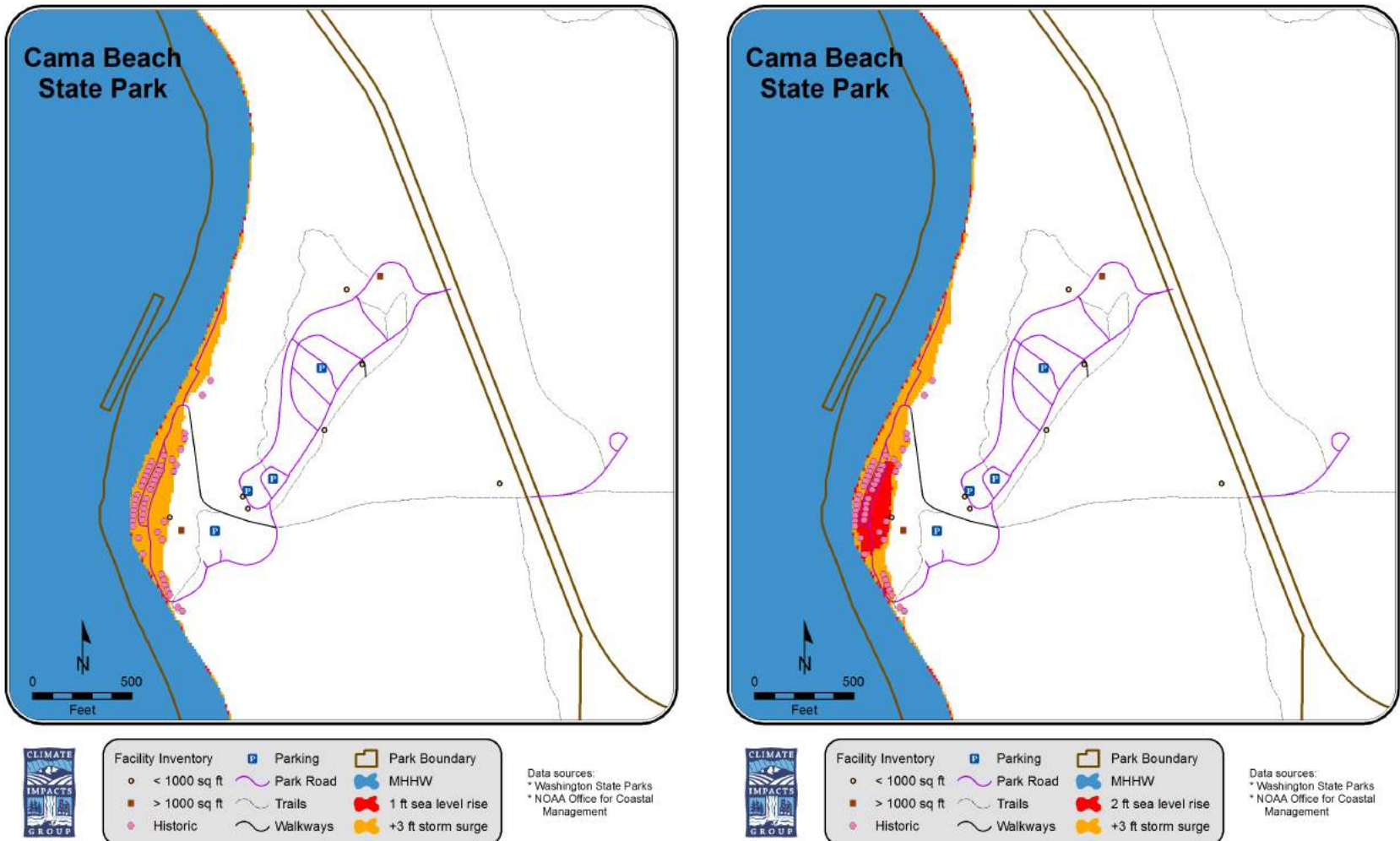


Figure 6. Sea level rise maps for *Cama Beach State Park*. The +1 and +2 foot sea level rise values shown on the maps are proximate to or within the current range of sea level rise projected for Washington for 2050 (mean of +6 in. with a range of -1 to +19 in.) and 2100 (mean of +24 in. with a range of +4 to +56 in.) (NRC 2012). A 1% annual probability storm surge value of +3 feet is also mapped. The maps do not capture the dynamic effects of coastal erosion and bluff sloughing, which can affect the reach of inundation zones over time. Figure source: R. Norheim, UW Climate Impacts Group.

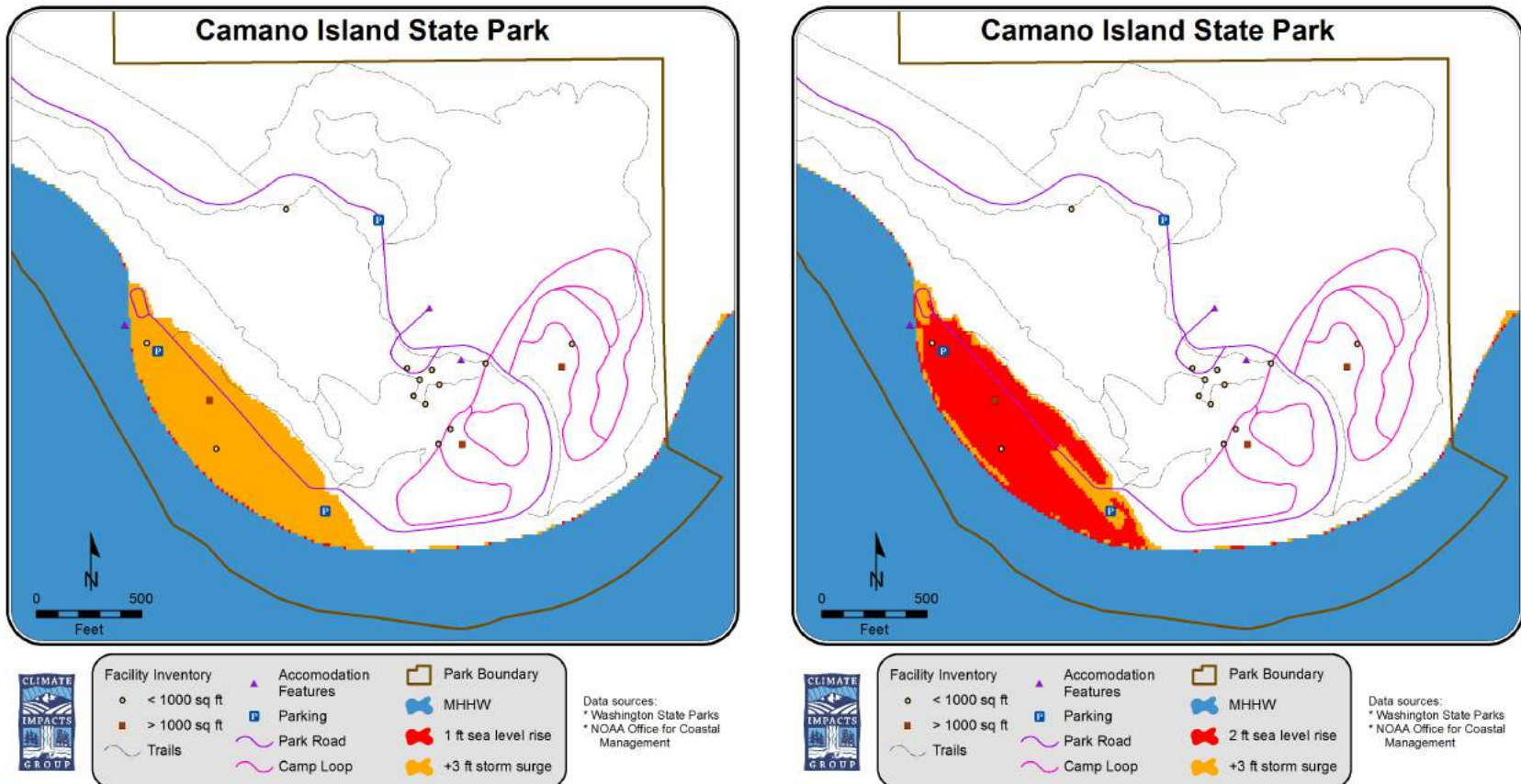


Figure 7. Sea level rise maps for *Camano Island State Park*. The +1 and +2 foot sea level rise values shown on the maps are proximate to or within the current range of sea level rise projected for Washington for 2050 (mean of +6 in. with a range of -1 to +19 in.) and 2100 (mean of +24 in. with a range of +4 to +56 in.) (NRC 2012). A 1% annual probability storm surge value of +3 feet is also mapped. The maps do not capture the dynamic effects of coastal erosion and bluff sloughing, which can affect the reach of inundation zones over time. Figure source: R. Norheim, UW Climate Impacts Group.

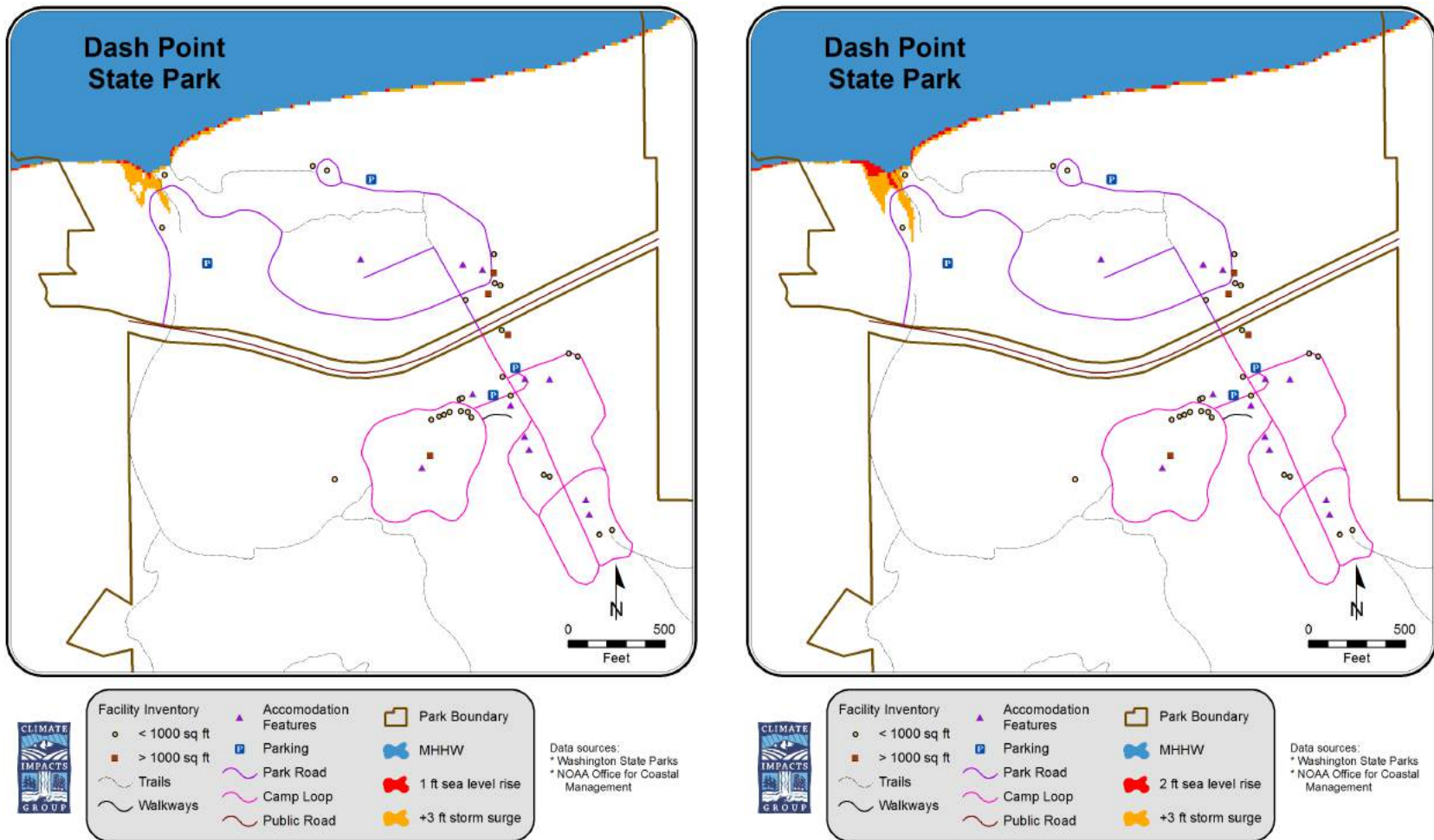


Figure 8. Sea level rise maps for *Dash Point State Park*. The +1 and +2 foot sea level rise values shown on the maps are proximate to or within the current range of sea level rise projected for Washington for 2050 (mean of +6 in. with a range of -1 to +19 in.) and 2100 (mean of +24 in. with a range of +4 to +56 in.) (NRC 2012). A 1% annual probability storm surge value of +3 feet is also mapped. The maps do not capture the dynamic effects of coastal erosion and bluff sloughing, which can affect the reach of inundation zones over time. Figure source: R. Norheim, UW Climate Impacts Group.

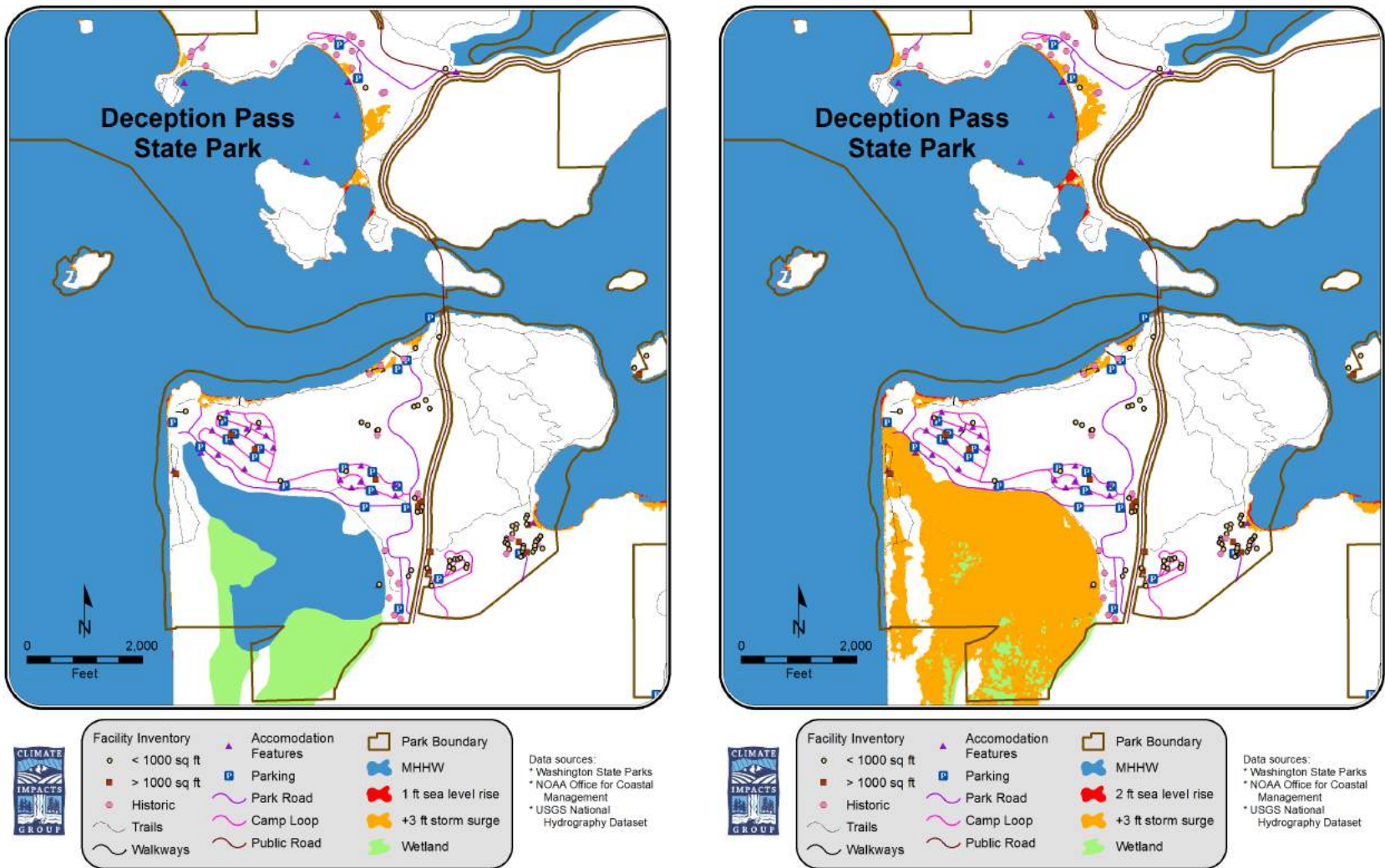


Figure 9. Sea level rise maps for *Deception Pass State Park*. The +1 and +2 foot sea level rise values shown on the maps are proximate to or within the current range of sea level rise projected for Washington for 2050 (mean of +6 in. with a range of -1 to +19 in.) and 2100 (mean of +24 in. with a range of +4 to +56 in.) (NRC 2012). A 1% annual probability storm surge value of +3 feet is also mapped. The maps do not capture the dynamic effects of coastal erosion and bluff sloughing, which can affect the reach of inundation zones over time. Figure source: R. Norheim, UW Climate Impacts Group.