MES Analytical Essay

California Mitigation Projects for Sea Level Rise

Sea Level Rise (SLR) refers to the rise of the ocean due to thermal expansion and glacial melt and these factors have been exacerbated by the anthropogenic effects of climate change and an increase in global pollution (NOAA 2019). Sea Level is rising at about one-eighth of an inch per year. Communities that are experiencing SLR experience things such as beach erosion, nuisance flooding, and loss of homes and livelihoods. As the need for development increases and the shoreline decreases it is becoming increasingly important to for coastal cities to have adaptive infrastructure and mitigation plans. The Nature Conservancy did a study on California's coastal infrastructure specifically analyzing California's mitigation and adaptation strategies for Sea Level Rise (Conservancy, 2019). California coastlines are not only a popular tourist attraction but are also home to millions of people. Sea level off the California coastline is roughly 6 inches higher than it was in 1950 and is projected to rise one inch every 10 years ("California's Sea Level is Rising"). In figure 1 below you can see the rapid and continuous rise in sea level in the San Francisco Bay. California has five major projects they are working on to mitigate SLR and below I discuss four of the mitigation strategies. The projects are the; San Francisco Bay Living Shorelines: Nearshore Linkages Project, Surfers' Point Managed Shoreline Retreat Project, Seal Beach National Wildlife Refuge: Thin-layer Salt Marsh Sediment Augmentation and the Hamilton Wetland Restoration Project. (Conservancy, 2019). Each of these projects demonstrate successful strategies to mitigate Sea Level Rise.

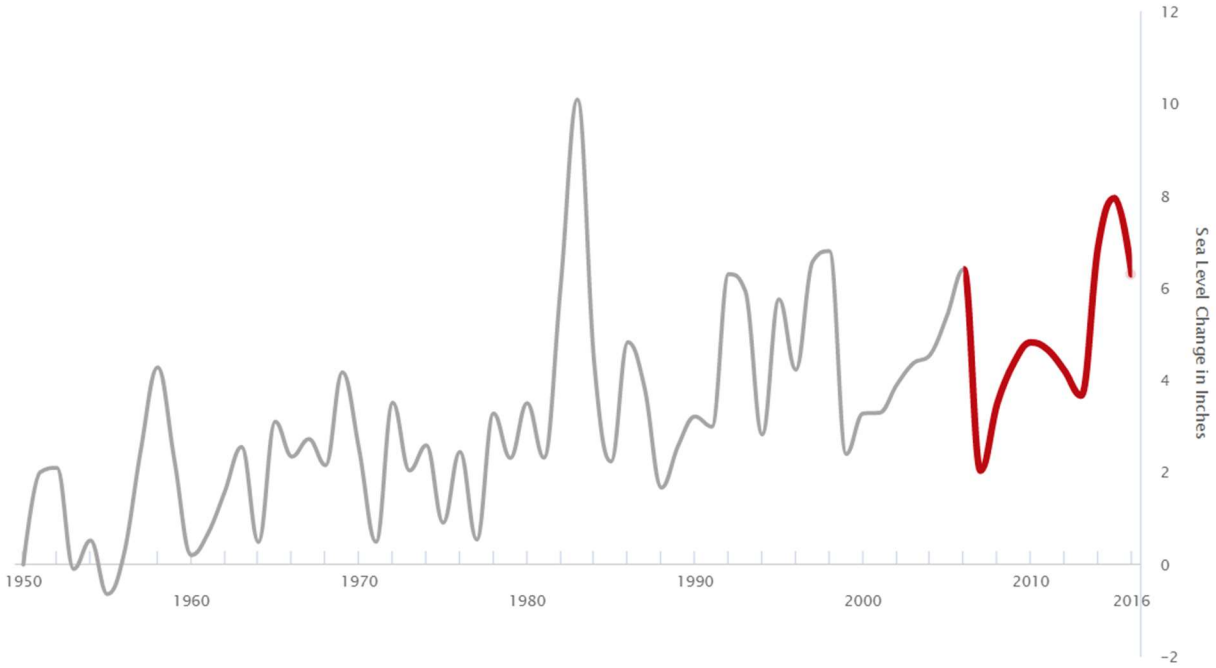

Figure 1: This graph from Sea Level Rise.Org shows the Sea level measurement from San Francisco area tide gauge since 1950

A mitigation strategy that was used in the San Francisco Bay Living Shorelines: Nearshore Linkages Project examined how the native ecosystems such as oyster reefs and eelgrass can protect the shoreline ecosystems by minimizing coastal erosion, maintain coastal processes all while protecting the natural habitat for fish and marine life. The objective is to create "biologically rich and diverse subtidal and low intertidal habitats" while reducing the negative effects of SLR (Conservancy, 2019). This strategy could be easily implemented by coastal cities around the world to preserve coastline vitality. Utilizing the natural environment like this also serves to support marine and aquatic ecosystems while also mitigating hazards like SLR, hurricanes and tsunamis. The benefits of this project include habitat restoration, food and nesting

resources for aquatic and bird species, erosion prevention, accretion of sediment and reduced wave energy ("Conservancy, 2019"). This strategy can be especially helpful for coastal low-income communities because it is relatively inexpensive and nearly self-sufficient after initial startup.

The California Bay Area transformed built infrastructure into natural infrastructure such as sand dunes in order to reduce the effects of SLR. The Surfers' Point Managed Shoreline Retreat Project turned a decaying bike path and parking lot into cobble beach front backed by sand dunes. This project was suggested by surfers who utilize the beach for recreation. Transforming coastlines into practical and sustainable infrastructure promotes tourism and provides flood protection, recreation, habitat restoration, improved water quality, lower erosion risk, and improved coastal access and aesthetics benefits. This mitigation action works to reduce the harmful effects of hazards and provides benefits such as habitat restoration and increased recreational use through natural environment restoration ("Conservancy, 2019").

The Hamilton Wetland Restoration project and the Seal Beach National Wildlife Refuge projects are working to combat SLR similarly, by using dredged materials to restore site elevation to marsh plains. These projects include "intertidal berms to slow down wind-generated waves, and allow suspended sediment carried into the site to deposit naturally" ("Conservancy, 2019"). This process essentially creates a larger barrier between water and sand creating a buffer for waves eroding the beach front. This mitigation method is the fastest way to revive marsh plains which helps restore habitats, including tidal marsh, seasonal wetlands, and transition zones. It also includes flood protection for adjacent areas while supporting complete system of tidal marsh to upland transition zones ("Conservancy, 2019"). This technique reduces the

detrimental impacts of natural hazards which can make communities less vulnerable and more resilient when disaster strikes.

These mitigative actions are suitable strategies for California coastlines to address SLR and related hazards. The mitigation technique used to restore oyster reefs and eelgrass in order to reduce coastal erosion and increase marine ecosystems is an effective technique, because it not only reduces the impacts of the disaster, but also creates and maintains marine ecosystems by creating habitats for fish and wildlife. This project is relatively inexpensive costing approximately $5 million including the initial work as well as all maintenance costs. The mitigation action that uses dredging to create levees and sand dunes is also very successful and has the potential for the quickest results because it would elevate the site, prevent flooding, and restore natural habitats, however this project is more costly than other mitigation strategies. The third possible mitigation action is beneficial because it takes infrastructure that is decaying or dilapidated and transforms it into natural features such as sand dunes, which can prevent or reduce the effects of Sea level Rise and give access to more recreational space and land for habitat restoration. Additionally, this intervention is not as expensive as dredging, but slightly more expensive than restoring oyster reefs and eelgrass (“Conservancy, 2019”).

Ultimately, the best mitigative technique would be to restore the oyster reefs and eelgrass because it is the least expensive technique and provides benefits for both humans and marine life. The installation of eelgrass and oyster reef plots was completed from July to early August 2012 however, due to timing delay was not successful but was re-planted in April and highly monitored and the 2014 and 2016 hydrographic surveys showed that this mitigation was

successful. Initially over 3 million native oysters returned to the reefs. These reefs also reduced wave energy by roughly 30-50 percent and the newly restored reefs accumulated anywhere between 15 and 24 cm of sediment. This project was also successful for marine wildlife. Results from the project showed that valuable native species such as black oystercatchers, Dungeness crabs, and Steelhead Salmon were quickly drawn to the restoration site ("Coastal Conservancy"). These results support my conclusion that the restoration of oyster reefs and similar ecosystems is the most effective technique for mitigating sea level rise's impacts on marine life and society.

Works Citied

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