



Sea Level Rise and Coastal Flooding Study Memorandum

Sewer Lift Station S-7 Reconstruction Project
Long Beach Public Utility District

Long Beach, CA
July 10, 2026



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1 Introduction

This memorandum summarizes the analysis of tides, flood maps, and future sea level rise (SLR) by compiling and reviewing the publicly available data, flood maps, and guidance documents to support the Long Beach Utilities Department (LBUD) in constructing the Sewer Lift Station S-7 Reconstruction Project (Project).

1.1 Project Background

LBUD operates and maintains over 700 miles of sanitary sewer lines, which deliver wastewater to the Sanitation Districts of Los Angeles County for treatment. The existing Sewer Lift Station S-7 (S-7) is part of the wastewater system owned and operated by LBUD, which helps to manage and transport wastewater within the Belmont Park neighborhood (Figure 1) in the City of Long Beach (City). The existing S-7 is a one-story masonry building with a below-grade dry well and concrete wet well, housing two submersible pumps, piping, and appurtenances. Previous studies found the existing S-7 structurally inadequate, and the Project aims to reconstruct S-7 to meet current standards, ensure reliable wastewater service, provide pump capacity with proper flow velocity, and construct a new force main to enhance system redundancy and access.



Figure 1: Aerial imagery showing part of Belmont Park neighborhood covering Sewer Lift Station S-7, proposed force main alignment, and the Project footprint. The Sewer Lift Station S-7 property is referred to as the “Project Site”.

2 Tidal Analysis

This section summarizes the analysis of tides, as well as extreme tidal and storm surge water levels in the vicinity of the Project Site.

2.1 Tide Station

Tidal observations and tidal datums from National Oceanic and Atmospheric Administration (NOAA) Los Angeles Station¹ (9410660) were used in the present study for tidal analysis. Figure 2 shows aerial imagery identifying the location of NOAA's Los Angeles Tide Station, situated to the west of the Project Site.



Figure 2: Aerial imagery showing the location of NOAA's Los Angeles Tide Station 9410660 in the vicinity of the Project Site.

¹ <https://tidesandcurrents.noaa.gov/stationhome.html?id=9410660>

2.2 Tidal Variations and Datums

Tides at Los Angeles Station are mixed semi diurnal with two high tides and two low tides of varying magnitude during a lunar day. Figure 3 shows time series of observed water levels at Los Angeles station along with the predicted astronomical tide cycles during a typical spring-neap tide cycle from late April to early May 2025.

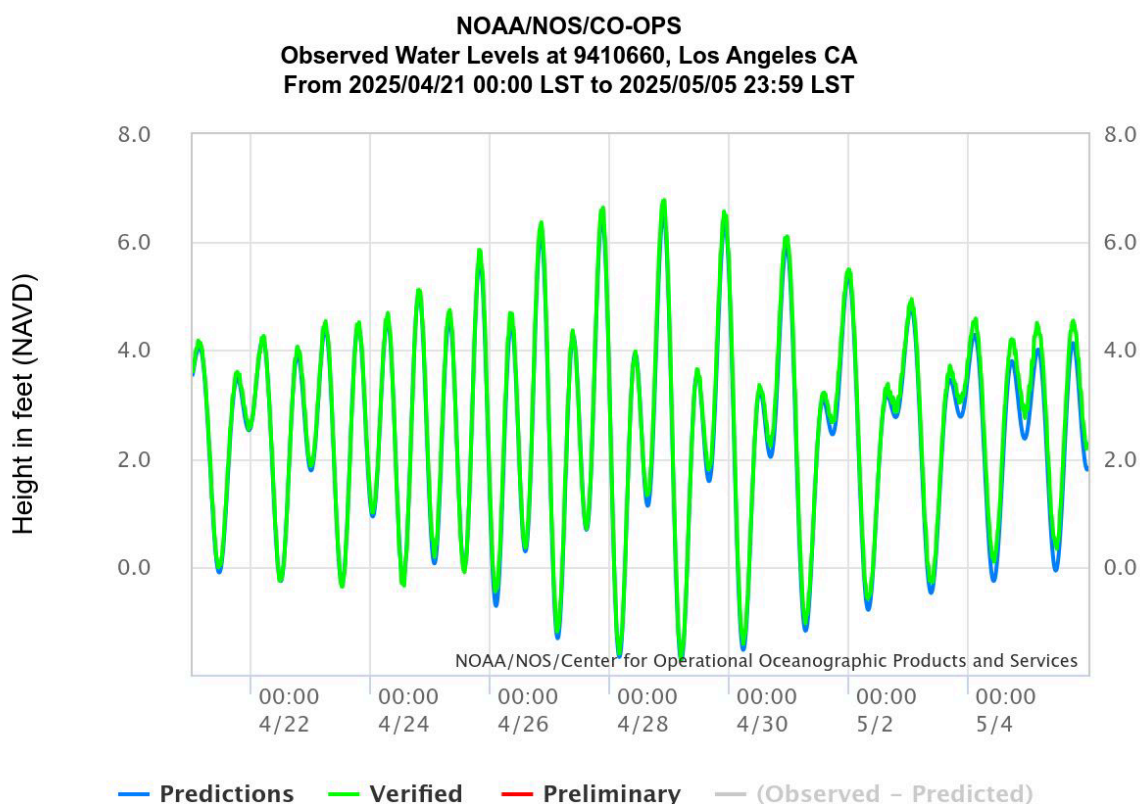


Figure 3: Time series of observed water levels and predicted astronomical tides for a typical spring-neap tide cycle from NOAA’s Los Angeles Tide Station.

Tidal datum data for NOAA’s Los Angeles Tide Station is reported in Table 1. The tidal datums shown in Table 1 are based on the epoch from 1983 to 2001, which NOAA referred to as the “present” epoch at the time this report was prepared. The tidal range (the height from the MLLW to MHHW) is 5.49 feet (1.67 meters) at NOAA’s Los Angeles Tide Station. According to the data inventory of Los Angeles Station, water levels have been recorded at this station from 1924 to the present.

Table 1: Tidal Datums from NOAA's Los Angeles Tide Station

Datum	Description	ft NAVD88	ft MLLW
MHHW	Mean Higher-High Water	5.29	5.49
MHW	Mean High Water	4.55	4.75
MTL	Mean Tide Level	2.64	2.84
MSL	Mean Sea Level	2.62	2.82
MLW	Mean Low Water	0.74	0.94
MLLW	Mean Lower-Low Water	-0.20	0.00
NAVD88	North American Vertical Datum of 1988	0.00	0.20

2.3 Historic Sea Level Trends

Historic sea level trends at Los Angeles Station, reported by NOAA are shown in Figure 4, which is based upon monthly mean sea level data from 1923 to 2024. The linear relative sea level trend is reported at rising 1.05 mm/yr (0.04 in/yr) with a 95% confidence interval of +/- 0.21 mm/yr (+/- 0.008 in/yr). This is equivalent to a change of 0.34 feet (0.1 meters) in 100 years.

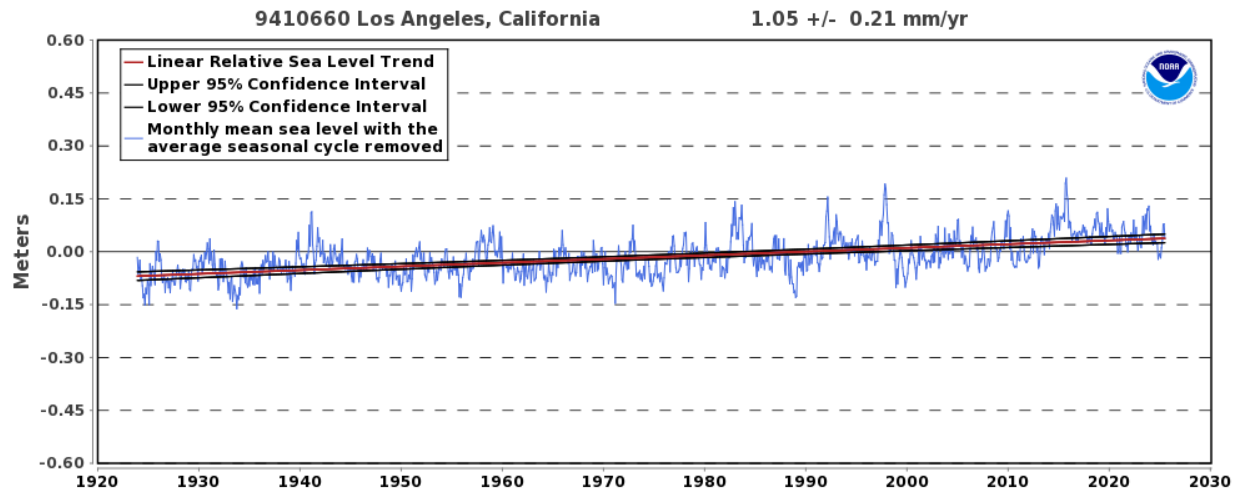


Figure 4: Historic sea level trends reported by NOAA at Los Angeles Station.

2.4 Extreme Water Levels

Figure 5 shows the time series of monthly maxima observed water levels at NOAA Los Angeles Station for the record of observed data from 1923 to 2025, along with the 1%, 10%, 50%, and 99% annual exceedance probabilities (AEPs) reported relative to MHHW datum. The monthly extreme water levels include a Mean Sea Level (MSL) trend of 1.07 mm/year.

The extreme water levels projected to December 2025 at Los Angeles Station for a variety of AEPs are reported in Table 2.

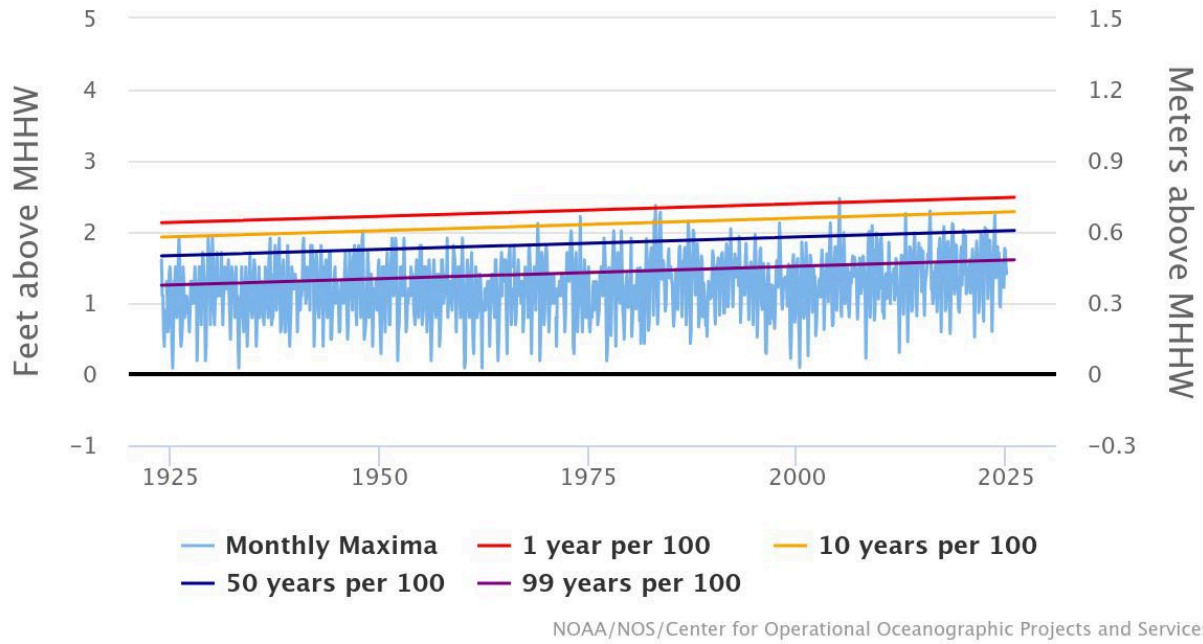


Figure 5: Monthly maxima of observed water levels at NOAA's Los Angeles Tide Station along with linear fits of extreme water levels for a range of AEPs.

Table 2: Extreme Water Levels Reported at NOAA's Los Angeles Tide Station for a Range of AEPs Projected to December 2025.

Annual Exceedance Probability	Water Level (ft MHHW)	Water Level (ft NAVD88)
1%	2.4	7.69
10%	2.2	7.49
50%	2.0	7.29
99%	1.6	6.89

3 Review of FEMA Hazard Mapping

The Federal Emergency Management Agency (FEMA) maps national coastal hazards using water level and wave data to develop Flood Insurance Rate Maps (FIRMs) which identify flood-prone zones, such as Special Flood Hazard Areas (SFHAs). FIRMs report base flood elevations (BFEs) and flooding extents under existing sea levels obtained based on geospatial analysis and compiling wave and tide data to determine extreme wave runup and storm surge.

FEMA FIRMs were reviewed for the Alamitos Bay in the vicinity of the Project Site. This review included the FIRM panels 06037C1970F (effective 9/26/2008) and 06037C1969G (effective 4/21/2021), and 06037C1988F (effective 9/26/2008). According to the FIRM panels:

- The highest BFE at Alamitos Bay in the vicinity of the Project Site is 8 ft above NAVD88 which corresponds to FEMA Zone AE (Figure 5).

To interpret BFEs and flood zones and extents, the effective FEMA Flood Insurance Study (FIS) for Los Angeles County (FEMA 2021) was reviewed, where FEMA Zone AE is defined as follows:

- Zone AE: The flood insurance rate zone that corresponds to the 1% annual chance floodplains. Base flood elevations derived from the hydraulic analyses are shown within this zone, either at cross section locations or as static whole-foot elevations that apply throughout the zone.

National Flood Hazard Layer FIRMette

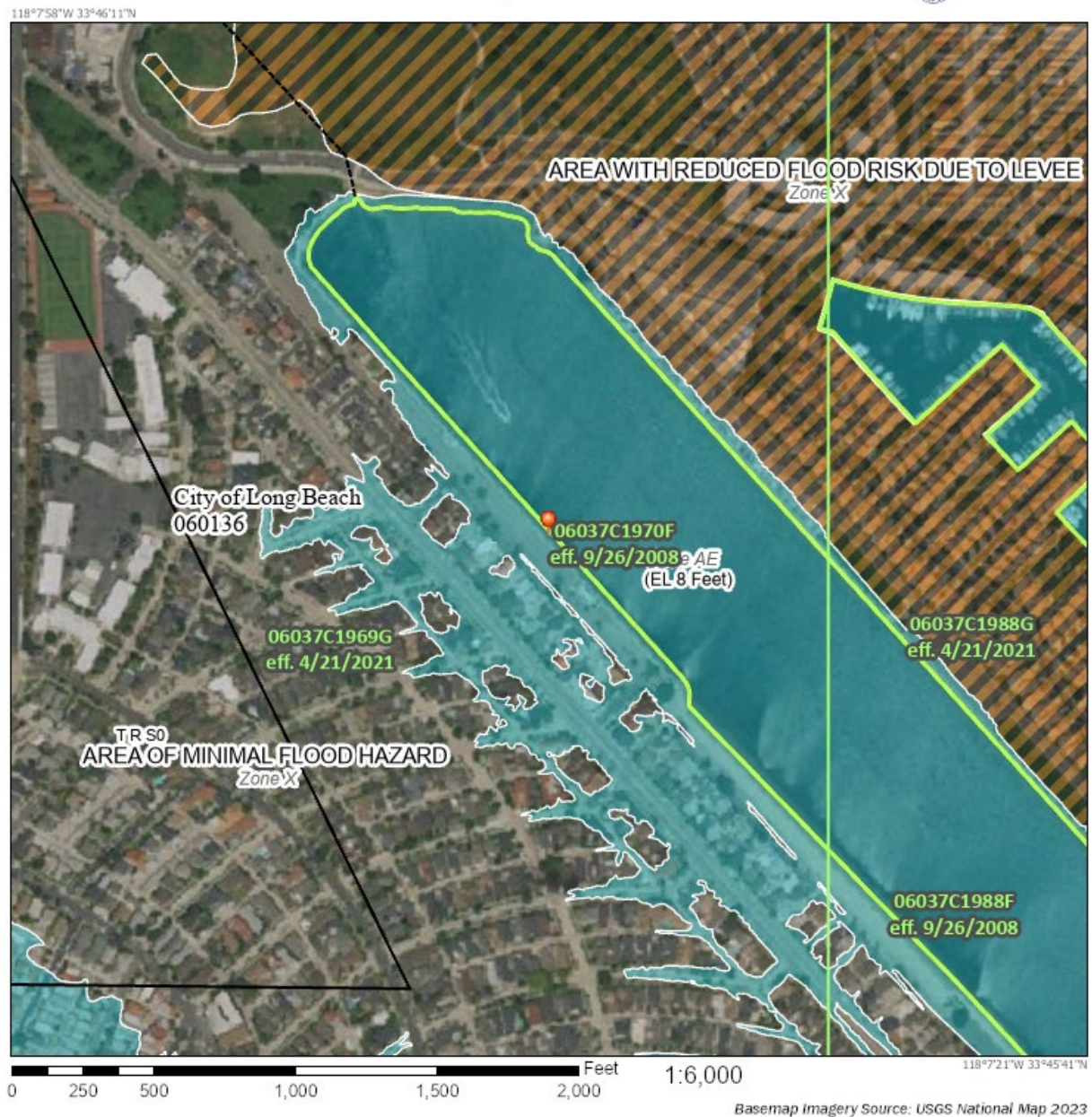


Figure 6: FEMA FIRMette including FIRM panels 06037C1970F, 06037C1969G, 06037C1988F, and 06037C1988G in the vicinity of the Project Site. The blue transparent areas indicate the SFHAs².

² SFHAs are classified as Zones AE, AO, AH, VE, and AR (areas with BFEs or depths) and Zones A, V, and A99 (areas without BFE).

4 Review of State and Local SLR Guidance

California Coastal Commission (CCC) plans and regulates the use of land and water in the coastal zone. CCC released an update of SLR Policy Guidance in November 2024 (CCC 2024, referred to as “CCC 2024 SLR Guidance” hereafter). This guidance focuses specifically on how to apply the California Coastal Act to the challenges presented by SLR through Local Coastal Program (LCP) certifications and updates and Coastal Development Permit (CDP) decisions. CCC 2024 SLR Guidance adopted the State of California Sea Level Rise Guidance developed by Ocean Protection Council ([OPC] 2024, referred to as “OPC 2024 SLR Guidance” hereafter). OPC 2024 SLR Guidance is referred to as the best available science on SLR in California by CCC 2024 SLR Guidance.

4.1 Future SLR Scenarios and Projections

OPC 2024 SLR Guidance provides SLR amounts toward the year 2150 for five SLR scenarios and for 14 NOAA tide gauge locations along the California coast. Table 3 reports the SLR amounts from OPC 2024 SLR Guidance at NOAA’s Los Angeles tide gauge through the year 2100. The corresponding SLR curves for different scenarios are shown in Figure 7.

Table 3: SLR Amounts in Feet from OPC 2024 SLR Guidance at NOAA’s Los Angeles Tide Gauge.

Year	Low	Intermediate -Low	Intermediate	Intermediate- High	High
2020	0.1	0.2	0.2	0.2	0.2
2030	0.2	0.3	0.3	0.4	0.4
2040	0.3	0.4	0.5	0.6	0.7
2050	0.4	0.5	0.7	0.9	1.1
2060	0.4	0.6	0.9	1.4	1.8
2070	0.5	0.8	1.2	2.1	2.7
2080	0.5	0.9	1.6	2.8	3.8
2090	0.6	1.1	2.2	3.6	5.0
2100	0.6	1.3	2.8	4.5	6.3

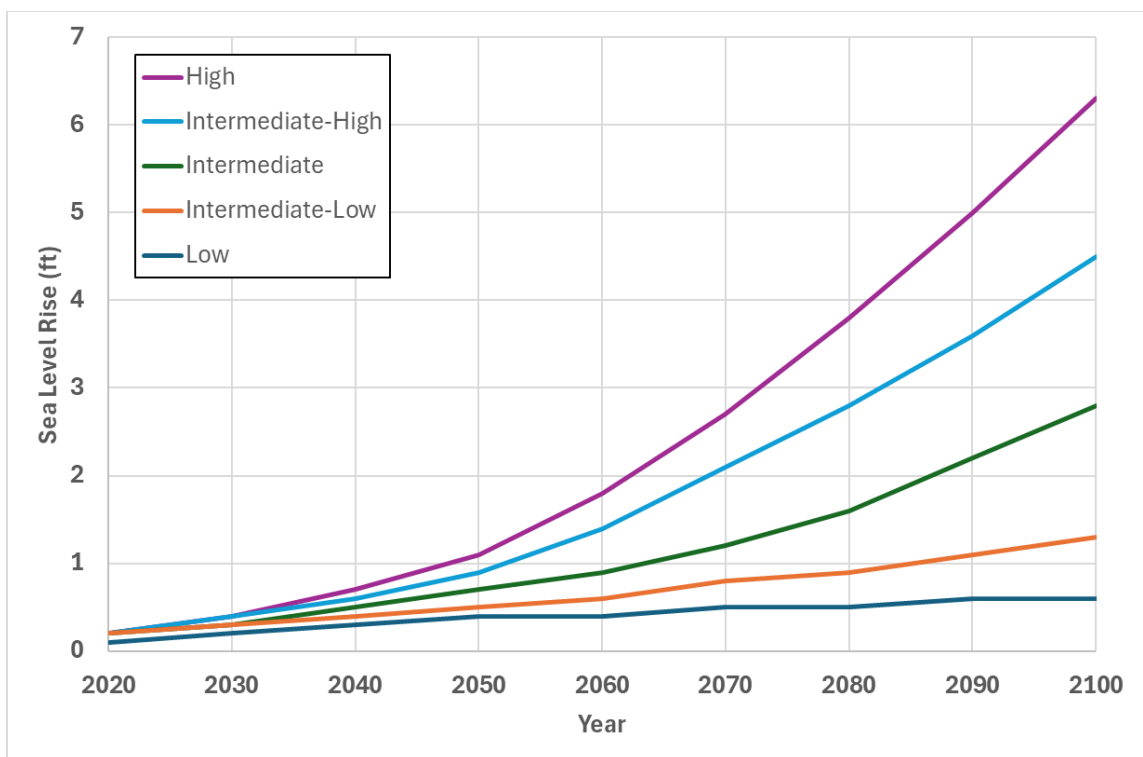


Figure 7: SLR amounts from OPC 2024 SLR Guidance at NOAA's Los Angeles tide gauge.

The five SLR scenarios including “Low”, “Intermediate-Low”, “Intermediate”, “Intermediate-High”, and “High” Scenarios were developed by OPC 2024 SLR Guidance to describe the likelihood of SLR amounts occurring in the future by taking into account SLR drivers including future warming and greenhouse gas emissions.

4.2 Guidance on Selecting SLR Scenarios

OPC 2024 SLR Guidance recommends selecting appropriate SLR Scenarios based on identifying the level of risk aversion for a specific project. OPC 2024 SLR Guidance classifies risk aversion in three categories including “Low”, “Medium-High”, and “Extreme” risk aversion. The following guidelines are given by OPC 2024 SLR Guidance:

- Low Risk Aversion:** *Adaptative, short lifespan (i.e., 2050-2075), lower consequence situations that are fairly risk tolerant, for instance a public bench or coastal recreational trail. Additionally, low risk should be considered for managing or restoring natural infrastructure, such as tidal wetland management and restoration, creating living shorelines, estimation of saltwater intrusion and coastal landscape migration, or protecting estuarine water quality. When an action has the capacity to be adapted or*

is not anticipated to persist long into the future, it is often more important to know the most likely sea level rise rather than the maximum plausible sea level rise. Therefore, if an adaptation action is part of a short lifespan adaptation pathway, a development type that might otherwise fall into a higher risk aversion category could be considered low risk in this situation. Low risk aversion projects should be resilient to the Intermediate Scenario.

- **Medium-High Risk Aversion:** *Appropriate for less adaptive, long lifespan (i.e., 2075 and beyond), more vulnerable projects that will experience medium to high consequences if impacted because of underestimating sea level rise. Multi-use paths that provide public access and/or are part of a transportation network may fall into the medium-high risk aversion category. Most commercial and residential development will fall in the medium-high or extreme risk averse categories, depending on the size and scale of the development. These efforts should be resilient to the Intermediate-High Scenario, when feasible.*
- **Extreme Risk Aversion:** *For high consequence and very long lifespan (i.e., beyond 2100) projects that have little to no adaptive capacity, would be irreversibly destroyed or significantly costly to relocate/ repair and would have considerable public health, public safety, or environmental impacts. For instance, critical infrastructure which includes but is not limited to, transit, roads, airports, ports, water storage and conveyance, wastewater treatment facilities, landfills, power plants, and railroads,) should be considered as extremely risk averse. Extreme risk aversion projects should be resilient to the High Scenario, through project design or through an adaptation pathway approach, when feasible and appropriate.*

Based on the three risk aversion categories discussed in OPC 2024 SLR Guidance, the “Intermediate”, “Intermediate-High”, and “High” Scenarios were analyzed in this memorandum.

4.3 City of Long Beach

On August 19, 2025, the City of Long Beach amended the Municipal Code with Ordinance No. ORD-25-0014, which provides new guidance for considering future SLR in the design of projects in coastal flood hazard areas. Pursuant to this ordinance, the Project is required to have a design flood elevation (DFE) at least 2 feet (24 inches) greater than the BFE.

The City of Long Beach adopted a Southeast Area Specific Plan (SEASP; City of Long Beach 2021) to guide land uses within portions of the City's Local Coastal Program. Although the existing S-7 pump station site falls outside the limits of the SEASP, portions of the force main alignment overlap the western edge of the SEASP in the vicinity of Marine Stadium. The SEASP identifies projected inundation areas resulting from sea level rise under, medium-high, and extreme aversion scenarios for 2060 (Figure 9-5) and 2100 (Figure 9-6). Based on Figure 9-5 of the SEASP, the force main alignment is not identified in an area subject to inundation by 2060 (City of Long Beach 2021). However, according to Figure 9-6 of the SEASP, the force main and existing sewer trunk connection are located within areas subject to inundation by 2100 (City of Long Beach 2021). The area of projected inundation extends from Marine Stadium Park to Appian Way and south to approximately Audra Drive.

In conjunction with the SEASP update, the City worked with the California Coastal Commission to incorporate additional consideration of SLR for project level analysis in future coastal development permits. This included incorporation of Chapter 6, Addressing Sea Level Rise in Coastal Development Permits, from the Commission's Sea Level Rise Policy Guidance as Appendix E. Additionally, the SEASP, as amended, now includes Coastal Hazard Policy 9 which states that "New or replacement critical facilities and infrastructure should not be located in an area subject to flood risk, including risk due to sea level rise."

5 Future Flood Elevations

Future flood elevations were developed based on the extreme water levels reported at NOAA's Los Angeles Tide Station (Section 2.4) and the BFEs from FEMA FIRM in the vicinity of the Project Site (Section 3) along with the SLR scenarios from OPC 2024 SLR Guidance (Section 4). Accordingly, a flood elevation of 8 ft NAVD88 was adopted as the flood elevation for existing sea levels, which corresponds to the more conservative of the two sources: the 1% AEP water level from the NOAA's Los Angeles Tide Station and the BFE of FEMA FIRM Zone AE in the vicinity of the Project Site. Future-projected flood elevations for the Project Site were developed using SLR amounts for Intermediate, Intermediate-High, and High SLR Scenarios (Figure 8). Future-projected flood elevations for the years 2050, 2075, and 2100 developed based on these SLR Scenarios for the Project Site are reported in Table 4.

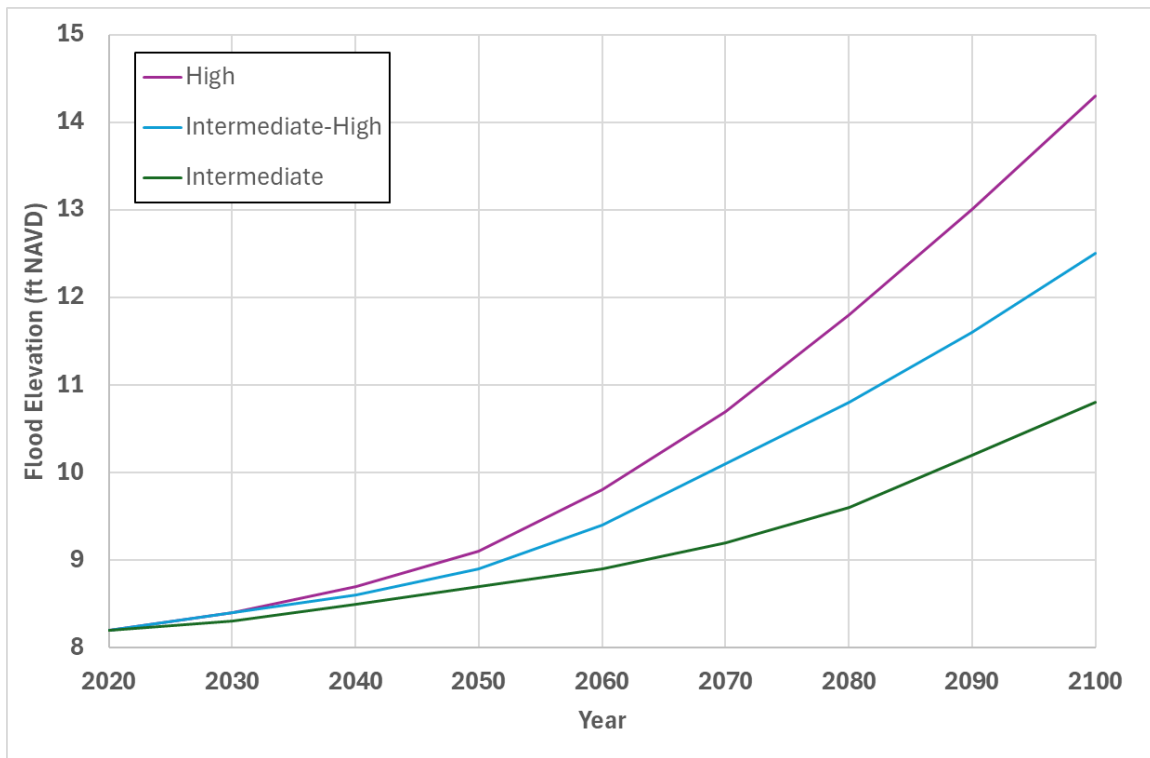


Figure 8: Future-projected flood elevations obtained from FEMA FIRM BFE along with SLR projections for "Intermediate", "Intermediate-High", and "High" Scenarios from OPC 2024 SLR Guidance.

Table 4: Future-Projected Flood Elevations in Feet Above NAVD88 for the Years 2050, 2075, and 2100.

Year	Intermediate	Intermediate-High	High
2050	8.7	8.9	9.1
2075	9.4	10.5	11.3
2100	10.8	12.5	14.3

6 Summary and Recommendations

To determine the potential for coastal flooding to affect the Project Site, future-projected flood elevations were compared to the elevation profile of the Project Site and proposed improvements. The elevation of the Project Site ranges from approximately 9.8 feet to 10.3 feet NAVD88 based on survey data from the Project design team³. Flooding related to SLR is not anticipated to occur at the Project Site by the year 2050 under any of the analyzed SLR projections. However, by 2075, Table 4 indicates that flooding could result under the Intermediate-High and High SLR scenarios.

As outlined in the City's Climate Action and Adaptation Plan (CAAP; City of Long Beach 2020), the City has planned for a range of actions to address the projections for coastal flooding in the vicinity of the Project Site as presented in Table 4. Furthermore, design measures consistent with CAAP action FLD-9 have been incorporated into the Project, including the use of a floodproof emergency generator and submersible pumps. Additionally, in conjunction with final design, LBUD will consider the implementation of additional flood adaptation strategies from adaptation action FLD-9 and other measures identified in the CAAP to further minimize the potential impacts of future coastal flooding on the Project.

From an operational lifespan perspective, the proposed concrete wet well structure and associated vaults are expected to function approximately 50 years before requiring any future modifications. These project features would be located below grade and therefore designed to withstand inundation and the corrosive soil environment. The new pumps are expected to last 20 years and most new electrical equipment is expected to last 15 years. Given the critical nature of the Project and its intended lifespan, the final design considered the Intermediate-High projected scenario for 2075 (10.5 feet).

The generator and associated diesel fuel storage tank would be designed to withstand temporary inundation. The only components of the Project that are expected to be susceptible to damage related to SLR would be the electrical components, including the electrical equipment pad and switchboard pad. Accordingly, the Project proposes installing electrical equipment at an elevation of 10.3-10.8 feet above NAVD88. This would be consistent with

³ Site elevations were surveyed using the National Geodetic Vertical Datum of 1929 (NGVD29), which is 2.3 feet below NAVD88 in this region. Thus, a site elevation of 7.5 to 8.0 feet NGVD29 would equate to 9.8 to 10.3 feet NAVD88.

the design requirements set forth by the City's Municipal Code, since it would be more than 24 inches above the BFE of 8 feet.

Although some of the auxiliary electrical components may remain below the 2075 intermediate-high projection of 10.5 feet; based on the expected lifespan (15-20 years) of the electrical equipment, physical replacement would be required several times prior to 2075. For those components, the Project design would accommodate the physical space and capacity to elevate in the future, as required. Flooding may result in minor aesthetic damage to the proposed generator building, but it is not expected to cause critical structural damage that would affect the function and reliability of the local wastewater collection system.

While sewer collection systems can be affected by flooding associated with storm events, the proposed sewer force main would be contained underground and designed to avoid inflow and infiltration during such events based on its existing susceptibility as illustrated in Figure 6. Additionally, the proposed force main would maintain required separations from local potable water lines. The proposed force main would be constructed of a monolithic, high density polyethylene pipe that would have no joints that could contribute to leakage over the long-term operational life span of the proposed force main. Existing and proposed isolation valves in the LBUD sewer collection system would further minimize the risk of pollutant release during inundation events.

During long-term maintenance of the existing force main in conjunction with LBUD's Sanitary Sewer Management Plan (SSMP), a decision would eventually be made to abandon the existing force main based on future condition assessments. Once these condition assessments conclude that the existing force main has reached the end of its operational life, the existing force main would be decommissioned, abandoned in place, and filled with a concrete slurry material. This would prevent any future leakage into the surrounding groundwater.

Once constructed, the Project would not exacerbate existing or future projected inundation hazards or create new inundation hazards. Based on the Project design features, further mitigation would not be necessary to meet the City's elevation requirements or the projected 2050 scenarios. In the long term and consistent with the City's SEASP Coastal Hazard Policy 9, the City may consider further elevating electrical equipment depending on the future progression of SLR and other planned City regional infrastructure improvements. The Project intends to upgrade Sewer Lift Station S-7 and the associated force main to increase its

lifespan and reliability, which would ultimately contribute to an improvement in climate resilience for Long Beach and the Belmont Park community.

7 References

- California Coastal Commission (CCC). 2024. Sea Level Rise Policy Guidance, Interpretive Guidance for Addressing Sea Level Rise in Local Coastal Programs and Coastal Development Permits.
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