4.20 FLOODPLAINS

This section addresses the effects of the Proposed Project on existing floodplains in the vicinity of Gnoss Field Airport (DVO or Airport) and the effects of sea level rise on the project site.

4.20.1 ENVIRONMENTAL SETTING

4.20.1.1 Regulatory Framework

Floodplains are defined by Executive Order (EO) 11988, *Floodplain Management*, as "the lowland and relatively flat areas adjoining inland and coastal waters including flood-prone areas of offshore islands, including at a minimum, that area subject to an annual one percent or greater chance of flooding" (i.e., area inundated by a 100-year flood). U.S. Department of Transportation (DOT) Order 5650.2, *Floodplain Management and Protection,* defines the values served by floodplains to include "natural moderation of floods, water quality maintenance, groundwater recharge, fish, wildlife, plants, open space, natural beauty, scientific study, outdoor recreation, agriculture, aquaculture, and forestry".

EO 11988 directs Federal agencies to take actions to reduce the risk of flood loss, minimize flood impacts on human safety, health and welfare, and restore and preserve floodplain natural and beneficial values. To do this, the EO bans approving activities in a floodplain unless:

(1) No practicable alternative exists; and

(2) Measures to minimize unavoidable short-term and long –term impacts are included.

4.20.1.2 Existing Conditions

Flooding

A Flood Insurance Rate Map (FIRM) prepared by the Federal Emergency Management Agency (FEMA), dated May 4, 2009,[1] was used to establish the boundary of the 100-year floodplain within the Detailed Study Area (DSA). The FIRM shows that all of DVO and the entire DSA for this study lies within the FEMA designated "100-year Floodplain with Additional Storm Wave Hazards," also known as "Area of Special Flood Hazard Zone VE," which describes high-risk coastal areas with a one percent or greater chance of flooding and an additional hazard associated with storm waves,[2] as shown in **Exhibit 4.20-1, *Floodplains***.

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[1] Federal Emergency Management Agency, *Flood Insurance Rate Map,* Community Number 0601730175D. Available online at: http://msc.fema.gov/webapp/wcs/stores/servlet/MapSearchResult?storeId=10001&catalogId=10001&langId=-1&userType=G&panelIDs=06041C0175D&Type=pbp&nonprinted=&unmapped= Accessed 5/27/09.

[2] *Definitions of FEMA Flood Zone Designations*, On-line at: http://msc.fema.gov Retrieved September 15, 2009.

A system of manmade ditches and levees constructed along the Petaluma River provides flood protection for the Airport, including the runway, taxiway, aircraft parking areas, and the administrative offices. However, the FIRM shows the entire Airport property to be located within the 100-year floodplain because the system of levees does not meet the physical criteria identified in the National Flood Insurance Program (NFIP) requirements as described in Title 44, Chapter 1, Section 65.10 of the Code of Federal Regulations (44 CFR Section 65.10). Therefore, for the purposes of this Environmental Impact Report (EIR), the Airport is considered to be located within the 100-year floodplain, but consideration will be given for the system of ditches and levees that help protect the Airport from flooding.

Sea Level Rise

The well-documented warming of the climate since the late 1800s or early 1900s resulted in an increase in global sea level rise of 1.7 + 0.5 mm (roughly 0.067 +inch) per year during the 20th century based on worldwide tide gauge measurements. More recently, during the ten-year period from 1993-2003, the estimated annual rate of sea level rise had nearly doubled to 3.1 + 0.7 mm.[3] Global sea level rise is occurring in response to thermal expansion of ocean waters and the melting of land ice (i.e. glaciers and ice sheets), both of which increase ocean volume. Human activities contributing to climate change and its attendant sea level rise include fossil fuel extraction and transport, automobile transit, power plant operations, agriculture, aircraft transport, and other activities that increase the emission of greenhouse gases (e.g. carbon dioxide and methane) above natural background levels. Other human activity that influences relative sea level includes aquifer withdrawals and storage of water behind dams. Aquifer pumping adds water to the ocean at the expense of long term subsurface storage, while reservoirs have a countervailing effect, i.e. they subtract water that would otherwise reach the ocean.[4]

Predictions of local sea level rise must account for other factors including climate patterns, such as the El Nino-Southern Oscillation, gravitational and deformational effects of melting glaciers and ice sheets, tectonic uplift, and land subsidence due to water and hydrocarbon pumping. In addition to the direct impacts of sea level rise on progressive inundation of low-lying coastal areas, rising seas are expected to significantly increase the severity and frequency of extremely high coastal wave events. Such events can erode both natural shorelines (e.g. coastal bluffs and dune systems) and engineered shoreline protection works (e.g. sea walls, riprapped levees), resulting in beach and shoreline retreat and substantial property damage. The rapidity of sea level rise and a declining sediment supply to the San Francisco Bay estuary could also hamper the adaptation of coastal wetlands and mudflats, resulting in decreases in biotic habitat.

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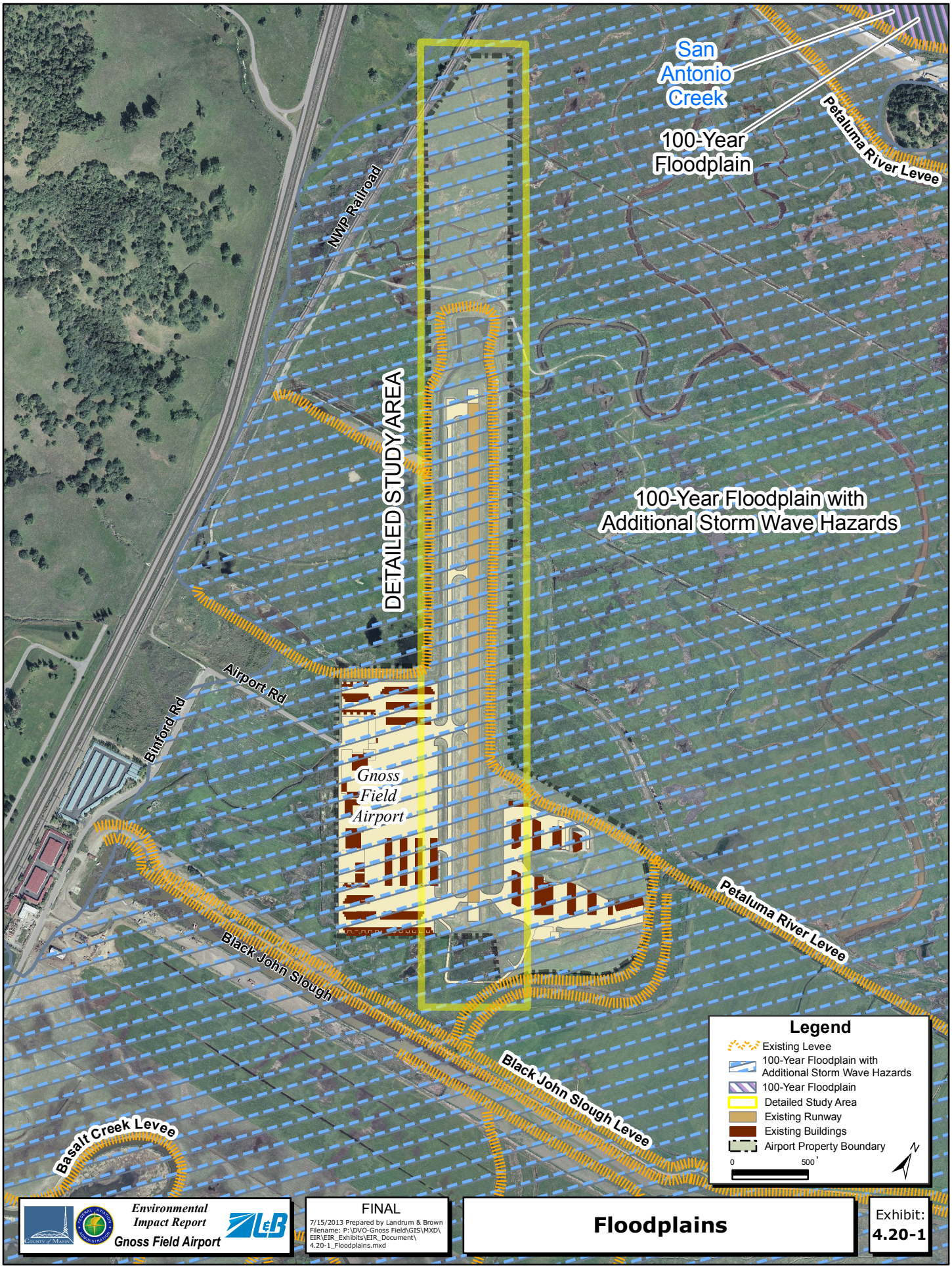
[3] Climate Change 2007: The Physical Science Basis, Contribution of Working Group I to the Fourth Assessment Report of the IPCC, Intergovernmental Panel on Climate Change (IPCC), S. Solomon et al., Cambridge University Press, Cambridge, 996 pp.

[4] Sea-Level Rise for the Coasts of California, Oregon, and Washington: Past, Present and Future, Committee on Sea Level Rise in California, Oregon and Washington, Board of Earth Sciences and Resources and Ocean Studies Board. Division of Earth and Life Studies, National Research Council of the National Academy of Sciences, 2012.



Environmental Impact Report
Gnoss Field Airport

FINAL

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Floodplains

Exhibit: **4.20-1**

BACK OF EXHIBIT 4.20-1

Numerous Federal, State and regional organizations are currently studying the potential effects of sea level rise and its implications for land use, flood control and other public infrastructure, and habitat conservation. These include the National Academy of Sciences/National Research Council (NRC), the National Oceanic and Atmospheric Administration (NOAA), the Federal Emergency Management Agency (FEMA), the US Geological Survey (USGS), the US Army Corps of Engineers (USACE), the US Fish and Wildlife Service (USFWS), the California Natural Resources Agency, the Coastal and Ocean Resources Working Group for the California Climate Action Team (CO-CAT), the San Francisco Bay Conservation and Development Commission (BCDC), and the Point Reyes Bird Observatory (PRBO). Several multi-agency initiatives that address climate change, sea level rise impacts and adaptation strategies are also underway, including the *California Vulnerability and Adaptation Study,*[5] *Adapting to Rising Tides* project,[6] the California Coastal Analysis and Mapping Project (CCAMP), which includes the Open Pacific Coast Study and the San Francisco Bay Area Coastal Study,[7] the *CASCaDE* (Computational Assessments of Scenarios of Change for the Delta Ecosystem) project,[8] and the *Our Coast- Our Future* project.[9] Also, the California Landscape Conservation Cooperative (CA LCC) and its Climate Commons project provides access to up-to-date climate change data and related resources tailored to conservation efforts.[10] Within the past three years, the USACE has issued two directives regarding consideration of predicted levels of sea level rise in the analysis and design of all of its Civil Works projects. These latest of the two nearly identical directives extends the earlier 2009 instruction to September 2013.[11]

In October 2011 the San Francisco Bay Conservation and Development Commission (BCDC) amended its San Francisco Bay Plan to reflect its assessment of potential flooding impacts resulting from climate-induced sea level rise. BCDC in cooperation with the US Geological Survey conducted its assessment of the causes of sea level rise, possible sea level rise scenarios, altered precipitation and storm characteristics, and vulnerabilities of Bay Area communities to flooding. The BCDC assessment, approved in October 2011, contains sub-regional maps of predicted tidal inundation

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5 Climate Change Impacts, Vulnerabilities, and Adaptation in the San Francisco Bay Area, the Third California Climate Change Assessment, referred to as the Vulnerability and Adaptation Study, prepared by UC Berkeley, S. Moser Research & Consulting and Stanford University for the California Energy Commission.

6 The Adapting to Rising Tides (ART) project is a collaborative planning effort initiated by BCDC, in partnership with NOAA's Coastal Services Center, Caltrans, the Metropolitan Transportation Commission, and local Bay Area governments to assist communities in developing sea level rise adaptation strategies, sustainable infrastructure and ecosystem protection.

7 San Francisco Bay Area Coastal Study- California Coastal Analysis and Mapping Project, FEMA digital brochure, Sept. 2012, available at: http://www.r9map.org/Documents/120904_FEMA-Brochure_SFBayArea_web.pdf, accessed April 2013.

8 A USGS program in collaboration (and funded by) the State of CA's Delta Stewardship Council, available at: http://cascade.wr.usgs.gov/index.shtm, accessed April 2013.

9 The Our Coast-Our Future project is a collaboration between PRBO, USGS and NOAA with the goal of developing analytical decision- support tools for climate change assessment and for assessing vulnerabilities to natural and build environments.

10 CA LCC website: http://www.californialcc.org/, accessed April 2013.

11 Water Resource Policies and Authorities Incorporating Sea-Level Change Considerations in Civil Works Programs, Circular No. 1165-2-212, USACE, Washington, DC, July 2009; and Sea Level Change Considerations for Civil Works Programs, Circular No. 1165-2-212, USACE, Washington, DC, Oct. 2011.

produced by the USGS, based on its hydrodynamic modeling of two sea level rise scenarios for San Francisco Bay: 1) a 16-inch rise in sea level by 2050, and 2) a 55-inch sea level rise by 2099.[12] Both of these scenarios were within the ranges of sea level rise predicted for these time periods by other research agencies, including the CO-CAT.

The 2009 California Climate Adaptation Strategy stated the following recommendation:

> *"The California Energy Commission will develop the Cal-Adapt Web site that will synthesize existing California climate change scenarios and climate impact research and to encourage its use in a way that is beneficial for local decision-makers."*

Cal-Adapt was designed to provide access to the wealth of data and information that has been, and continues to be, produced by the State's scientific and research community. The data available at this site offers a view of how climate change might affect California at the local level. **Exhibit 4.20-2, *Sea Level Rise – Threatened Areas Map***, shows DVO in relationship to the areas that will be threatened by sea level rise in the future. Blue color on the exhibit indicates areas already in threat today, while the lighter shades are areas projected to also be in threat given the expected sea level rise. These maps do not take into account existing levees. DVO is currently located in an area that is considered under threat today.

4.20.2 ENVIRONMENTAL IMPACTS AND MITIGATION

4.20.2.1 Significance Criteria

DOT Order 5650.2 contains policies and procedures for carrying out EO 11988. Based on DOT Order 5650.2, if an action includes development within a floodplain, the analysis shall indicate if the encroachment would be a "significant encroachment," that is, whether it would cause one or more of the following impacts:

(1) The action would have a high probability of loss of human life;

(2) The action would likely have substantial, encroachment-associated costs or damage, including interrupting aircraft service or loss of a vital transportation facility (e.g., flooding of a runway or taxiway; important navigational aid out of service due to flooding, etc.); or

(3) The action would cause adverse impacts on natural and beneficial floodplain values.

[12] Living with a Rising Bay: Vulnerability and Adaptation in San Francisco Bay and on its Shoreline (Staff Report), Bay Conservation and Development Commission, October 2011.

SOURCE: http://cal-adapt.org/sealevel/

Environmental Impact Report
Gnoss Field Airport

FINAL
7/15/2013 Prepared by Landrum & Brown
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Sea Level Rise: Threatened Areas Map

Exhibit: **4.20-2**

Back of Exhibit 4.20-2

According to Appendix G of the California Environmental Quality Act (CEQA), a project would generally have a significant effect on floodplains if it would:

- Place housing within a 100-year flood hazard area as mapped on a Federal Flood Hazard Boundary or FIRM or other flood hazard delineation map;
- Place within the 100-year flood hazard area structures which would impede or redirect flood flows;
- Expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam; or
- Cause inundation by seiche, tsunami, or mudflow.

4.20.2.2 Environmental Impacts of the Proposed Project

Impact 4.20-1: Development within the 100-year floodplain (less than significant).

The project would include development within the 100-year floodplain of the proposed 1,100-foot extension of Runway 13, the extension of the parallel taxiway adjacent to the runway, and the extension of the levee and drainage ditch adjacent to Runway 13. Approximately 13 additional acres of the approximately 3,875 acre 100-year floodplain behind the airport levee would be encroached upon as discussed in Chapter Two, *Summary*, Chapter Six *Alternatives*, and Appendix D, *Runway Length Analysis*, off-site alternatives such as using another airport or another mode of transportation are not practicable as they do not meet the project purpose. No on-site alternatives other than extending the runway at DVO by a minimum of 1,100 feet to a total runway length of 4,400 feet would meet the project's purpose and need, which is to provide the necessary runway length for ~~existing users to more efficiently use the Airport~~the critical aircraft at DVO. In addition, FAA design standards require a 240-foot runway safety area at each end of the 4,400 foot runway to meet FAA airport design standards. Therefore it is not practicable to implement the ~~Sponsor's~~ Proposed Project or Alternative D without constructing the proposed runway extension in an area currently in the 100-year floodplain.

In order to determine if these improvements would result in a significant encroachment, each of the issues, as defined by DOT Order 5650.2, *Floodplain Management and Protection,* and by Appendix G of CEQA, are addressed below:

- The project would not have a high probability of loss of human life, would not place housing within a 100-year flood hazard area, and would not expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam. Further, the project would not:
    - Place within the 100-year flood hazard area structures which would impede or redirect flood flows;

  - Construct new buildings or any structure designed for human habitation;
  - Change the Airport access road, thereby increasing the risk of preventing access during a flood event;
  - Decrease the safety or ability to use the Airport during a flood event; or
  - Increase the likelihood of flood-induced spills of hazardous materials.
- The project would not have substantial, encroachment-associated costs or damage. The proposed development would occur within a 100-year floodplain, but the existing ditch and levee system would be extended to provide flood protection for the runway, taxiway, aircraft parking areas, and administrative offices. As a result, the Airport would be at no greater risk for flood damage than it currently is today.
- The development would occur within a large contiguous floodplain that encompasses the Airport and continues east until reaching the Petaluma River. The size of the contiguous area is approximately 3,875 acres. The project would extend the existing levee and ditch system to the northwest and result in an additional 13 acres of land being protected by a levee. Impounding this relatively small area (less than one percent of contiguous area) would not result in new areas being subject to 100-year floods, nor would it result in existing areas subject to 100-year floods becoming more prone to floods.
- The project would not cause adverse impacts on natural and beneficial floodplain values. The proposed development would result in a larger land area being developed and the extension of the ditch and levee system. However, due to the size of the floodplain in and around the Airport, there would be no adverse impacts on the natural and beneficial floodplain values. Based on analysis in this section and in other sections of this EIR, the project would not result in significant impacts to agricultural activities, aquacultural activities, aquatic or terrestrial organisms, flood control, groundwater recharge, or water quality.
- A seiche is a standing wave in an enclosed or partially enclosed body of water (seen on lakes, bays, and seas) that is caused by strong winds blowing across a long axis in the lake or embayment. Since the project area is located approximately four miles from the northwestern shoreline of the San Pablo Bay, seiche effects as a result of the project would be unlikely. Likewise, mudflows would be unlikely due to the location of the project area at nearly sea level and not atop a hillslope. Tsunamis are oceanic waves that are generated by earthquakes, submarine volcanic eruptions, or large submarine landslides. The waves are generally formed in groups that may have very long wavelengths (several miles to more than 100 miles), but only a few feet high. As a tsunami enters shallow water near coastlines, the wave velocity diminishes and the wave height increases. If the trough of the wave reaches land first, the arrival of a tsunami is preceded by recession of coastal waters; if the crest of the wave reaches land first, there would be a rise in water level. The large waves that follow can crest at heights of more than 50 feet and strike with devastating force. As demonstrated in Section 4.3,

Geology, Soils, and Seismicity, of this chapter, since the study area is more than four miles from San Pablo Bay and seventeen miles from the nearest coastline, the potential for this condition is considered low.

With this project, approximately 13 additional acres of the approximately 3,875 acre 100-year floodplain behind the airport levee would be encroached upon, but because the existing Airport levee and drainage ditch system would be extended to surround and protect the proposed runway and taxiway extension and the size of the development in relationship to the size of the surrounding floodplain would make the development unlikely to negatively affect surrounding uses, it would not cause a significant encroachment, as would be evidenced by an increase in the risk of human hazards or property damage from flood waters, or degrade natural and beneficial floodplain values. Therefore, the project impact on the floodplain, and the possibility of the project being subject to flood waters is deemed less-than-significant.

Mitigation: None required.

Impact 4.20-2: The Proposed Project will not result in an impact on sea level rise, but is located within an area that could be subject to sea level rise. (Less-Than-Significant)

The Proposed Project would include development within an area identified as being subject to sea level rise. The project would not worsen conditions in the area if sea level rise does occur as projected. As such, implementation of the project would not result in an impact.

Based on the available data and projections, it is difficult to determine the impact sea level rise would have on the Airport given the uncertainty of when and how quickly sea level rise will occur, the effectiveness of the current levees, and the potential measures that BCDC, Marin County, and other organizations may employ to reduce the impact of sea level rise in the future. Because the effects of sea level rise in the vicinity of Gnoss Field are currently speculative the extent of impact on the airport is unknown. Accordingly no mitigation is required. However, it is recommended that Marin County consider revising the Countywide Plan to include the following policies:

> **Anticipate Climate Change Impacts, including Sea Level Rise**. Recent predictions of sea level rise for the San Francisco Bay region by BCDC and USGS based on climate models and hydrodynamic modeling of the San Francisco Bay Estuary indicate 16 inches of rise by mid-century and 55 inches by 2100. Cooperate with the U.S. Geological Survey, the San Francisco Bay Conservation and Development Commission, the California Landscape Cooperative's Climate Commons project and other monitoring agencies to track bay and ocean levels and share baseline topographic and resource data obtained by the County in implementing its own projects to enhance hydrodynamic and ecosystem modeling efforts and assessment of regional climate change impacts. Use official estimates for mean sea level rise and topographic data for environmental review. Environmental review for development applications and County infrastructure should incorporate official

mid-century sea level rise estimates, and require adaptive strategies for end-of-century sea level rise for any such project with expected lifetimes beyond 2050.

Plan for Climate Change Impacts, including Sea Level Rise. Consider sea level rise in future countywide and community plan efforts. Apply for membership in the National Flood Insurance Program's (NFIP) Community Rating System (CRS), and as appropriate through revisions to the Marin County Code, obtain reductions in flood insurance rates offered by the NFIP to community residents. Cooperate with FEMA in its efforts to comply with recent congressional mandates to incorporate predictions of sea level rise into its Flood Insurance Studies and FIRM. For development of watershed management plans and flood control infrastructure consider official mid-century and end-of-century sea level rise estimates in hydraulic/hydrodynamic modeling, as well as climate adaptation strategies, including; avoidance/planned retreat, enhance levees, setback levees to accommodate habitat transition zones, buffer zones and beaches, expanded tidal prisms for enhanced natural scouring of channel sediments, raising and floodproofing structure, provision for additional floodwater pumping stations, and inland detention basin to reduce riverine peak discharges. Participate in the Bay Area Climate & Energy Resilience Project and its March 2013 Proposed 12-Month Action Plan, developed by the Bay Area Joint Policy Committee of the Association of Bay Area Governments. Revise the Marin County Hydrology manual to, at a minimum, incorporate use of updated rainfall frequency data from NOAA's Atlas 14Volume 6, Vers. 2.1 California (rev. 2012).

Mitigation: None required.

4.20.3 CUMULATIVE IMPACTS OF THE PROPOSED PROJECT

Because the project would not result in significant impacts to floodplains and sea level rise, it would therefore not result in subsequent contribution to cumulative impacts to floodplains and sea level rise.