7.1 NATURE OF THE CONCLUSIONS PRESENTED

The conclusions presented in this section have been developed to identify for the general public the key findings this report. These conclusions are limited to the predicted changes in San Francisco Bay hydrodynamics, sediment transport, and water quality resulting from SFO's proposed runway reconfiguration alternatives and the responses of the Bay's aquatic biotic communities to those changes. The predicted changes and responses are based on the best professional judgment of multi-disciplinary scientific teams applying the conceptual impact model presented in Section 1 and analyses of the data presented in Sections 5 and 6 of this report. No significance criteria have been applied at this time to the projected changes and responses. That application will occur in the FAA's EIS and CCSF's EIR that this technical report will support.

7.2 CONCLUSIONS REGARDING PREDICTED CHANGES TO PHYSICAL AND CHEMICAL CONDITIONS

7.2.1 Predicted Changes in Hydrodynamics

In this report, hydrodynamics includes changes to circulation patterns and current velocities. Circulation patterns can be affected when flows are diverted or the bathymetry is changed. Current velocities will change from existing conditions when flows converge (causing increased velocity) or diverge (causing decreased velocity). The current velocity will also change if obstacles, such as piles, are installed in the flow path.

7.2.1.1 Circulation

Construction of the BX-6 platforms would block the flow along the shore near the airport and divert it to the east towards the main channel of the South Bay. Construction of the platforms would therefore increase flows in the channel offshore of the new runways. Because of the orientation of the new 10/28 Runway, the effect would be greater during ebb tide than flood tide. The change would be greatest south of the airport and would be greatest for the all-fill option. The change would be reduced for the hybrid option. Changes in circulation would be limited to the west side of the Bay between Oyster Point and Coyote Point.

Because the proposed platforms would affect flow less during flood tide than ebb tide, residual flow near the airport would be changed. When ebb and flood tides are averaged over time, there is a net southerly flow in the immediate vicinity of the airport under the No Project Alternative. Because of the position of the new 10/28 Runway, that net residual flow would be northerly with the proposed project. This change would only occur in the immediate vicinity of the airport. North of Oyster Point and south of Coyote Point, the project would not change residual flow because the small shift near the airport would be counterbalanced by a decrease in the residual flow in the main channel of the South Bay.

7.2.1.2 Current Speed

Changes in current speed are represented by the Root Mean Square (RMS) speed. RMS speed does not have a direction and represents an average speed that is influenced more by larger values than the arithmetic mean.

Changes in RMS speed caused by the BX-6 platforms would be limited to the west side of the Bay. Those changes can be generally characterized as follows:

- The change in RMS speed would not vary between water years.
- RMS speed would increase at the tips of the platforms for Runways 19L and 28R as flows divert around these new platforms. The increase would be between 8 and 16 cm/s for the platforms on fill and between 2 and 8 cm/s for the platforms on piles.
- For the new 10/28 Runway on fill, the increase in current speed at the end of the runway would extend into the main channel of the South Bay. East of the tip of the runway, the main channel current would increase between 2 and 4 cm/s.
- RMS speed would decrease underneath the 10/28 Runway platform built on piles. The decrease would be about 4 to 8 cm/s.
- RMS speed would decrease on all sides of the new platforms.

Hydrodynamic changes associated with the proposed project also considered wetland restoration in the South Bay at two sites: the 4,900-acre (2,000 ha) Baumberg Wetlands complex near Hayward, California, and a 2,900-acre (1,200 ha) site near the west end of the Dumbarton Bridge. Hydrodynamic modeling was done by assuming a 200-meter wide opening in the dikes to each of these sites allowing Bay water to flow into and out of the sites.

Breaching the dikes would enlarge the tidal prism of the South Bay, increasing the RMS current speed near the new inlets/outlets of the mitigation areas. Near the Baumberg Wetlands Complex, the changes would extend approximately 2 km into the Bay and range from over 20 cm/s at the inlet to 2 to 4 cm/s at 2 km from the wetlands. At the Dumbarton Bridge site, the change in RMS current speed would be closer to the inlets, extending only 1 km into the Bay. The change would be about 8 to 16 cm/s near the inlets and 2 to 4 cm/s in the Bay. There would also be a 2 to 8 cm/s increase in the southern channel of the South Bay near Bair Island.

Excavation of the borrow pits would cause a small increase in flow over the borrow pits because of the reduced bottom friction. There would be a corresponding decrease in flow east and west of the borrow pits to compensate for this change. The change in RMS speed would be about 2 to 8 cm/s.

7.2.2 Predicted Changes in Sediment Transport

Sediment transport would be affected by the proposed project as a result of changes in advective and dispersive transport caused by project-related changes in circulation. Potential changes in suspended sediment concentrations (SSCs), erosion, and deposition that would be caused by

these project-related changes in sediment transport are summarized below for the operational and construction phases of the project.

7.2.2.1 Operation Phase

For a number of years after construction the rates of deposition and erosion of sediments in the vicinity of the new platforms, potential mitigation sites, and East Bay borrow sites would be different than those predicted for the No Project Alternative. The rate of deposition and erosion, as well as corresponding SSCs, would be highest immediately following construction. However, modeling results indicate that the differences in sedimentation and SSCs with and without the project would diminish over time as the bathymetry adjusted itself in response to the new conditions. In other words, the long-term geomorphologic evolution of the Bay would continue to be governed by large-scale Bay-wide processes (hydrodynamics and variations in sediment loading from the contributing watersheds). The proposed project would introduce some local bathymetric changes near the proposed platforms and East Bay borrow sites.

The major predicted geomorphological changes associated with the proposed BX-6 platforms are summarized as follows:

- If new Runway 10/28 is constructed on piles, the piles would reduce current speed resulting in deposition beneath the runway at an initial rate of 5 to 15 mm/year. Owing to the low rates of accretion, the seabed elevation is predicted to rise by only 0.25 to .75 meter in 50 years under this runway.
- If new Runway 10/28 is constructed on fill, reduced current speed would result in deposition on the eastern side of the runway at an initial rate of 10 mm/year. The seabed elevation is predicted to rise by only 0.5 meter in 50 years. Therefore, the area on the eastern side of the new 10/28 Runway would remain shallow subtidal Bay.
- Increased current speed would result in erosion at the tip of new Runway 28R at an initial rate of 25 to over 100 mm/year if the runway is constructed on fill material. The scour hole is predicted to range from 0.5 to 2 meters in depth over 50 years.
- Deposition on the eastern side of the existing 10/28 Runway platform would decrease since the sediment would settle out in the deeper waters on the east side of the new Runway 10/28 platform. The area of mudflat to the east of the existing 10/28 Runway platform is predicted to grow in the long-term under the No Project Alternative, whereas essentially no increase in this mudflat is predicted for Alternative BX-6 as a result of the cut-off of sediment supply.
- The presence of the new platforms for the 19 runways would reduce the amount of erosion occurring at the tip of new Runway 28R because part of the flow would be intercepted and diverted to the east. A scour hole would be formed at the tip of new Runway 19L but is predicted to be much smaller than that at Runway 28R. The actual scour depth would largely depend on the local sediment profile.
- Less than 5 mm/year of deposition is predicted to occur between the 1/19 runways since little exchange of water takes place between this area and the main channel. The bulk of the

sediment would settle out of the water column at the open end of this area near the tip of the runways, prior to reaching the back of this semi-enclosed area.

The additional flow in the vicinity of the South Bay wetland restoration sites described above would result in an initial rate of erosion near the inlet and outlet of these restoration areas of between 30 and 80 mm/year. The erosion rate would be higher for the all-fill option because of the larger increase in RMS speed. This rate is predicted to slow down over time as the Bay adapts itself to the new conditions and would stop naturally when it hits a more resistant stratum of the bed.

There would be an increase in current speed in the mudflats bordering the Bay side of the restoration sites, particularly near the Baumberg Wetlands Complex. This area is large and drains directly to the Bay. Opening this wetlands complex to the Bay would reduce deposition near the entrance to the site and increase erosion in some areas. Moreover, because a certain amount of sediment would be trapped in the site (where velocities are low and resistance to flow is high due to the presence of vegetation), less sediment would be available elsewhere to maintain the sediment budget. Deposition would therefore be reduced along the eastern shore within 5 km of the Baumberg Wetlands Complex, as well as in the shallow mudflats south of Dumbarton Bridge.

In the long term, some mudflats bordering the wetlands would be lost due to increased erosion and the formation of new mudflats along the eastern shoreline would be less than predicted for the No Project Alternative. The extent of mudflats south of Dumbarton Bridge would increase under the No Project Alternative. With the opening of the restoration sites these mudflats would not increase because the wetlands would act as sediment sinks and deprive other areas of the sediment supply.

The redistribution of sediments associated with the wetland restoration sites would not change the sediment transport patterns caused by the proposed runway platforms. However, because restoration of the South Bay sites considered in this study would increase the tidal prism of the South Bay, current speeds would be higher throughout the South Bay, including in the vicinity of the proposed new runway platform. This increase in current speed would result in an increase in sediment transport.

Sediment redistribution resulting from the Alternative BX-6 runway platforms and restoration of the South Bay wetland sites would be limited to the South Bay. Use of the East Bay Shoals borrow site would alter sediment flux in the Central Bay as well as the South Bay because of it's the proximity of this potential borrow site to the Bay Bridge. Sediment would be retained in the borrow pits once it settled because of the low bed shear stress, and less sediment would leave the South Bay during the ebb tide. The primary change in the Central Bay would be a decrease in deposition in the eastern shallow waters from the Bay Bridge north.

The incremental rate of deposition inside the borrow pit would be about 50 to 75 mm/year initially for both the hybrid and all-fill options in the deeper parts of the excavation. Over time the borrow pits would become smaller as they were filled with sediments. This would slow down the sedimentation rate in the borrow pits as the tidal current adjusted itself to the changing

bed elevation. Partially refilling the borrow pits with dredged material would decrease the time it would take for the pits to completely fill in.

Suspended sediment concentrations (SSC) throughout the Bay are highly variable and can range from 10 to 2,000 mg/L depending on the season and specific location. The increase in sediment transport associated with the proposed project would result in an increase in SSC. The Alternative BX-6 platforms constructed on all fill would cause an increase in SSC of up to 15 mg/L off of the tip of new Runway 28R between Coyote Point and Belmont Slough. The hybrid platform option would increase SSC up to 10 mg/l off the tip of new Runway 28R between Coyote Point and the San Mateo Bridge. These changes in SSC would occur west of the South Bay main channel, and would diminish as the bathymetry in the vicinity of the airport reached equilibrium.

The South Bay wetland restoration sites would act as a sediment trap when the dikes are breached. This would result in a reduction in SSC by up to 20 mg/L in an area extending approximately 5 kilometers off the eastern shore of the South Bay between the San Mateo and Dumbarton bridges. This would last until the wetlands reached equilibrium with the tidal influences of the Bay.

The potential East Bay borrow pits created by dredging would also decrease SSC north of the pits by up to 10 mg/L for the all fill platform option. The area covered by this decrease would extend approximately 10 kilometers north of the pits and it would be about 3 kilometers wide. The hybrid platform option would cause a similar magnitude change in SSC but the extent of the change would be about two-thirds the size of the all fill platform option. The change in SSC would gradually decrease as the borrow pits filled in.

7.2.2.2 Construction Phase

During construction of Alternative BX-6, the sediment generated from dredging and placement operations would be released into the water column, and would form a plume with decreasing concentration away from the point of discharge. Suspended sediment concentrations associated with dredging would typically be between 200 and 2000 mg/L within tens of meters of the source, declining exponentially away from the source in the direction of the current.

Suspended sediment plumes with concentrations in excess of 250 mg/L are predicted to be less than 100 meters long and 20 meters wide at SFO and the potential East Bay Shoals borrow site. An average far-field increase in SSC of about 7 mg/L is predicted near SFO and 15 mg/L at the potential East Bay Shoals site. Most of the sediment is expected to rapidly settle out of the water column.

Overburden and sand dredging at potential East Bay and San Bruno Shoals rehandling facilities is also predicted to generate suspended sediment plumes. These plumes are predicted to be smaller than those at SFO, predominantly because the sediment contains more sand than the material to be dredged at SFO.

No suspended sediment plumes are predicted to be introduced into receiving waters of the Bay from confined disposal at potential disposal and reuse sites in the North Bay.

7.2.3 Predicted Changes in Water Quality

7.2.3.1 Operation Phase

Increases in total chemical concentrations of PAHs, PCBs, and mercury are predicted to occur near the proposed runways and in the vicinity of the East Bay Shoals borrow site. These chemicals would be predominantly associated with suspended sediments, and the predicted changes are equivalent to increases in SSC described above. The concentrations of these three chemicals would decrease with time as SSC decreases with the equilibration of bathymetry in the vicinity of the new runway platforms and the East Bay Shoals borrow pits.

Water quality modeling also indicated the possibility of the new runway platforms causing increases in concentrations of PAHs, PCBs, and mercury during the dry season in a small area of the Lower South Bay west of the mouth of Coyote Creek. If the South Bay wetland sites considered in this study were opened to the Bay, concentrations of these chemicals are predicted to decrease as sediment is trapped in the restoration sites.

The 30-day averaged concentrations of PAHs, PCBs, and mercury are predicted to exceed chronic water quality objectives (WQOs) in the dry season in much of the South Bay for the No Project Alternative. The effect of the proposed project would be to cause additional exceedances of chronic WQOs for PAHs in small areas near SFO and the East Bay Shoals borrow site. For mercury and PCBs, no additional areas of the Bay are predicted to exceed chronic WQOs that are not already exceeded under existing conditions. Changes in concentrations of chemicals associated with suspended solids would likely diminish with time as the sediment cycle of the Bay adapted to the altered physical environment.

For the No Project Alternative, the highest dissolved copper concentrations are predicted to occur in the South Bay below the Dumbarton Bridge during the dry season due to chemical effects favoring desorption of metals from suspended sediments. These concentrations may exceed chronic WQOs. For Alternative BX-6, in combination with the potential East Bay Shoals borrow site and the proposed wetlands restoration in the South Bay, increases in dissolved copper concentrations are predicted to occur immediately north of East Bay Shoals borrow site and in the Bay adjacent to the wetland restoration sites.

Dissolved copper concentrations at the East Bay Shoals are predicted to increase between 0.05 to 0.25 µg/L, with a slightly larger area affected by all-fill platform option that the hybrid platform option. Concentrations in the Bay immediately adjacent to the South Bay mitigation sites may increase between 0.05 and 0.5 µg/L. No new sections of the Bay are predicted to exceed chronic WQOs for copper as result of the project.

The proposed project is not predicted to cause exceedances of the chronic WQOs for nickel. In addition, the project is not expected to cause measurable changes in salinity.

Residence time, which is a measure of the degree of flushing in the Bay, was estimated near the mouth of Coyote Creek to address potential project changes on flushing in the South Bay below the Dumbarton Bridge. Residence times were also estimated for points north and south of SFO

to evaluate the influence of circulation pattern changes associated with the Alternative BX-6 platforms.

For the far South Bay below the Dumbarton Bridge, both the MIKE21 and TRIM3D models predict no change in residence time due to the proposed runway platforms, potential South Bay restoration sites, and the potential East Bay Shoals borrow site. The residence time immediately south of SFO was predicted to slightly increase (0.5 to 2 days) with new Runway 10/28 constructed on fill. This would occur because the runway platform would physically block the exchange of water between the nearshore shallows and the main channel of the South Bay. In general, the influence of the project on residence time is predicted to be about the same for wet and dry season conditions.

7.2.3.2 Construction Phase

Increases in total chemical concentrations of PAHs, PCBs, and mercury are predicted to occur at SFO and the East Bay Shoals borrow site during construction. These chemicals would be predominantly associated with suspended sediments, and predicted changes are equivalent to increases in suspended sediment concentrations. Project construction is predicted to result in exceedances of PAH chronic WQOs near the East Bay Shoals borrow site. Project construction would not cause exceedances of chronic WQOs for PCBs or mercury in any part of the Bay where these objectives are already being exceeded.

Dissolved copper concentrations are predicted to increase between 0.05 and 0.5 µg/L in the vicinity of SFO and the East Bay Shoals borrow site during construction. Copper concentrations as much as 0.05 µg/L above background may extend from the SFO construction site to the Dumbarton Bridge. Although plumes in the vicinity of the Dumbarton Bridge are predicted to cause additional exceedances in a small area during the dry season, the results are within the uncertainty in the model.

Increases in dissolved copper concentrations above acute WQOs are predicted to occur during dredging of four of the thirteen SFO dredging units. Plumes associated with dredging are relatively narrow and change direction in response to the tide. Additional exceedances of acute WQOs for copper are predicted to occur in a 60 x 60 meter area during placement of sand fill material at the East Bay Shoals rehandling facility when a large hopper dredge is used and current speeds are high. Finally, water decanting from North Bay confined disposal facilities would require dilution in receiving waters to meet applicable WQOs for four of the fifteen dredging units designated for upland disposal.

7.3 CONCLUSIONS REGARDING PROJECTED CHANGES TO BIOLOGICAL COMMUNITIES

7.3.1 Predicted Primary Productivity Responses

Predicted changes to photosynthetic rate (and primary productivity) are directly related to predicted changes in suspended sediment concentrations. As suspended sediment concentrations

increase, light attenuation increases due to increased scattering of light by suspended sediment particles. An increase in light attenuation decreases the amount of available light energy for photosynthesis, subsequently decreasing photosynthetic rate. Therefore, any predicted decrease in photosynthetic rate that would result from the proposed project would be directly attributable to an increase in suspended sediment concentrations or to the direct removal of Bay waters due to the placement of fill.

7.3.1.1 Permanent Effects

Long-term, or "operational," impacts to photosynthetic rate (and primary productivity) are limited to a near-field region in and around the proposed platform. The greatest impact to photosynthetic rate associated with the proposed platform is the direct loss of Bay waters due to platform fill. This loss would represent a 1 percent decrease in photosynthetic rate for the entire South Bay assuming an even distribution of photosynthetic activity across the Bay. Predicted changes to suspended sediment concentrations near, but outside, the proposed platform footprint indicate almost equivalent areas of increases and decreases. Overall, the areas of increased photosynthetic rate are comparable to the areas of decreased photosynthetic rate.

7.3.1.2 Construction Effects

Predicted construction impacts to photosynthetic rate (and primary productivity) show greater change than do operational impacts if one excludes the portion of the Bay covered by the proposed platform. Dredging activities during construction would increase suspended sediment concentrations near the proposed platform as well as in and around the proposed borrow pits. This increase in suspended sediment concentration would cause localized decreases in photosynthetic rate near the dredging activities. Photosynthetic rate would decrease approximately 10 percent in and around the proposed borrow pit and approximately 8 percent in and around the proposed platform during construction activities. When the South Bay is viewed as a whole, these localized impacts represent less than a 2 percent decrease in photosynthetic rate and primary productivity across the entire South Bay (again assuming an even distribution of photosynthetic activity across the Bay). Once project dredging activities cease, photosynthetic rates should rebound to "typical" rates as the suspended sediment concentrations return to pre-construction values.

7.3.2 Predicted Benthic Community Responses

7.3.2.1 Permanent Effects

Infaunal Communities

The BX-6 alternative would result in the permanent loss of soft bottom, shallow subtidal and intertidal mudflat habitats and benthic (bottom dwelling) organisms associated with these habitats. Losses of shallow subtidal benthic habitat would range from approximately 0.49 percent (BX-6 Hybrid) to 0.53 percent (BX-6 fill) of the shallow, soft-bottom habitat in the South Bay (from the Bay Bridge south). Permanent loss of mudflat habitat represents 0.2

percent of the available South bay mudflat habitat. Affected benthic species would include amphipods, bivalves, and polychaete worms.

The reconfigured runways would result in an increase in hard substrate habitat from the placement of concrete or rock armoring around the perimeter of the runway and from piles used for the hybrid alternative. It is expected that colonization of the new hard substrates would be by species similar to those found along the existing runway perimeter. This hard substrate community is relatively sparse, with barnacles being the most common organism.

Long-term geomorphologic changes (e.g., changes in habitat from subtidal to mudflat) could result in changes to the benthic community structure. However, hydrodynamic and sediment transport modeling does not indicate substantial changes in habitat type over a 50-year period as a result of the project. Modeling of changes in sedimentation and bathymetry resulting from runway placement suggests long-term shifting of sediments and gradual changes in depth of up to 2 meters in some areas. These gradual changes in depth over 50-years are not expected to alter benthic community structure as none of these changes would result in a fundamental change in habitat type (i.e., a change from mudflat to subtidal habitat).

Eelgrass

Eelgrass occurs in very patchy areas near Coyote Point (south of the airport) and in larger beds near Bay Farm Island. The runway reconfiguration would not result in the direct removal of any eelgrass. Results of the hydrodynamic modeling do not suggest that long-term sedimentation or erosion would occur near these beds, thus no adverse permanent changes to habitat type near these beds is expected.

7.3.2.2 Construction Effects

Infaunal Communities

Dredging and associated sedimentation during construction would result in temporary disturbance to benthic habitats around the runway structures, the San Bruno Shoals rehandling basin, and at the East Bay Shoals borrow site. Dredging would result in the removal of benthic organisms. Settling of sediment in areas adjacent to the dredging and filling operations could bury fauna or clog feeding and respiration structures, resulting in the loss of some organisms in these areas. Dredging would directly affect between 193 and 303 ha at the East Bay Shoals borrow site, up to 24 ha at the San Bruno Shoals rehandling basin, and approximately 50 to 70 ha at the SFO construction area.

The dredging operations would not result in the permanent loss of organisms. The benthos would be expected to recolonize areas after the disturbance is complete. Recovery of the disturbed areas is expected to begin almost immediately after the disturbance ceases in a given area, and (based on the literature) could take 1 to 5 years to recover completely.

The species that recolonize an area after disturbance would depend in part on factors such as the type of substrate remaining and the pool of available larvae. The disturbance could favor nonindigenous species to the exclusion of native species. Alternatively, if recruitment is from

adjacent undisturbed areas, assemblages over time could resemble assemblages occurring in these areas now.

Eelgrass

Based on the modeling results, estimated suspended sediment concentrations and sediment deposition are expected to be low in areas where eelgrass occurs and are not expected to adversely affect eelgrass during construction.

7.3.3 Predicted Fish Community Responses

7.3.3.1 Permanent Effects

The construction of the BX-6 platform would exclude and displace fish from currently available habitat, and is expected to result in increased densities of fish within other intertidal and subtidal areas within the Bay. The biological importance of habitat displacement is expected to vary among species depending on carrying capacity, quality, and availability of suitable habitat. The greatest displacement of fish would occur for topsmelt, Pacific herring, and northern anchovy in intertidal areas, and for northern anchovy, Pacific herring, white croaker, bay goby, and shiner surfperch in subtidal areas.

Topsmelt, Pacific herring, and northern anchovy and other species (such as California halibut) which actively move throughout large areas of the Bay and coastal waters may be less subject to density dependent mortality factors resulting from displacement. This would reduce the potential risk of population level effects. Displacement of other species such as white croaker, shiner surfperch, and Bay goby could potentially result in an increased density of fish in other portions of the Bay, and thereby could result in localized density dependent mortality.

In general, San Francisco Bay in the vicinity of the project is not a unique habitat and similar intertidal and subtidal habitats are distributed throughout the bay. Species displaced from existing intertidal and subtidal habitat by permanent facilities associated with the proposed project would be expected to inhabit other suitable habitat within the bay.

For some species the magnitude of the habitat loss would potentially be offset through the creation of additional intertidal rocky habitat associated with riprap used to stabilize the runways. Rocky intertidal areas, including riprap, serve as foraging areas during high tide for a variety of resident Bay fish species and also provide important spawning areas for Pacific herring. Thus, the proposed project may increase the availability of suitable spawning habitat within the project area.

The fill option is expected to result in changes to the local hydrodynamic characteristics in the area and would alter the quality and availability of localized aquatic habitat for fish and macroinvertebrates. The localized changes in circulation patterns resulting from the fill option are not, however, expected to substantially alter habitat quality or availability within the Bay on a larger regional scale.

The construction of the BX-6 platform may affect migration for various fish species migrating nearshore and may cause changes in migration patterns including behavioral avoidance of

localized areas, delays in migration, an increase in length of the migration route and potentially increased vulnerability to predation. The proposed project would not result in the complete blockage of migration. Given the tidal currents and circulation patterns in the area, and the length and orientation of the reconfigured runways extending into the Bay from the shoreline, potential delays in migration are expected to be on the order of hours or days. Although not quantified, a short-term delay (hours or days), and an increase in migration distance is not expected to considerably contribute to incremental mortality of migratory species.

7.3.3.2 Construction Effects

Dredging and filling activity at the SFO site and at the East Bay Shoals borrow sites would physically disrupt intertidal and subtidal habitat currently utilized by fish. Many fish species inhabiting these areas would be expected to avoid exposure to suspended sediments and construction activity by moving out of the area of disturbance, while other more sedentary species, including many flatfish, would likely remain sedentary during the period of exposure.

Adverse effects on fish species and their habitat as a result of dredging are anticipated to last for the duration of the dredging period. Fish are expected to be adversely affected in the immediate project vicinity, but this is not anticipated to result in substantial regional changes in either the abundance or geographic distribution of fish and macroinvertebrates within the Bay and nearshore coastal waters. After completion of dredging and excavation activity, suspended sediment concentrations are anticipated to return to background conditions.

Suspended sediments in the water column can adhere to and smother fish eggs (such as those of Pacific herring), clog and erode the gill structures, reduce feeding rates and growth, and, in severe circumstances, may result in mortality. Increased suspended sediments from runway construction activities may affect the distribution and hatching success of Pacific herring spawning in the area, and the survival of eggs and larvae. The potential risk of adverse affects to Pacific herring spawning is expected to be minor since the majority of spawning occurs nearshore on hard substrates within the Central Bay.

Suspended sediments and construction activity would potentially adversely affect the movement and migration of fish and may cause behavioral avoidance of the construction area that could cause delays in migration and potentially increase exposure to predators. Based on local tidal currents and circulation patterns, the size and location of the plumes during construction, short-term delays to migration are expected, but would not likely result in substantial increases in mortality.

Construction activities associated with the placement of riprap and pile driving could result in increased underwater noise and acoustic pressure waves that would result in exclusion of sensitive fish species from an area extending approximately 150-200 meters from the pile driving, and may result in sublethal or potentially lethal conditions to sensitive fish species in areas immediately adjacent (e.g., within 15 to 20 meters) of pile driving activities. Adverse effects resulting from underwater sound pressure levels would terminate at the completion of pile driving and construction activity.

7.3.3.3 Special-Status Species

Fish species listed under the California and/or Federal Endangered Species Acts that are present within the San Francisco Bay and Sacramento-San Joaquin Delta include winter-run chinook salmon, spring-run chinook salmon, steelhead, delta smelt, Sacramento splittail, coho salmon, and tidewater goby. Of these species, chinook salmon and steelhead are likely to occur in areas that may be affected by the project. The proposed project would result in permanent and construction-related changes to habitat quality and availability for fish including the loss of both subtidal and intertidal habitat and modifications to habitat quality and availability.

San Francisco Bay in the vicinity of the project is not a unique habitat and similar intertidal and subtidal habitats are distributed throughout the bay. Special-status species displaced from existing intertidal and subtidal habitat by permanent facilities associated with the proposed project would be expected to inhabit other suitable habitat within the bay.

The proposed project has the potential to affect migration patterns of chinook, steelhead, and lamprey within the South Bay as a result of changes in localized current patterns, shoreline topography, and water quality associated with either the hybrid or fill runway configurations. Although not quantified, the incremental effect of short-term (hours or days) delay or alteration in migration is not expected to result in a considerable increase in mortality or reduced condition of these fish.

7.3.4 Predicted Bird Community Responses

7.3.4.1 Permanent Effects

Shorebirds

The project would result in the direct loss of approximately 27 ha of tidal flat habitat. Based on surveys conducted for this project, the majority of birds using this habitat are shorebirds. Other studies have estimated that between 225,000-325,000 shorebirds occupy the Bay in winter. Therefore, loss of tidal flat habitat from this project represents displacement of an estimated 0.7 to 1.2 percent of all shorebirds utilizing the Bay in winter.

Shorebirds may also be displaced or have reduced foraging success within areas adjacent to new runways due to changes in sediment texture, a decrease in habitat continuity, and operational disturbances. Small shorebirds in the genus *Calidris* are expected to be the most affected because they were observed in the highest densities during surveys conducted for this project and are the most sensitive to sediment characteristics.

Displacement and disturbance of habitat will likely result in increased shorebird densities in adjacent habitats and potentially within other areas of the Bay. Increased shorebird densities may result in prey reduction and increased foraging interference among individual birds resulting in a decrease in foraging success overall.

Waterfowl

The BX-6 alternative would result in a maximum direct loss of approximately 240 ha of shallow bay habitat due to new runway construction. The majority of birds observed using shallow bay

habitat around SFO during surveys conducted for this project were diving ducks (primarily scaup species). Based on population estimates from other studies, loss of shallow bay habitat represents displacement of an estimated 0.4 to 2.7 percent of the baywide diving duck population (not including Suisun Bay). Diving ducks may also be displaced from areas around the new runways due to operational disturbance.

The majority of birds at the East Bay Shoals borrow site were also diving ducks (primarily species of scaup and scoter). Dredging at the East Bay Shoals borrow site would deepen between approximately 190 ha (BX-6 hybrid) to 303 ha (BX-6 fill) to depths outside foraging range for both scaup and scoter. Approximately 20 ha of this area may be refilled back to depths within the foraging range of these birds.

Permanent effects from the project are expected to be small because there is a large amount of available shallow bay habitat in the Bay (approximately 60,000 ha, not including Suisun Bay).

Special-Status Species

Permanent effects to special-status species would primarily be limited to a reduction in shallow bay and tidal flat foraging habitat. Loss of foraging habitat is expected to have a small effect since special-status species including California brown pelican, long-billed curlew, double-crested cormorant as well as others were all observed to make limited use of shallow bay habitat around SFO during surveys conducted for this project.

The only special-status species known to nest in the vicinity of SFO is the California clapper rail. A population of clapper rail occurs approximately 1 kilometer north of SFO within San Bruno Marsh. Based on results from the hydrodynamic and sediment transport model, permanent effects to clapper rail nesting and foraging habitat are not expected as a result of the project.

7.3.4.2 Construction Effects

Shorebirds

Areas affected by noise and visual disturbance are expected to overlap. During runway construction, it is expected that daily activity levels will be high enough to exclude most shorebirds from the 100 ha tidal flat habitat along the Burlingame shoreline. Shorebirds are not expected to be displaced from other tidal flats in the vicinity because they are located several kilometers from construction activity.

Waterfowl

Areas affected by construction noise, visual disturbance, suspended sediment and sedimentation are expected to overlap. During runway construction, it is expected that daily activity levels producing these effects would be high enough to exclude most waterfowl from areas around the BX-6 footprint. The area of effect is roughly approximated to be 1,700 ha. The area of effect at the East Bay Shoals borrow site is not expected to be more than 50 ha at any given time and would likely be much smaller.

Special-Status Species

Effects to special-status species would be as described for shorebirds and waterfowl. Effects are expected to be minimal since special-status birds were observed to make limited use of areas where effects are anticipated.

7.3.5 Predicted Mammal Community Responses

7.3.5.1 Permanent Effects

Runway placement would decrease the amount of benthic habitat available for marine mammal foraging. Losses of shallow subtidal habitat due to runway placement would range from approximately 0.49 percent (BX-6 Hybrid) to 0.53 percent (BX-6 fill) of the shallow, soft-bottom habitat in the South Bay (from the Bay Bridge south). Marine mammals that forage in the Bay near SFO would include harbor seals, gray whales and sea otters. Occurrence of gray whales and sea otters in the SFO vicinity is considered rare. Harbor seals are much more common, although the area around SFO is not a primary foraging area for them.

Harbor seals in the Bay forage over large areas and have been known to travel up to 82 km in one day. Assuming that a harbor seal can forage throughout the South Bay, the loss of foraging habitat due to runway placement would represent 0.1 percent of the total potential foraging habitat. This is not expected to cause a decline in the population.

Long-term changes in sediment transport and deposition are not predicted to cause permanent changes in habitat types or changes in the area available as haul-out sites. Most harbor seal haul-out sites are n areas of the South bay well away from the proposed project.

Project-specific effects of airborne noise to marine mammals have not yet been analyzed for the proposed project. An aircraft noise study will be completed and the results will be used to assess potential effects to marine mammals. Permanent effects to marine mammals from underwater noise are not expected since there would be no ongoing estuarine activities within the proposed project. All increased noise related to the proposed project is expected to be airborne.

7.3.5.2 Construction Effects

Dredging and filling at both the SFO site and the East Bay Shoals borrow site would increase suspended sediment concentrations in the water column in the vicinity of the dredging activities. The suspended sediment concentrations would generally be within the range of natural variability in bay, to which marine mammals in the bay are adapted. The highest concentrations of suspended sediment would be localized around the dredging activity. It is anticipated that marine mammals would avoid these near-field areas due to the increased suspended sediment as well as the general disturbance and noise created by the work, and that foraging success in these areas would be lower due to the decreased visibility and decreased prey availability. Suspended sediment concentrations in areas removed from construction activities are expected to be low, and are not likely to have a substantial effect on marine mammal foraging.

Underwater noise effects from pile driving for the BX-6 hybrid alternative could affect marine mammals during the construction phase of the project. The National Marine Fisheries Service has indicated that sound pressure levels of 190 dB should be the maximum level of noise exposure, especially for harbor seals. Specific sound pressure levels that would potentially be generated during pile driving for the proposed project are unknown, but would depend in part on factors such as the type of piles being driven, the size of the pile driving hammer and water depth.

Airborne noise from construction could potentially disturb marine mammals in the area if levels are 50-60 dBA above ambient noise levels.

The presence and operation of vessels and construction equipment can either attract or repel some marine mammals. However, generally marine mammals are wary of humans and vessels and will alter their path or avoid an area if the amount of disturbance is excessive.

It is anticipated that the marine mammals would avoid the work areas to some extent during construction due to the combined effects of noise, human disturbance, and suspended sediments. This is not expected to have an effect on the overall population. Harbor seal population sin he bay are already stressed, possibly due to pollutants and human disturbance. Construction activities may add to the stress levels of these animals.