Chapter 3
Hydrology

3.1 Environmental Setting

3.1.1 Introduction and Sources of Information

This chapter describes the hydrology in the project area. It includes regulatory, regional, and project settings to provide a context for analyzing the effects of the project. Sources of data used in the preparation of this chapter include

- *the Bay Plan* (San Francisco Bay Conservation and Development Commission 2001*)*;
- *Report of the San Francisco Airport Science Panel* (National Oceanic and Atmospheric Administration 1999);
- *Evaluation of Ground Water Resources: Sonoma County* (California Department of Water Resources 1982);
- *Baylands Ecosystem Habitat Goals* (Goals Project 1999, 2000); and
- *CALFED Bay-Delta Program Final Programmatic Environmental Impact Report/Environmental Impact Statement* (CALFED Bay-Delta Program 2000).

3.1.2 Regulatory Setting

3.1.2.1 Federal Plans, Programs, and Policies

Rivers and Harbors Act

The Rivers and Harbors Act (RHA) of 1899 prohibits the unauthorized obstruction or alteration of any navigable waters of the United States. As defined by the RHA, navigable waters include all waters that are

- subject to the ebb and flow of tides and/or
- presently, historically, or potentially used for foreign or interstate commerce.

Regulations implementing Section 10 of the RHA are coordinated with those implementing CWA Section 404. Specifically, the RHA regulates

- construction of structures in, under, or over navigable waters;
- excavation or deposition of material in navigable waters; and
- all work affecting the course, location, condition, or capacity of navigable waters.

The RHA is administered by the Corps. If a proposed activity falls under the authority of both CWA Section 404 and RHA Section 10, the Corps processes and issues a single permit. For activities regulated only under RHA Section 10, such as installation of a structure not requiring fill, permit conditions may be added to protect water quality during construction.

Coastal Zone Management Act

The Coastal Zone Management Act of 1972 requires that federal actions be consistent with approved state coastal plans. BCDC's Bay Plan (Bay Plan) is an approved coastal plan under this act (see "McAteer-Petris Act" below for more information about this plan). Therefore, after suitable coordination with BCDC, the Corps would prepare a determination that the project is consistent with the Bay Plan.

3.1.2.2 State Plans, Programs, and Policies

McAteer-Petris Act

The McAteer-Petris Act of 1965 established BCDC as a temporary state agency charged with preparing a plan for the long-term use of the bay (the Bay Plan). In August 1969, the McAteer-Petris Act was amended to make BCDC a permanent agency and to incorporate the policies of the Bay Plan into state law.

Under the McAteer-Petris Act and the Bay Plan, any person or agency proposing to place fill in, to extract materials from, or to make any substantial change in the use of any water, land, or structure in BCDC's jurisdiction in San Francisco Bay is required to secure a San Francisco Bay permit. BCDC grants San Francisco Bay permits for projects that meet either of the following qualifications:

- The project is necessary to the health, safety, or welfare of the public in the entire Bay Area.
- The project is consistent with the provisions of the Bay Plan and implementing regulations.

There are three types of San Francisco Bay permits: regionwide permit, administrative permit, and major permit. The type of permit issued depends on the scope and nature of the proposed activities. The project sponsors would prepare a major permit or conformity determination for the proposed project.

California Fish and Game Code Sections 1601–1607 (Lake or Streambed Alteration Agreement Program)

Pursuant to Sections 1601–1607 of the California Fish and Game Code, DFG regulates projects that affect the flow, channel, or banks of rivers, streams, and lakes. Sections 1601 and 1603 require public agencies and private individuals to notify and enter into a lake or streambed alteration agreement with DFG before beginning construction of a project that would

- divert, obstruct, or change the natural flow or the bed, channel, or bank of any river, stream, or lake;
- use materials from a streambed; or
- result in the disposal or deposition of debris, waste, or other material containing crumbled, flaked, or ground pavement where it can pass into any river, stream, or lake. Lake or streambed alteration agreements may impose conditions to protect water quality during construction.

Sections 1601–1607 may apply to any work undertaken within the 100-year floodplain of any body of water or its tributaries, including intermittent stream channels. In general, however, they are construed as applying to work within the active floodplain and/or associated riparian habitat of a wash, stream, or lake that provides benefit to fish and wildlife. Sections 1601–1607 typically do not apply to drainages that lack a defined bed and banks, such as swales, or to very small bodies of water and wetlands, such as vernal pools.

The project sponsors would prepare a lake or streambed alteration agreement for the proposed project.

3.1.3 Regional Setting

3.1.3.1 Climate and Precipitation

The San Francisco Bay area, like much of California’s central coast, experiences a Mediterranean climate characterized by mild, wet winters and warm summers. Moderated by proximity to the San Francisco Bay system and the ocean, temperatures are seldom below freezing. Summer weather is dominated by sea breezes caused by differential heating between the interior valleys and the coast, while winter weather is dominated by storms from the northern Pacific Ocean that produce nearly all the annual rainfall.

San Pablo Bay typically receives about 90% of its precipitation in the late fall and winter months (November–April); January has the greatest average rainfall.

Average annual precipitation ranges from about 20 inches in San Pablo Bay to 40 inches in the upper watersheds of the region's major tributaries (Napa River and Sonoma Creek) (Rantz 1971).

3.1.3.2 Tides

San Francisco Bay experiences a mixed diurnal tide cycle, with two high tides and two low tides per day. Tide data relevant to the project area are collected by the National Oceanic and Atmospheric Administration (NOAA) in San Pablo Bay near the mouth of the Napa River and on the Napa River near Edgerley Island (next to Pond 8) and in Napa (Table 3-1). The tidal data were collected relative to the mean lower low water datum, which has not been surveyed to the land-based data (NGVD 29 or NAVD 88).

Table 3-1. Elevations of Tidal Datum Referred to Mean Lower Low Water, in Feet

Tide	San Pablo Bay at Mare Island	Napa River at Edgerley Island	Napa River at Napa
Mean Higher High Water	5.73	6.30	6.66
Mean High Water	5.18	5.55	6.15
Mean Tide Level	3.05	3.20	3.54
Mean Low Water	0.93	0.86	0.94
Mean Lower Low Water	0.00	0.00	0.00

Source: National Oceanic and Atmospheric Administration 2001.

The tidal influences in the Napa River Unit from San Francisco Bay can be observed throughout the slough network with little or no muting by friction, which indicates that existing channels are large enough to allow full tidal exchange under existing conditions. Tidal flows are important because they contribute to channel shape and form through erosion and sedimentation.

3.1.3.3 Bay-Delta Estuary

The Bay-Delta estuary is the largest estuary on the West Coast of North and South America. It can be divided into three distinct component bays or "subestuaries": San Francisco Bay, San Pablo Bay, and Suisun Marsh (Figure 1-1). Located on the central coast of California, this estuary system occupies a natural topographic separation between the northern and southern coastal mountain ranges and functions as the only drainage outlet for waters of the Central Valley.

The Central Valley is drained by the Sacramento and San Joaquin Rivers, which enter San Pablo Bay and San Francisco Bay through the Delta at the eastern end of Suisun Bay. The Sacramento and San Joaquin Rivers contribute more than 95% of the estuary's freshwater inflow. Many smaller rivers and streams also convey fresh water to the Bay-Delta estuary.

The volume and timing of freshwater inflow are among the most important factors affecting physical, chemical, and biological conditions in the estuary. Freshwater input from the Delta peaks during the spring, when snow from the Sierra and other high mountain ranges of California melts. Input from smaller local tributaries, influenced by the region's Mediterranean climate, is strongly seasonal, with more than 90% of net annual runoff occurring during the winter (November–April) rainy season (Goals Project 1999).

In the north bay region, the principal groundwater-bearing aquifer is composed of alluvial deposits, which cover most of the valley areas in the Sonoma and Napa Valleys. These aquifers are largely continuous, with general flow toward San Pablo Bay. In the region adjacent to the bay, however, local flow has been reversed as a result of groundwater extraction, leading to saltwater intrusion. Groundwater levels in the alluvial deposits vary locally, but are generally 5–75 feet below the ground surface. In southern Sonoma County, local variations are observed because of the presence of local impermeable layers, which create small semiconfined aquifers. *Specific yield* is a measure of aquifer productivity, and is defined as the volume of water drained divided by the total volume of the sample. In alluvial deposits, the specific yield is moderate to high (8%–17%), which illustrates that the aquifer can produce substantial amounts of water.

The most significant natural recharge into alluvial aquifers occurs from rivers and streams. Generally, the alluvial deposits are not permeable enough to allow natural recharge from surface infiltration, although there is some limited recharge through surface infiltration resulting from precipitation.

As the land elevation ascends into the Huichica mountain range, the groundwater aquifer changes because volcanic deposits are present. The Huichica formation is composed of reworked volcanic sediments, with a low specific yield ranging from 3% to 7%. The low specific yield illustrates that this aquifer has lower productivity than alluvial deposits.

The Huichica formation produces limited amounts of groundwater, and the same soil conditions that limit productivity also limit recharge. The primary source of recharge is infiltration, usually through outcrops of the formation in the higher mountainous areas.

3.1.4 Project Setting

3.1.4.1 Surface Waters

San Pablo Bay

San Pablo Bay is a shallow bay strongly influenced by runoff from the Sacramento and San Joaquin Rivers. Natural runoff from tributaries directly into San Pablo Bay is highly variable. The upper elevations of the tributary watersheds are low enough to preclude any significant snowpack in most years, so there is no significant snowmelt runoff. In addition, permeability of soils and bedrock is generally low in the Coast Ranges. Thus, infiltration rates are slow and runoff rates are high, and the majority of the area's runoff occurs during and shortly after rainfall events. Consequently, tributary base flow is poorly sustained; runoff volume and streamflow depend almost entirely on total precipitation, which is variable from year to year.

This variability has important implications for the behavior of all San Francisco Bay Area streams including the Napa River and Sonoma Creek, which drain to San Pablo Bay on either side of the project area (Figure 3-1). Many smaller tributary streams are naturally dry during the summer, particularly in basins that receive less than 35 inches of precipitation annually; in others, summer base flow is far less than winter peak flow. In addition, flows vary markedly between dry and wet years.

Napa River

The Napa River watershed encompasses approximately 425 square miles. The Napa River flows south through the Napa Valley approximately 40 miles from its headwaters on the southern slopes of Mt. St. Helena and the Mayacamas Mountains to its mouth in San Pablo Bay (Figure 3-1).

Flows from the Napa River vary markedly between dry and wet years. The long-term average discharge of the Napa River is approximately 66,000 af; however, the minimum recorded annual discharge (~5,000 af) occurred in 1931, and the maximum recorded annual discharge (in excess of 200,000 af) occurred in 1986 (U.S. Geological Survey 2001).

Sonoma Creek

The Sonoma Creek watershed encompasses approximately 160 square miles. The watershed is commonly divided into three subbasins: Fowler Creek and the smaller creeks west of Sonoma; Nathanson Creek and the creeks east of Schellville; and the mainstem of Sonoma Creek. The headwaters of the western tributaries lie in the Sonoma Mountains; most of the small creeks are collected by Fowler Creek, which eventually drains to Sonoma Creek near the town of

Sonoma. The eastern tributaries drain the hills to the north and east of Sonoma and join Schell Creek just south of town. Schell Creek flows for 5 miles before entering a network of channels and sloughs that interconnect with Sonoma Creek (Figure 3-1).

Sonoma Creek flows into San Pablo Bay via a number of circular sloughs and channels that have been highly modified over the last 150 years by dredging, levees, and realignment.

Flows from Sonoma Creek also vary markedly between dry and wet years. The long-term average discharge of Sonoma Creek is approximately 43,000 af; however, the minimum recorded annual discharge (~3,000 af) occurred in 1939, and the maximum recorded annual discharge (in excess of 115,000 af) occurred in 1956 (U.S. Geological Survey 2001).

Petaluma River

The Petaluma River watershed includes approximately 146 square miles and is 19 miles long. The upper 7 miles are upland in mountainous or hilly terrain, and the lower 12 miles are in an estuary area known as the Petaluma Marsh. The river starts upstream of the city of Petaluma and is used to transport commercial goods to and from Petaluma. The headwaters of the river are on the southwest slope of Sonoma Mountain, the southern slope of Mecham Hill, and the eastern slopes of Weigand’s Hill and Mt. Burdell.

The Corps began dredging the Petaluma River for navigation in 1880, when it widened the existing creek to 50 feet wide and 3 feet deep at high tide. The Corps continued making the creek wider and deeper to allow additional navigation, and Congress declared the creek a river in 1959. High rates of siltation require the Corps to dredge the river regularly, with the San Pablo Bay channel being dredged on a 12-year cycle and the upper river channel being dredged on a 4-year cycle. (Southern Sonoma County Resource Conservation District 1999.)

Schell Slough

Schell Slough is a small waterway that flows into San Pablo Bay via several other sloughs, including Steamboat Slough, Third Napa Slough, Second Napa Slough, and Sonoma Creek. Wastewater from SVCSD is discharged into Schell Slough during the winter months.

Huichica Creek

Huichica Creek is an ephemeral stream that flows from the grasslands north of the project area. The creek is diverted in several locations into detention reservoirs for later use in vineyards. It terminates at Hudeman Slough.

Hudeman Slough

Hudeman Slough is a small waterway that flows into San Pablo Bay via Second Napa Slough. Treated wastewater from SVCSD is discharged into Hudeman Slough during the winter months, but SVCSD has a zero-discharge limit from May through the end of October. SCWA, which runs the plant, has created a mitigation and enhancement wetlands project on the site of Hudeman Slough. SCWA's objective is to restore freshwater and muted tidal marshes, and it uses recycled water to aid in the restoration effort. (Camp Dresser and McKee 2000.)

Suscol Creek

Suscol Creek is an intermittent stream that flows into the Napa River immediately north of the Suscol WWTP.

Salt Ponds

The creation and operation of the salt ponds is described in detail in Chapter 2, "Site Description and Alternatives." In general, hydrology in the ponds is driven by operation of the facilities and precipitation. There is a net evaporative loss of water from the ponds, which was important in the salt-production process. The net evaporative loss typically ranges from 22 to 23 inches per year (Philip Williams and Associates 2002a). Bed elevations were measured before the hydrologic modeling effort and are illustrated in Figure 2-3. Water levels vary based on the season and operational conditions of the water control structures, but were historically maintained by Cargill at 0.5–4.5 feet deep.

3.1.4.2 Groundwater

Section 3.1.3.3, "Bay-Delta Estuary," above, provides a general description of the principal groundwater-bearing aquifer in the north bay region.

Groundwater hydrology in the area of the currently proposed pipelines for the Water Delivery Option (i.e., near the pipelines from the Sonoma and Napa WWTPs) is characterized by alluvial deposits with moderate to high productivity. Less than 0.5 mile north of the Sonoma Pipeline, the terrain starts to rise and the dominant groundwater feature becomes the Huichica formation. The Napa Pipeline travels along the border of the alluvial deposits (southeast of the pipeline) and the Huichica formation (northwest of the pipeline). South of the Sonoma and Napa Pipelines and for the length of the CAC Pipeline, the alluvial deposits are covered with a layer of Bay Mud. Bay Mud deposits typically contain brackish or saline water, which has the potential to influence the alluvial deposits underneath.

In the area surrounding the Sonoma and Napa Pipelines, the domestic and agricultural water use is split between surface water and groundwater. Along the

CAC Pipeline, a limited amount of groundwater is pumped for domestic uses because this area receives treated drinking water from the City of American Canyon. The surrounding agricultural areas depend on a mix of surface water and groundwater.

3.1.4.3 Geomorphology

The geomorphology of stream and slough channels in the project area reflects a long history of reclamation and water management. The major historical sloughs in the Napa River Unit remain intact, as reclamation occurred along these channels to minimize the amount of effort to convert the land from marsh to grazing land, but additional marsh has evolved as the hydrology of the slough system was altered.

3.1.5 Analysis Conducted for This Project

PWA has conducted extensive modeling of the proposed project area as part of Phase 1 of the hydrodynamic and geomorphologic analysis. One document recently released entitled *Hydrodynamic Modeling Analysis of Existing Conditions* (Philip Williams and Associates 2002a) was prepared to characterize the baseline or existing hydrodynamic conditions and construct a hydrodynamic model to simulate these conditions. In addition, geomorphic interpretation of the response of slough channels to the tidal restoration of the marsh system was investigated.

The existing physical conditions include parameters such as water surface elevation and salinity, and sediment transport, using a combination of one- and two-dimensional computational modeling. One-dimensional (1-D) computational modeling is used to describe the predominantly 1-D flow through the network of slough channels and rivers (the Napa River and Sonoma Creek), and two-dimensional (2-D) computational modeling is used to describe the predominantly 2-D mixing processes in the former salt ponds. This study is closely connected to other recent projects upon which this study draws information:

- The investigation of the USGS and UCD, to collect velocity, salinity, depth, suspended sediment concentration, and temperature data at a series of 17 monitoring locations in the slough channels and rivers across the site between September 1997 and March 1998 (Warner 2000). These data were used to provide boundary data for the existing conditions model and for calibration and validation purposes of the 1-D computational model of the slough channels and rivers that extend across the site of the former salt ponds.
- The contract undertaken by Towill, Inc., of San Francisco to produce a Digital Terrain Model (DTM) of the slough channels, rivers, salt ponds, and marsh plains of the site using a combination of topographical and

bathymetrical surveying, aerial photography, and photogrammetry (Towill 2001). The DTM was used by PWA to construct the geometrical information required for the hydrodynamic model.

- The contract undertaken by PWA to physically measure the stage-discharge relationships for a selection of siphon water conveyance structures connecting the former salt ponds (Philip Williams and Associates 2002a). This information was used to characterize and identify the flow through the siphons to supplement theoretical discharge relationships that have been developed as part of the 2-D modeling of the former salt ponds.
- *Napa-Sonoma Marsh Restoration Project Phase I and Phase II Feasibility Studies for the Napa River, California* (Philip Williams and Associates 2002a, b, and c). These reports identified issues associated with the influence of the proposed restoration of Skaggs Island and Cullinan Ranch, technical issues identified by the MTAG, and restoration option modeling and analysis.

3.2 Environmental Impacts and Mitigation Measures

3.2.1 Methodology and Significance Criteria

Criteria based on professional judgment and the State CEQA Guidelines were used to determine the significance of hydrology impacts. The project would have a significant impact on hydrology if it would

- substantially alter existing drainage patterns;
- substantially alter groundwater recharge patterns; or
- increase the risk of substantial property loss, injury, or death as a result of flooding.

The State CEQA Guidelines also state that a project would have a significant impact if it would

- substantially increase runoff, resulting in flooding on-site or off-site;
- create or contribute runoff water that would exceed the capacity of existing or planned stormwater drainage systems; or
- place within a 100-year flood hazard area structures that would impede or redirect floodflows.

The project or options would not affect runoff or stormwater infrastructure, or be an impediment to floodflows. Additionally, these criteria are intended for evaluation of development of urban land uses and do not apply to the proposed project.

3.2.2 No-Project Alternative

DFG would continue to manage water in the salt ponds as it does today. Water is pumped, as funding allows, directly from the Napa River and from San Pablo Bay to manage salinity in the ponds for wildlife habitat. No water is released back to the slough system, Napa River, or San Pablo Bay (from the north side of Pond 1). Although some water may percolate to groundwater, the vast majority is lost to evaporation. Continued operations under the existing regime would not alter drainage or recharge patterns, increase runoff, or contribute runoff that would exceed the capacity of the existing stormwater system. Therefore, there would be no impact on hydrology. No mitigation is required.

DFG would also continue to maintain the flood protection infrastructure. The levee system is in various states of disrepair. Levees are constructed of native bay muds dredged from the sloughs or the insides of the islands and are not engineered for flood protection purposes. The levee system does not provide 100-year flood protection. While flooding may occur in the area, continued operations under the existing maintenance regime would not substantially increase the risk of property loss, injury, or death. Therefore, there would be no impact on flooding. No mitigation is required.

3.2.3 Salinity Reduction Option 1A: Napa River and Napa Slough Discharge

3.2.3.1 Beneficial Impact H-1: Reduced Risk of Property Damage, Injury, or Death as a Result of Flooding

The existing levee system is in various states of disrepair (Figure 2-2). If the weak sections in Pond 6A levee failed, Pond 6A would greatly increase the volume of the tidal prism that flows through adjacent sloughs. These increased flows would in turn lead to accelerated slough channel erosion, which could cause additional levee failures on either side of the slough channel. Levee failures along the western side of the project area would result in the inundation of adjacent agricultural lands. The levee system would be repaired under this option, including the Pond 3 ditches, to facilitate salinity reduction, thus reducing the risk of failure. This impact is considered beneficial. No mitigation is required.

3.2.3.2 Impact H-2: Modification of Surface Drainage Patterns

Implementation of this option would result in minor changes in surface flow to and from the Napa River and sloughs. However, the change on a daily basis (approximately 70–500 cfs, depending on phase) is inconsequential when compared to the daily flow of the tidal prism of the lower Napa River and slough system (approximately 25,000 cfs). The 0.3–2% change is further minimized by the variability of freshwater flow of the Napa River. The changes in surface drainage patterns are small enough that they can be accommodated within the existing channels without an adverse effect. Therefore, this impact is considered less than significant. No mitigation is required.

3.2.4 Salinity Reduction Option 1B: Napa River and Napa Slough Discharge and Breach of Pond 3

Impacts under Salinity Reduction Option 1B are nearly the same as those under Salinity Reduction Option 1A for Beneficial Impact H-1 (except the Pond 3 ditches would not be repaired) and Impact H-2. In addition, as described below under Impact H-3, there would be an increased risk of damage to adjacent properties.

3.2.4.1 Impact H-3: Increased Risk of Property Damage, Injury, or Death as a Result of Flooding

Breaching the levee system would open Pond 3 to substantial daily tidal flows that would result in periods of time when the ponds are deeper than under existing conditions. Increased depth may cause additional weakening on the internal sides of the remaining levee by increased wind and wave erosion and by daily wetting and drying of the levee materials.

A subsequent levee failure from one of the breached ponds to an adjacent slough (South, Devil’s, Dutchman, or China Slough) would open an additional pathway for tidal flow that could result in channel erosion and could expose other levees to increased risk of failure. Although this sort of cascading levee failure would be generally consistent with the overall habitat restoration goals of the project site, adjacent properties such as Cullinan Ranch could also be affected. Therefore, this impact is considered significant. Implementation of Mitigation Measure H-1 would reduce this impact to a less-than-significant level.

Mitigation Measure H-1: Repair Unintended Levee Breaches

To prevent channel erosion and potential damage to adjacent levee systems, the project sponsors will repair unintended levee breaches that are not consistent with the restoration option selected for implementation.

3.2.5 Salinity Reduction Option 1C: Napa River and Napa Slough Discharge with Breaches of Ponds 3 and 4/5

Impacts under Salinity Reduction Option 1C (Beneficial Impact H-1 and Impact H-2) are nearly the same as those under Salinity Reduction Option 1B. Impact H-3 is slightly different and is described below.

3.2.5.1 Impact H-3: Increased Risk of Property Damage, Injury, or Death as a Result of Flooding

The impact is nearly the same as that under Salinity Reduction Option 1B except that the severity of the impact would be somewhat greater because Pond 4/5 would also be opened for salinity reduction. This impact is considered significant. Implementation of mitigation measure H-1, "Repair Unintended Levee Breaches," would reduce this impact to a less-than-significant level.

3.2.6 Salinity Reduction Option 2: Napa River and San Pablo Bay Discharge

Impacts under Salinity Reduction Option 2 (Beneficial Impact H-1 and Impact H-2) are nearly the same as those under Salinity Reduction Option 1A.

3.2.7 Water Delivery Option

This option would provide treated wastewater to increase the dilution rate of the saline waters stored in the ponds. It could be applied to any of the salinity reduction options discussed previously. The total annual flow would be 5,000 af, which is about 7.5% of the average annual Napa River discharge.

3.2.7.1 Impact H-2: Modification of Surface Drainage Patterns

Water Delivery Project Component

Construction of the Sonoma, Napa, and CAC Pipelines could alter existing surface drainage patterns on a temporary and localized basis. Such alteration of drainage patterns would occur when sandbags, dikes, pumps, or other means are used to divert surface runoff around open-trench areas, pipe-jacking pits and receiving areas, and other such work areas. Such diversion generally would be short-term (typically 1–5 days) and limited to areas of active construction (i.e., pipeline construction segments would typically be about 200–300 feet long).

The Sonoma Pipeline route would cross Schell Slough, Huichica Creek, and two unnamed creeks as well as several smaller unnamed drainage ditches. Crossing of Schell Slough, Huichica Creek, and the two unnamed creeks (near where Ramal Road reaches the NWPRA railroad alignment and just west of Huichica Creek) would be accomplished using a jack-and-bore or other trenchless method whereby the pipeline is advanced beneath the subject stream and there is no alteration of the streamcourse or waters therein. At the smaller unnamed drainage ditches, trenching would be used for pipeline construction and, to the extent feasible, would be timed to avoid storm events/periods. It may be necessary on occasion, however, to employ short-term drainage diversion and control measures such as those described above. The pipeline route would also be within 400 feet of Hudeman Slough, but areas surrounding Hudeman Slough would be outside the limits of construction for the pipeline.

The Napa Pipeline route would cross under the Napa River, Suscol Creek, and several culverted drainage channels along county roadways. Crossing of the Napa River would be accomplished by directional drilling; crossing of Suscol Creek would use jack and bore or other trenchless methods. To cross the drainage canals, trenching would be used for pipeline construction and, to the extent feasible, would be timed to avoid storm events/periods.

The CAC Pipeline would cross the Napa River and would use an existing 24-inch transite and 16-inch rubber pipeline; hence, this surface watercourse would not be affected by pipeline construction.

In summary, implementation of the Water Delivery Project Component would result in short-term localized alterations of existing drainage patterns that would be limited to the time of construction activities. This impact does not represent a substantial alteration of existing drainage patterns.

This impact is considered less than significant. No mitigation is required.

Water Delivery Program Component

Exact alignments and construction methods have not yet been determined for the Water Delivery Program Component of the Water Delivery Option (i.e., potential future pipelines from the City of Petaluma, Novato SD, and LGVSD WWTPs). It is anticipated, however, that potential impacts on drainage patterns would be comparable to those described above for the Water Delivery Project Component, based on overall similarities in the nature of the subject improvements. Such similarities include the placement of pipeline primarily within existing roadways, railroad ROWs, and other improved corridors and the interest, from a regulatory standpoint, in using jack-and-bore or other trenchless methods to avoid direct crossings through rivers and major water bodies. Impacts on drainage patterns from implementation of the Water Delivery Program Component are anticipated to occur primarily from the temporary diversion of runoff around pipeline construction corridors and would be short-term and localized in nature.

It is anticipated that the impacts of the Water Delivery Program Component would be comparable to those of the Water Delivery Project Component; however, because the exact alignments and construction methods for the Program Component are uncertain, actual alteration of drainage patterns could be substantially different from and greater than assumed above.

This impact is considered significant. Implementation of Mitigation Measure H-2 would reduce this impact to a less-than-significant level.

Mitigation Measure H-2: Avoid Drainage Pattern Alteration in Plans for Future Pipeline Alignments

When the exact alignments and construction methods are determined for pipelines from the City of Petaluma, Novato SD, and LGVSD WWTPs, existing drainage patterns will be taken into consideration. Measures to avoid substantial alteration of the drainage patterns will be identified, evaluated, and applied as feasible and appropriate. Such measures may include, but not necessarily be limited to,

- placing pipeline in existing roadways and other such corridors with drainage improvements suitable for temporary rerouting of surface flows;
- avoiding placement and/or construction of pipeline in or through rivers, streams, or major drainage channels requiring substantial diversion or alteration of surface flows;
- avoiding any notable permanent alteration of drainage patterns;
- designing a construction program to enable pipeline advancement to occur in segment lengths that avoid extended periods of open trench and/or associated conditions requiring runoff diversion; and
- minimizing, if not avoiding, pipeline construction in major drainage areas during the rainy season (November–April).

3.2.7.2 Impact H-4: Alteration of Groundwater Supplies or Recharge Patterns

Water Delivery Project Component

Construction of the currently proposed pipelines may require dewatering during excavation for, and placement of, pipelines from the Sonoma, Napa, and CAC WWTPs. Similarly, excavation and use of pipeline jacking and receiving pits at the crossing of Huichica Creek, Napa River, and Suscol Creek may require temporary dewatering. These dewatering activities would be relatively short-term (approximately 5–10 days on average) and very localized. Such construction-related activities would not substantially deplete groundwater supplies nor would they alter groundwater recharge patterns.

Operation of the project would not result in any depletion of groundwater supplies and could, in the long term, contribute to the reduced use of local groundwater supplies for agricultural purposes. As the need for reclaimed water as part of the Napa River Salt Marsh Restoration Project diminishes over time, more reclaimed water would be available to agricultural operations along the pipeline routes. Those agricultural operations that rely on groundwater as a source of irrigation water would have an additional water source to offset and reduce the reliance on groundwater supplies. The project’s potential to reduce depletion of groundwater supplies is considered a beneficial impact.

The project could alter recharge patterns, but with positive results by increasing recharge. Portions of land currently irrigated with groundwater instead would be irrigated with recycled water, which produces “in-lieu recharge.” In-lieu recharge occurs when groundwater pumping is reduced, allowing natural mechanisms to recharge the groundwater without withdrawal. In addition to in-lieu recharge, there could be water from newly irrigated crops. Increased water availability could cause a crop shift from dry farming to irrigated farming, which could provide additional percolation from agricultural fields.

Overall, this impact is considered less than significant; in some respects, it may be beneficial. No mitigation is required.

Water Delivery Program Component

Although the exact alignments and construction methods have not yet been determined for the Water Delivery Program Component of the Water Delivery Option, the overall construction- and operations-related impacts of the Water Delivery Program Component would likely be comparable to those described above for the Water Delivery Project Component based on similarities in the basic nature and design of the pipelines. Implementation of the Water Delivery Program Component is not expected to substantially deplete groundwater supplies or substantially alter groundwater recharge patterns.

Overall, this impact is considered less than significant; in some respects, it may be beneficial. No mitigation is required.

3.2.8 Habitat Restoration Option 1: Mixture of Tidal Marsh and Managed Ponds

3.2.8.1 Beneficial Impact H-2: Modification of Surface Drainage Patterns

Activities associated with habitat restoration, including the reestablishment of full tidal exchange, would result in long-term alteration of surface drainage patterns in the project area. Existing surface drainage patterns would largely be disrupted. However, human activities around the margins of San Pablo Bay during the past 150 years have substantially altered existing drainage patterns from their natural condition and function. After restoration, drainages would convey the full amount of runoff and tidal flow, representing a return to a more natural hydrologic condition and function. Consequently, this impact is considered beneficial. No mitigation is required.

3.2.8.2 Beneficial Impact H-5: Increased Flood Conveyance Capacity

Tidal channels on and adjacent to restored marshlands would be larger after restoration than under existing conditions, as a result of natural channel erosion, as areas adjacent to dredged channel segments achieve dynamic equilibrium with adjusted channel form and invert elevation of modified channel reaches.

Consequently, flood conveyance capacity of major tidal channels would be increased, lowering flood risk on nearby parcels. This impact is considered beneficial. No mitigation is required.

3.2.8.3 Impact H-6: Continued Adjustment of Invert Elevation and Channel Form near Breached Channel Segments

Channel reaches adjacent to breaches made during construction would continue to adjust to the new increased tidal prism. Because existing channel gradients are gentle, and because breaching would not result in large changes in invert elevation or channel form, this effect would be minor and would be confined to the immediate vicinity of the project site. However, short-term channel incision would likely result in increased sediment suspension and water turbidity downstream of areas where erosion is taking place. (These effects are described in more detail in Chapter 4, “Water Quality.”) Appropriate site-specific design should ensure that this effect would be comparatively minor and that it would decrease and disappear as the system equilibrates as part of habitat restoration. This impact is considered less than significant. No mitigation is required.

3.2.8.4 Impact H-7: Potential Increase in Flood Risk on Adjacent Properties as a Result of Increased Discharge in Tidal Channels

Where tidal connectivity is established by opening the former salt ponds to an existing tidal channel rather than creating a direct connection to San Pablo Bay or the Napa River, site development has the potential to increase flood risk on properties that surround the project site. Several factors influence the potential change in flood risk, including increased tidal prism (increased discharge) in existing tidal channels, and the design characteristics and tolerances of existing levees.

Reestablishing tidal connectivity initially would increase the average discharge in tidal channels. Increased discharge would increase the potential for erosion of levees as a result of tidal currents and for seepage and seepage-related failures as a result of increased hydraulic gradient attributable to erosion of slough side materials. The effects of increased discharge would be most pronounced immediately after tidal connectivity is reestablished and would moderate as restored marshlands aggrade and tidal prism decreases. The new equilibrium size of the South and Dutchman Slough channels needed to convey the new tidal prism would be substantially wider than the existing channels. Assuming that the channel would erode quickly and symmetrically along the centerline of the existing channel, the levees on both banks would be undercut. Because there would be an initial increase in the risk of property loss, particularly along South and Dutchman Sloughs, this impact is considered significant. Implementation of Mitigation Measure H-3 would reduce this impact to a less-than-significant level.

Mitigation Measure H-3: Refine Project Design to Limit Adverse Effects of Increased Tidal Discharge

Additional hydraulic modeling is being conducted by the Coastal Conservancy and the Corps to identify channel reaches where channel or levee erosion is likely once tidal connectivity is restored as a result of project implementation (Philip Williams and Associates 2002c).

As part of the development of final project design, data from site-specific hydraulic modeling will be further evaluated to determine channel size and morphology, width of buffer zones, and levee improvements if necessary, to ensure that all channels are adequate for anticipated post-restoration discharge. Design features that have not yet been identified in the project description, such as levee breach phasing or alternate levee breach locations, may be recommended.

Once the project is implemented, a monitoring and adaptive management plan will also be implemented to monitor the expansion of the slough channels to accommodate the additional tidal prism and to ensure that the expansion does not threaten the adjacent levee systems. If channel expansion threatens adjacent levees, the adaptive management team will recommend measures to protect the levee in question. These measures may include additional levee breaches, altering the phasing of pond levee breaching, or requiring levee repairs or revetment.

3.2.8.5 Impact H-8: Potential Increase in Flood Risk on Adjacent Properties as a Result of Wave Erosion

Breaching and lowering selected portions of perimeter levees would connect restored marsh, creating larger, potentially deeper areas of open water. The potential is greatest in the larger and deeper ponds—Ponds 4, 5, and 6. Initially, breaches would remain comparatively small and the levees would provide barriers to wind-driven waves. Because the levees would no longer be maintained after tidal connectivity is reestablished, they would erode gradually, representing progressively less important barriers to wind-driven waves and allowing fetch across open waters at high tide to increase. As a result, wind-driven waves that affect adjacent levees may be larger after habitat restoration than under existing conditions.

Increased wave activity may increase the potential for levee damage and failure as a result of wave erosion, potentially increasing the risk of flooding on adjacent properties such as Skaggs Island and Cullinan Ranch. Increased wave erosion effects would moderate somewhat as the restored marshlands naturally aggrade; smaller waves would be generated and waves would shoal progressively farther from levees, and correspondingly more wave energy would be dissipated before impinging on the levees.

The severity of this effect would depend on the length of time it takes for the marsh plain to develop and the distance between the levee and open water to increase. Based on the accretion modeling done to date, this problem would be most likely to occur during the first 20 years of restoration in each pond. In the event of such an occurrence, nearby levees could be damaged.

This impact is considered significant. Implementation of Mitigation Measure H-4 would reduce this impact to a less-than-significant level.

Mitigation Measure H-4: Evaluate Susceptibility of Levees to Wind-Driven Wave Erosion and Conduct Repairs as Needed

The project sponsors will have a California-licensed civil engineer evaluate the stability of the levee system with respect to wind-driven wave erosion resulting from project implementation. If necessary, the civil engineer will recommend measures to reduce the risk of erosion. These measures may include monitoring and adding sacrificial soil material at the toe of the levee as needed, limiting fetch by installing in-pond barriers or deflectors, or repairing levees as needed.

3.2.8.6 Impact H-9: Potential Navigation Hazard as a Result of Increased Velocity in Mare Island Strait

Implementing the project will result in increased tidal prism that would flow through the relatively narrow Mare Island Strait. The increased volume of tidal water will result in an increased velocity in the shipping channel. The channel velocity may increase by up to 1 meter per second (1.9 Knots). It is not anticipated that this increase in velocity would have an adverse effect on pleasure boating as most small craft are very maneuverable and can greatly exceed the anticipated velocity. Larger ships are substantially less maneuverable and require large distances to alter course turn or slow. Generally, the arrival and departure of ships is scheduled to coincide with the tides. Ships arriving with the flood tide and departing on the ebb to maximize the depth of water under the keel and to minimize the tidal effects on maneuverability. Therefore, no mitigation is required. This impact is considered less than significant.

3.2.9 Habitat Restoration Option 2: Tidal Marsh Emphasis

Impacts of Habitat Restoration Option 2 are nearly the same as those under Habitat Restoration Option 1 for Beneficial Impacts H-2 and H-5 and Impacts H-6, H-8, and H-9. Impact H-7 is slightly different and is described below.

3.2.9.1 Impact H-7: Potential Increase in Flood Risk on Adjacent Properties as a Result of Increased Discharge in Tidal Channels

This impact is nearly the same as that under Habitat Restoration Option 1 except that the severity of the impact would be somewhat greater under Habitat Restoration Option 2 than under Habitat Restoration Option 1. More area would be restored to tidal marsh in this option, increasing the total tidal prism. Because the total tidal prism that would have to be conveyed through the tidal slough network would be greater, there would be more channel erosion to reach equilibrium. Therefore, the risk to adjacent levees would be somewhat greater than under Habitat Restoration Option 1. The threat to levees would still exist; therefore, this impact is considered significant. Implementation of Mitigation Measure H-3, “Refine Project Design to Limit Adverse Effects of Increased Tidal Discharge,” would reduce this impact to a less-than-significant level. This measure is described under Habitat Restoration Option 1.

3.2.10 Habitat Restoration Option 3: Pond Emphasis

Impacts of Habitat Restoration Option 3 are nearly the same as those under Habitat Restoration Options 1 and 2 for Beneficial Impacts H-2 and H-5 and Impacts H-6, H-8, and H-9. Impact H-7 is slightly different and is described below.

3.2.10.1 Impact H-7: Potential Increase in Flood Risk on Adjacent Properties as a Result of Increased Discharge in Tidal Channels

This impact is nearly the same as described under Habitat Restoration Option 1 except that the severity of the impact would be somewhat less under Habitat Restoration Option 3. Much more area would be retained as managed pond in this option, reducing the total tidal prism compared to Habitat Restoration Option 1. Because the total tidal prism that would have to be conveyed through the tidal slough network would be less, there would be less channel erosion to reach equilibrium. Therefore, the risk to adjacent levees would be somewhat lower than under Habitat Restoration Option 1.

The threat to levees would still exist. Therefore, this impact is considered significant. Implementation of Mitigation Measure H-3, “Refine Project Design to Limit Adverse Effects of Increased Tidal Discharge,” would reduce this impact to a less-than-significant level. This measure is described under Habitat Restoration Option 1.

3.2.11 Habitat Restoration Option 4: Accelerated Restoration

Impacts of Habitat Restoration Option 4 are nearly the same as those under Habitat Restoration Option 1 for Beneficial Impacts H-2 and H-5, and Impacts H-6, H-8, and H-9. Impact H-7 is slightly different and is described below.

3.2.11.1 Impact H-7: Potential Increase in Flood Risk on Adjacent Properties as a Result of Increased Discharge in Tidal Channels

This impact is nearly the same as described under Habitat Restoration Option 1 except that the severity of the impact would be somewhat less under Habitat Restoration Option 4 than under Habitat Restoration Option 1. Some fill would be used to reduce the total tidal prism and other measures would be implemented to maximize the marsh accretion rate (e.g., an increase in the number of starter channels and berms created). Because the total tidal prism that would have to be conveyed through the tidal slough network would be less, there would be less channel erosion to reach equilibrium. The risk to adjacent levees would be somewhat lower than under Habitat Restoration Option 1; therefore, the threat to levees would still exist.

This impact is considered significant. Implementation of Mitigation Measure H-3, “Refine Project Design to Limit Adverse Effects of Increased Tidal Discharge,” would reduce this impact to a less-than-significant level. This measure is described under Habitat Restoration Option 1.