4.3 GEOLOGY AND SOILS

4.3.1 Summary of Environmental Consequences

Potentially significant impacts to the proposed evaporation ponds, displacement dike, and EES facilities are related to the structural damage that could be caused by seismic activity in the Salton Trough. The potential for damage is related primarily to ground rupture and ground acceleration; although the associated potential for structural damage due to liquefaction and dynamic settlement also could have significant impacts. Seiches could affect the evaporation ponds by causing the brine in the ponds to mix with Salton Sea water by overtopping the dikes. Such mixing could also occur along the Southwest shoreline shorebird/pupfish protection pond associated with the evaporation pond. Less than significant impacts are related to the foundation materials on which these facilities would be constructed. The possibility of expansive or corrosive soils, compaction potential, stormwater, and wind erosion, should be considered in designing and siting these facilities.

For the No Action Alternative with continuation of existing inflows, no direct impacts to unique geologic resources or significant changes to geologic resources are anticipated. The No Action Alternative with reduced inflows would not result in significant changes to geologic resources; however, additional bottom sediments would be exposed around the perimeter of the Sea. Some of these sediments contain elevated levels of some chemical constituents of concern, such as heavy metals and volatile organic compounds.

Alternative 1 would have potentially significant impacts related to ground rupture and ground acceleration and less than significant impacts related to liquefaction and dynamic settlement, landsliding, seiches, compaction, expansive soils, erosion, corrosive soils, and disturbance of potentially hazardous Sea bottom sediments. Alternative 1 would have no impacts on unique geologic features.

Alternatives 2 and 3 under current inflow conditions would have less than significant impacts related to ground rupture, ground acceleration, liquefaction and dynamic settlement, landsliding, seiches, compaction, expansive soils, erosion, and corrosive soils. Alternative 2 also would have less than significant impacts on unique geologic features. Alternatives 2 and 3 would have no impacts on potentially hazardous Sea bottom sediments, and Alternative 3 would have no impacts on unique geologic features. Under reduced inflow conditions with the construction of a displacement dike, both Alternatives 2 and 3 would have potentially significant impacts related to ground rupture and ground acceleration.

Alternatives 4 and 5 would have potentially significant impacts regarding ground rupture and ground acceleration and less than significant impacts related to liquefaction and dynamic settlement, landsliding, seiches, compaction, expansive soils, erosion, corrosive soils, and disturbance of potentially hazardous Sea bottom sediments. Alternatives 4 and 5 would have no impacts on unique geologic features. All alternatives would result in more exposure of currently submerged bottom sediments when compared to the No Action Alternative scenarios.

4.3.2 Significance Criteria

A project alternative may result in significant geologic impacts if the physical actions taken during construction or operation could directly or indirectly affect the physiography, geology, or vulnerability to geologic hazard of the project area or region. Significant impacts could result from impacts involving unique geologic or physical features, or exposure of people to impacts associated with: fault rupture; seismic ground shaking; seismic ground failure; liquefaction; seiches; tsunamis; volcanic hazards; expansive soils; severe erosion; changes in topography; unstable soil conditions from excavation, grading, or fill; landslides or mudflows; or subsidence of the land.

4.3.3 Assessment Methods

The effects of project alternatives on geology and soils are analyzed by comparing the baseline topography, stratigraphy, soils and sediments, mineral resources, landforms, slope stability, and seismic hazard conditions identified for the project area against the conditions generated by the construction and operation of each alternative, including the No Action Alternative. The analysis is based on the susceptibility of the project area to geologic hazards. This assessment takes into consideration the proximity of active faults, frequency and types of seismic events, existing ground acceleration data and models, and the type of soils and their engineering properties, the probability of disturbing Salton Sea sediments or any of the geologic features and resources unique to the area. Regulatory constraints concerning these resources also are considered.

The effects of each alternative and the severity of these effects are evaluated based on the significance criteria for geology and soils impacts. Several of the alternatives will require earthwork and borrow materials and will involve installing structures within the study area. The effects of each of these alternatives on topography, soils and sediments, mineral resources, landforms, and slope stability is evaluated based on the design of the alternative, volume of earthmoving and grading, the amount of borrow material needed, size, shape, and use of structures specified or estimated for each alternative. The probability of each alternative encountering geologic hazards is evaluated using the project area assessment of the proximity of active faults, frequency and types of seismic events, existing ground acceleration data and models, and the type of soils and their engineering properties. Mitigation measures that could reduce the severity of identified impacts and incorporate applicable regulatory requirements also are identified, as appropriate.

4.3.4 No Action Alternative

Effect of No Action Alternative with Continuation of Current Inflow Conditions

With the continuation of current inflow conditions to the Sea under the No Action Alternative, the level of the Sea would not change substantially over time. Recent projections indicate that the elevation would increase slightly from the current level of about –227 feet to approximately –224 feet over the next 100 years. This increase would not result in the inundation of unique geologic resources or in significant changes to geologic resources.

Effect of No Action Alternative with Reduced Inflows

For inflows of 1.06 maf/yr under the No Action Alternative, the elevation of the Sea would drop from the current level of approximately –227 feet to about -234 feet. The Sea would reach this level after about 30 years, after which the elevation would fluctuate around this level, provided inflows remained constant. This drop would not result in significant changes to geologic resources; however, additional bottom sediments totaling approximately 16,000 acres would be exposed around the perimeter of the Sea. As shown in a recent study by Levine-Fricke (1999), these exposed sediments would include elevated concentrations of zinc and copper at the northern tip of the Sea, nickel along most of the shoreline except the southern end, and cadmium along the northeast and central eastern shoreline.

4.3.5 Alternative 1

Effect of Alternative 1 with Current Inflow Conditions

Alternative 1 with current inflow conditions includes implementation of the common actions (described in Chapter 5) plus construction of two evaporation ponds along the southwest shore of the Sea and a pupfish pond adjacent to the south evaporation pond.

Alternative 1 would result in a decrease of the Sea's elevation to –229 at the end of Phase 1. This drop would result in exposure of approximately 26,000 acres of currently submerged bottom sediments and rocky substrate when compared to current conditions. Exposure of these sediments would not represent a significant geologic resources impact but could have public health and safety and air quality ramifications. The effect would be more severe under Alternative 1 with current inflow conditions than under the No Action Alternative.

The size and extent of the numerous dikes and proposed (including the displacement dike proposed under Alternative 1, reduced inflow) will require a sizable borrow area and will result in the extraction of a considerable amount of rock. While a potential borrow area has identified within the Torres Martinez Indian reservation, it has not been evaluated with respect to potential geologic hazards or constraints and geologic evaluation will need to be conducted prior to removal of material. It is possible that there could be a significant impact to local geologic resources due to the large quantities of material that would be removed.

North and South Evaporation Ponds (98 kaf/yr)

Unique Geologic Features. Creation and operation of the evaporation ponds is not expected to adversely affect any of the unique geologic features in the area. The sand hills and the volcanic remnants to the southeast of the sea would be avoided during construction by ensuring that construction vehicles do not enter these sensitive areas and would not be affected by the presence of the diked evaporation ponds.

Ground Rupture. As identified in Chapter 3, several fault zones extend into the Salton Basin and also could extend beneath the Sea itself. This could result in significant adverse effects on the evaporation ponds. Rupture along these or previously unknown fault structures that could underlie the area of the evaporation ponds, due to an earthquake along these or other nearby faults, could cause the dikes that retain these ponds to fail. Rupture of the dikes would result in the pond contents infiltrating the Sea, which could cause a sudden large increase in salinity, with consequent deleterious effects on aquatic life.

Ground Acceleration. The peak ground acceleration for the maximum credible earthquake in the area of the proposed evaporation ponds is estimated to be .60 g for a 7.0 magnitude earthquake along the Superstition Hills or Elmore Ranch Fault. An earthquake of this magnitude could have an intensity in the vicinity of the Salton Sea of IX on the Mercalli scale, which could result in significant damage to the dikes retaining the evaporation ponds. A single event of intense motion may contribute less to cumulative structural effect than several periods of less intense ground motion, which eventually could lead to dike failure if reinforcement against such loads were not incorporated into the design of the dikes. Repeatable high ground acceleration generally is estimated at 65 percent of peak acceleration for areas within 20 miles of an earthquake epicenter and approaching 100 percent at greater distances. The repeatable high ground acceleration in the area of the Salton Sea is estimated to range from 0.15g to 0.40g.

Liquefaction and Dynamic Settlement. Locating the dike structures in areas subject to liquefaction would subject these structures to damage during a major earthquake. During a strong earthquake, liquefaction could occur throughout areas underlain by a shallow water table and loose, sandy sediments. The surface sediments in the vicinity of the southern evaporation pond have a relatively low sand content and high silt content; therefore, liquefaction would be unlikely in this area. The western evaporation pond barrier is in an area where sediments have a relatively high sand content, making the dike for the western evaporation pond more subject to potential liquefaction. Dredging down to more stable material, which is planned as part of dike construction, would minimize the potential for liquefaction and differential settlement to less than significant levels.

Landsliding. In general, landsliding is not anticipated to affect the integrity of the retention dikes surrounding the evaporation ponds due to the level area where the evaporation ponds would be constructed. However, the dikes would be sloped and could be subject to seismically induced failure, which would be a less than significant possibility provided that proper design parameters, such as degree of compaction along with slope and stabilizing features, are incorporated into the design of the dikes.

Seiches. The potential for wave-like or oscillatory movement in the Salton Sea and in the evaporation ponds from an earthquake causing dike over-topping and saline solution in the ponds mixing with the Sea water would be less than significant. It would be unlikely that quantities of the shallower pond water would wash over the top of the dike into the deeper Sea water.

Disturbance of Bottom Sediments. The disturbance of bottom sediments during pond construction is not expected to have a significant impact. The dike structures and both ponds would be built in an area of the Sea with relatively high nickel concentrations in bottom sediments (Levine-Fricke 1999). However, high concentrations of other potentially deleterious elements have not been shown to be present in the area of the evaporation ponds. The sediments containing nickel would likely be disturbed by dike construction and dredging and redistributed within the Sea during discharge of the dredged material. The dikes would not disturb sediments in the areas of the highest observed selenium concentrations (Levine-Fricke 1999); therefore, remobilization of selenium into Salton Sea water for potential biological uptake would be at low levels.

Compaction. The process of dredging materials from the dike foundation area would likely remove unstable material so that the dike foundations would rest on firm material, which would be less subject to compaction.

Expansive Soils. The possibility of expansion due to clayey nature of material under the pond barriers would be a less than significant impact with the appropriate site-specific study and preparation prior to construction. The most recent sediment studies have indicated relatively high percentages of clays in the sediments in the southern area of the western evaporation pond and the northern portion of the southern evaporation pond. These sediments are currently saturated and probably would be removed during dredging for the dike foundations; however, the underlying sediments could be of a similar clay content.

Erosion. The effects of wind and erosion due to wave action on the evaporation pond dikes would be minimized to a less than significant level by the use of proper compaction and stabilization measures in constructing the dikes.

Corrosive Soils. Potentially corrosive soils could damage foundations and subsurface structures, such as pipes and drainage channels, and should be identified during a geotechnical investigation for the evaporation ponds. Proper design of subsurface structures would minimize this impact to a less than significant level.

North Wetland Habitat

Unique Geologic Features. The area identified for the north wetland habitat does not include unique geologic features. No impacts are expected as a result of this action.

Ground Rupture. As identified in Chapter 3, several fault zones extend into the Salton Basin and could extend beneath the Sea itself. While the southern portion of the Salton Sea clearly has a much greater rate of seismicity than does the northern area, rupture along previously unknown faults that may underlie the area of the north shorebird and pupfish protection pond could affect these structures. Depending on the extent of the damage and the level of Sea water relative to the level of pond water, short term impacts could be significant to less than significant. Repairs to damaged structures would be made under the long-term operation and management program for the Salton Sea

Restoration Project, reducing the potential for these impacts to a less than significant level.

Ground Acceleration. The impacts would be similar to those described for the pupfish pond, Alternative 1.

Liquefaction and Dynamic Settlement. Liquefaction and dynamic settlement are not likely to impact this action due to the construction techniques and underlying soils present in the area.

Landsliding. Landsliding is not expected to significantly affect the area of the north shorebird and pupfish protection pond.

Seiches. The impacts would be similar to those described for the evaporation ponds.

Disturbance of Bottom Sediments. The impacts would be similar to those described for the evaporation ponds.

Compaction. The impacts would be similar to those described for the evaporation ponds.

Expansive Soils. The impacts would be similar to those described for the evaporation ponds.

Erosion. Material eroded from within the various agricultural drains that would enter the north shorebird and pupfish protection pond would be trapped within the pond due to its isolation from the rest of the Sea. This increased sedimentation would adversely affect the operation and maintenance of the pond, potentially requiring frequent dredging, particularly after storm events. Depending on the frequency, dredging would also create a disturbance with potential adverse effects to the invertebrates, fish, shorebirds and pupfish inhabiting the pond. Potential for this impact should be taken into consideration during design of the pond.

Corrosive Soils. The impacts would be similar to those described for the evaporation ponds.

Pupfish Pond

Unique Geologic Features. Creation and operation of the pupfish pond is not expected to adversely affect any of the unique geologic features in the area.

Ground Rupture. The impacts of ground rupture on the pupfish pond would be similar to those described for the evaporation ponds. Failure of the dikes could cause a rapid mixing of the pond water with the Sea water, and result in a large increase of salinity within the pond. This rapid change could be deleterious to aquatic life, particularly the endangered pupfish.

Ground Acceleration. The impacts would be similar to those described for the evaporation ponds.

Liquefaction and Dynamic Settlement. The surface sediments in the vicinity of the pupfish pond have a relatively low sand content and high silt content; therefore liquefaction and dynamic settlement would be unlikely in this area.

Landsliding. The impacts would be similar to those described for the evaporation ponds.

Seiches. The impacts would be similar to those described for the evaporation ponds.

Disturbance of Bottom Sediments. The impacts would be similar to those described for the evaporation ponds.

Compaction. The impacts would be similar to those described for the evaporation ponds.

Expansive Soils. The impacts would be similar to those described for the evaporation ponds.

Erosion. Material eroded from within the San Felipe Creek drainage and the various agricultural drains that would enter the pupfish pond would be trapped within the pond due to its isolation from the rest of the Sea. This increased sedimentation would adversely affect the operation and maintenance of the pond, potentially requiring frequent dredging, particularly after storm events. Depending on the frequency, dredging would also create a disturbance with potential adverse affects to the invertebrates, shorebirds and pupfish inhabiting the pond. Potential for this impact should be taken into consideration during design of the pond.

Corrosive Soils. The impacts would be similar to those described for the evaporation ponds.

Effect of Alternative 1 with Reduced Inflow Conditions (1.06 maf/yr)

The impacts of Alternative 1 with reduced inflows would be similar to those described above for Alternative 1 under current inflow conditions, with the additional effect of increased exposure of Salton Sea sediments around the perimeter of the Sea. With reduced inflows by the end of Phase 1, the Sea elevation would be 10 feet below the current elevation. This would result in exposure of a band of sediments and rocky substrate totaling approximately 53,000 acres that are currently submerged. This is approximately 37,000 acres more than under the No Action Alternative with reduced inflows. Sediments with elevated concentrations of zinc and copper would be exposed near the mouth of the Whitewater River. Relatively high concentrations of nickel have been identified in sediments that would be exposed along most of the Salton Sea shoreline except the southern shore. Sediments containing elevated cadmium levels would be exposed between Corvina Beach and North Shore and just south of Corvina

Estates along the eastern shore (Levine-Fricke 1999). Exposure of these sediments would not represent a significant geologic resources impact but could have public health and safety and air quality ramifications. The effect would be more severe under Alternative 1 with reduced inflows than under the No Action Alternative with reduced inflows.

Alternative 1 with reduced inflow conditions also includes impacts resulting from construction of: a displacement dike; a southeast shorebird and pupfish protection pond/island protection pond that includes some deep water habitat; and a north shorebird and pupfish protection pond. These impacts are discussed below.

Displacement Dike

Unique Geologic Features. The area identified for the displacement dike is currently within the Sea and construction is not expected to affect any unique geologic features. The volcanic remnants southeast of the Sea would be avoided during construction by ensuring that construction vehicles do not enter this sensitive area.

Ground Rupture. As identified in Chapter 3, several fault zones extend into the Salton Basin and also could extend beneath the Sea itself. This could result in significant adverse effects on the displacement dike. Rupture along these or previously unknown fault structures that could underlie the area of the dike, due to an earthquake along these or other nearby faults, could cause the dike to fail. Rupture of the dike would result in flooding of the land behind the dike by the Sea, which could cause a drop in the overall Sea elevation.

Ground Acceleration. The peak ground acceleration for the maximum credible earthquake in the area of the proposed displacement dike is estimated to be .70 g for a 7.0 magnitude earthquake along the Elmore Ranch Fault. An earthquake of this magnitude could have an intensity in the vicinity of the Salton Sea of IX on the Mercalli scale, which could result in significant damage to the dike. A single event of intense motion may contribute less to cumulative structural effect than several periods of less intense ground motion, which eventually could lead to dike failure if reinforcement against such loads were not incorporated into the dike design. Repeatable high ground acceleration generally is estimated at 65 percent of peak acceleration for areas within 20 miles of an earthquake epicenter and approaching 100 percent at greater distances. The repeatable high ground acceleration in the area of the Salton Sea is estimated to range from 0.15g to 0.40g.

Liquefaction and Dynamic Settlement. The surface sediments in the vicinity of the displacement dike have relatively high clay and silt content and relatively low sand content; therefore, liquefaction would be unlikely in this area.

Landsliding. In general, landsliding is not expected to affect the integrity of the displacement dike. However, the dike would be sloped and could be subject to seismically induced failure, which would be a less than significant possibility provided that proper design parameters, such as degree of compaction, along with slope and stabilizing features, are incorporated into the design.

Seiches. The potential for wave-like oscillatory movement in the Salton Sea from an earthquake could cause dike over-topping and subsequent flooding of the land behind the displacement dike. This is not expected to be a significant impact.

Disturbance of Bottom Sediments. The disturbance of bottom sediments during dike construction is not expected to have a significant impact. The dike structure would be built in an area of the Sea with moderate levels of cadmium in the bottom sediments (Levine-Fricke 1999). However, high concentrations of other potentially deleterious elements have not been shown to be present in either the dike area or the submerged area that would be exposed behind the dike.

Compaction. The process of dredging materials from the dike foundation area would likely remove unstable material so that the dike foundation would rest on firm material, which would be less subject to compaction.

Expansive Soils. The possibility of expansion due to clay content under the dike would be a less than significant impact with the appropriate site-specific study and preparation prior to construction. The most recent sediment studies indicate relatively high percentage of clay in the sediments on the west side of the displacement dike location. These sediments are currently saturated and probably would be removed during dredging for the dike foundation; however, the underlying sediments could have similar clay content.

Erosion. The effects of wind and erosion due to wave action on the displacement dike would be minimized to a less than significant level by the use of proper compaction and stabilization measures during construction.

Corrosive Soils. Potentially corrosive soils could damage foundations and subsurface structures, such as pipes and drainage channels, and should be identified during a geotechnical investigation for the displacement dike. Proper design of subsurface structures would minimize this impact to a less than significant level.

Southeast Shorebird and Pupfish Protection Pond/Island Protection with Deep Water Habitat

Unique Geologic Features. The area identified for the southeast shorebird and pupfish protection pond/island protection with deepwater habitat includes Mullet Island. Construction of the pond is expected to protect this feature within a dike. Maintenance of the pond is expected to avoid this feature. No other unique geologic features have been identified at this site.

Ground Rupture. The San Andreas Fault extends through the area south of Bombay Beach. Ground rupture along this and previously unknown faults could damage the z-shaped dike structures to be built there. Depending on the extent of the damage and the level of Sea water relative to the level of pond water, short term impacts could be significant to less than significant. Repairs to damaged structures would be made under the long-term operation and management program for the Salton Sea Restoration Project, reducing the potential for these impacts to a less than significant level.

Ground Acceleration. The impacts would be similar to those described for the pupfish pond, Alternative 1.

Liquefaction and Dynamic Settlement. Liquefaction and dynamic settlement are not likely to impact this action due to the construction techniques and underlying soils present in the area.

Landsliding. Landsliding is not expected to significantly affect the area of the southeast shorebird and pupfish protection pond/island protection with deep water habitat.

Seiches. The impacts would be similar to those described for the evaporation ponds.

Disturbance of Bottom Sediments. The impacts would be similar to those described for the evaporation ponds.

Compaction. The impacts would be similar to those described for the evaporation ponds.

Expansive Soils. The impacts would be similar to those described for the evaporation ponds.

Erosion. Material eroded from within the various agricultural drains that would enter the southeast shorebird and pupfish protection pond would be trapped within the pond due to its isolation from the rest of the Sea. This increased sedimentation would adversely affect the operation and maintenance of the pond, potentially requiring frequent dredging, particularly after storm events. Depending on the frequency, dredging would also create a disturbance with potential adverse effects to the invertebrates, fish, shorebirds and pupfish inhabiting the pond. Potential for this impact should be taken into consideration during design of the pond.

Corrosive Soils. The impacts would be similar to those described for the evaporation ponds.

4.3.5 Alternative 2

Alternative 2 with current inflow conditions includes implementation of the common actions (described in Chapter 5) plus construction of an Enhanced Evaporation System (EES) located north of Bombay Beach capable of processing 150 kaf/yr of Salton Sea water using a showerline technology. A southeast shorebird pond/island protection with deep water habitat would also be constructed.

Effect of Alternative 2 with Current Inflow Conditions

Alternative 2 with current inflow conditions would result in a decrease in the Sea's elevation to –232 by the end of Phase 1. This drop would result in exposure of approximately 11,000 acres of currently submerged bottom sediments and rocky substrate compared to current conditions. Exposure of these sediments would not represent a significant geologic resources impact but could have public health and safety and air quality ramifications. The effect would be more severe under Alternative 2 with current inflow conditions than under the No Action Alternative.

EES Located North of Bombay Beach(150 kaf/yr – showerline technology)

Unique Geologic Features. The area identified for the EES facility at Bombay Beach includes the Bat Caves Buttes area at the northwestern corner of the EES site. Construction and operation of the EES facility is expected to avoid this feature. No other unique geologic features have been identified at this site.

Ground Rupture. Both the Calipatria Fault and the Coachella Branch of the San Andreas Fault extend through the area of Bombay Beach. Ground rupture along these or previously unknown fault structures could damage the system of interconnected towers that make up the EES, cause structural damage to the catchment basin, and rupture the intake pipe for the system. Repairs to damaged structures would be made under the long-term operation and maintenance program for the Salton Sea Restoration Project, reducing the potential for these impacts to a less than significant level.

Ground Acceleration. The potential peak and maximum repeatable ground acceleration in the area of Bombay Beach would be the same as described under Alternative 1. A single event of intense motion or a series of less intense seismic events could damage the EES towers and system of interconnected hoses, cause structural damage to the catchment basin, and rupture the intake pipe. Repairs to damaged structures would be made under the long-term operation and maintenance program for the Salton Sea Restoration Project, reducing the potential for these impacts to a less than significant level.

Liquefaction and Dynamic Settlement. Soils in the area of Bombay Beach are made up of the sands, silts, and clays of the basin of former Lake Cahuilla (US Department of Agriculture Soil Conservation Service 1979; US Department of Agriculture Soil Conservation Service 1981). These soils in general tend to be well-drained, except those adjacent to the Sea, and in general the water table in the area is not high. Liquefaction and dynamic settlement therefore would not be likely to occur in the area of the Bombay Beach EES.

Landsliding. Landsliding is not expected to significantly affect the EES area at Bombay Beach due to the absence of steep slopes.

Seiches. Earthquake-induced seiches in the Salton Sea could affect the Bombay Beach EES site if the waves generated were large enough to reach the facility. The literature concerning seismic activity in the area does not indicate that seiches have been historically significant in the area, and the likelihood of seismic activity producing waves large enough to affect this site is small. Therefore this would be a less than significant impact.

Disturbance of Bottom Sediments. Construction and operation of the EES at Bombay Beach would not disturb Salton Sea bottom sediments.

Compaction. No significant impacts related to compaction are expected as a result of the proposed Bombay Beach EES. However, if localized areas susceptible to compaction are identified during construction, the effects could be mitigated through standard construction techniques, such as the placement of more stable materials at the tower foundations and catchment basin.

Expansive Soils. Expansive soils are not expected to significantly affect the proposed EES facility at Bombay Beach. The proposed catchment basin would be lined, which would control the addition of moisture to any clayey soils.

Erosion. The proposed Bombay Beach EES site may be subject to both wind and stream erosion. Substantial winds are common in the Salton Basin, and several stream channels cross the site. Storm runoff in these channels could erode disturbed areas unless measures are developed to protect the towers and catchment basin.

Corrosive Soils. Potentially corrosive soils could have the significant impact of damaging the intake pipe. Soils along the Sea margin are highly saline, and salt-resistant construction materials should be used for any subsurface structures in this area.

Southeast Shorebird and Pupfish Protection Pond/Island Protection with Deep Water Habitat

The impacts would be the same as described under Alternative 1, reduced flows.

Effect of Alternative 2 with Reduced Inflow Conditions (1.06 maf/yr)

The impacts of Alternative 2 with reduced inflows would be similar to those described above for Alternative 2 with current inflow conditions however, with reduced inflows by the end of Phase 1, the Sea elevation would be 10 feet below the current elevation. This would result in exposure of a band of sediments and rocky substrate totaling approximately 37,000 acres that are currently submerged. This is approximately 21,000 acres more than under the No Action Alternative with reduced inflows. Sediments with elevated concentrations of zinc and copper would be exposed near the mouth of the Whitewater River. Relatively high concentrations of nickel have been identified in sediments that would be exposed along most of the Salton Sea shoreline except the southern shore. Sediments containing elevated cadmium levels would be exposed between Corvina Beach and North Shore and just south of Corvina Estates along the eastern shore (Levine-Fricke 1999). Exposure of these sediments would not represent a significant geologic resources impact but could have public health and safety and air quality ramifications. The effect would be more severe under Alternative 2 with reduced inflows than under the No Action Alternative with reduced inflows.

Alternative 2 also includes the addition of impacts resulting from construction of: a displacement dike; a pupfish pond; a north shorebird and pupfish protection pond; and imported flood flows. These impacts are discussed below.

Displacement Dike

The impacts would be the same as described under Alternative 1, reduced flows.

Pupfish Pond

The impacts would be the same as described under Alternative 1, reduced flows.

North Shorebird and Pupfish Protection Pond

The impacts would be the same as described under Alternative 1, reduced flows.

Import Flood Flows

Unique Geologic Features. Flood flows would be brought to the Salton Sea through existing facilities and therefore no unique geologic features would be impacted by this action.

Ground Rupture. As identified in Chapter 3, several fault zones extend into the Salton Basin and are crossed by the existing water conveyance facilities. Rupture due to an earthquake along these or previously unknown fault structures that underlie the area could result in significant adverse effects to the water conveyance facilities. If a rupture coincided with the transfer of floodflows, significant water loss could occur. However, operation and maintenance of these structures consistent with standard earthquake design requirements would reduce this impact to less than significant levels.

Ground Acceleration. The impacts would be similar to those described in Alternative 1, current inflow conditions.

Liquefaction and Dynamic Settlement. No impacts from this action are anticipated.

Landsliding. No impacts from this action are anticipated.

Seiches. No impacts from this action are anticipated.

Disturbance of Bottom Sediments. No impacts from this action are anticipated.

Compaction. No impacts from this action are anticipated.

Expansive Soils. No impacts from this action are anticipated.

Erosion. This action includes improvements and some minor maintenance of evacuation areas to the Sea. Since the amount of flood flows anticipated is within the current capacity of the channels indicated for use, less than significant impacts due to erosion are anticipated.

Corrosive Soils. No impacts from this action are anticipated.

4.3.6 Alternative 3

Alternative 3 with current inflow conditions includes implementation of the common actions (described in Chapter 5) plus construction of an Enhanced Evaporation System (EES) located on the Salton Sea Test Base capable of processing 150 kaf/yr of Salton Sea water using a showerline technology. A southeast shorebird pond/island protection with deep water habitat would also be constructed.

Effect of Alternative 3 with Current Inflow Conditions

Alternative 3 with current inflow conditions would result in a decrease of approximately 5 feet in the Sea's elevation to –232 by the end of Phase 1. This drop would result in exposure of approximately 11,000 acres of currently submerged bottom sediments and rocky substrate compared to existing conditions. Exposure of these sediments would not represent a significant geologic resources impact but could have public health and safety and air quality ramifications. The effect would be more severe under Alternative 3 with current inflow conditions than under the No Action Alternative.

EES Located at the Salton Sea Test Base (150 kaf/yr – showerline technology)

Unique Geologic Features. The area identified for the Salton Sea Test Base EES facility does not include unique geologic features. The sand dunes to the south of the test base would be just south of the test base EES facility boundary.

Ground Rupture. No known fault structures extend through the test base EES site; therefore, ground rupture along known faults would not have a significant impact on this facility. However, ground rupture along previously unknown faults, given the high level of seismic activity in the area, could damage the system of interconnected towers that make up the EES, cause structural damage to the catchment basin, and rupture the intake pipe for the system. Repairs to damaged structures would be made under the long-term operation and maintenance program for the Salton Sea Restoration Project, reducing the potential for these impacts to a less than significant level.

Ground Acceleration. As described for the Bombay Beach EES site, potentially significant ground acceleration impacts could occur to the Salton Sea Test Base EES facility if seismic shaking is not taken into account in the facility's design. Repairs to damaged structures would be made under the long-term operation and maintenance program for the Salton Sea Restoration Project, reducing the potential for these impacts to a less than significant level.

Liquefaction and Dynamic Settlement. Soils in the area of the test base are made up of the sands, silts, and clays of the lacustrine basin of former Lake Cahuilla and alluvial fans(US Department of Agriculture Soil Conservation Service 1979; US Department of

Agriculture Soil Conservation Service 1981). These soils in general tend to be well drained except for those adjacent to the Sea, and in general the water table in the area is not high. Liquefaction and dynamic settlement therefore would not be likely to occur in the area of the Salton Sea Test Base EES.

Landsliding. Landsliding is not be expected to significantly affect the Salton Sea Test Base EES area due to the absence of steep slopes.

Seiches. Earthquake-induced seiches in the Salton Sea could affect the Salton Sea Test Base EES site if the waves generated were large enough to reach the facility. The literature concerning seismic activity in the area does not indicate that there have been significant seiches in the area, and the likelihood of seismic activity producing waves large enough to affect this site is small. Therefore this would be a less than significant impact.

Disturbance of Bottom Sediments. Construction and operation of the Salton Sea Test Site EES would not disturb Salton Sea bottom sediments.

Compaction. No significant impacts related to compaction are expected as a result of the proposed Salton Sea Test Site EES. However, if localized areas susceptible to compaction are identified during construction, the effects could be mitigated through standard construction techniques, such as placing more stable materials at the tower foundations and catchment basin.

Erosion. The proposed Salton Sea Test Site EES site may be subject to both wind and stream erosion. Substantial winds are common in the Salton Basin, and several stream channels cross the site. Storm runoff in these channels could erode disturbed areas unless measures are developed to protect the towers and catchment basin. Effects could be mitigated by constructing diversion structures to protect the towers and catchment basin.

Corrosive Soils. Corrosive soils could have the significant impact of damaging the intake pipe. Soils along the Sea margin are highly saline, and salt resistant construction materials should be used to construct any subsurface structures in this area. In addition, soils of moderate alkalinity are found in the area of the Salton Sea Test Base site.

North Wetland Habitat

The impacts would be the same as described under Alternative 1.

Effect of Alternative 3 with Reduced Inflow Conditions (1.06 maf/yr)

The impacts of Alternative 3 with reduced inflows would be similar to those described above for Alternative 3 with current inflow conditions, however, with reduced inflows by the end of Phase 1, the Sea elevation would be 10 feet below the current elevation or approximately –237 feet. This would result in exposure of a band of sediments and rocky substrate totaling approximately 37,000 acres that are currently submerged. This is approximately 21,000 acres more than under the No Action Alternative with reduced inflows. Sediments with elevated concentrations of zinc and copper would be exposed near the mouth of the Whitewater River. Relatively high concentrations of nickel have been identified in sediments that would be exposed along most of the Salton Sea shoreline except the southern shore. Sediments containing elevated cadmium levels would be exposed between Corvina Beach and North Shore and just south of Corvina Estates along the eastern shore (Levine-Fricke 1999). Exposure of these sediments would not represent a significant geologic resources impact but could have public health and safety and air quality ramifications. The effect would be more severe under Alternative 3 with reduced inflows than under the No Action Alternative with reduced inflows.

Alternative 3 with reduced inflows also includes the addition of impacts resulting from construction of: a displacement dike; a pupfish pond; a north shorebird and pupfish protection pond; and imported flood flows. These impacts are discussed below.

Displacement Dike

The impacts would be the same as described under Alternative 1, reduced flows.

Pupfish Pond

The impacts would be the same as described under Alternative 1, reduced flows.

Import Flood Flows

The impacts would be the same as described under Alternative 2, reduced flows.

4.3.7 Alternative 4

Alternative 4 with current inflow conditions includes implementation of the common actions (described in Chapter 5) plus construction of an Enhanced Evaporation System (EES) located at the Salton Sea Test Base capable of processing 100 kaf/yr of Salton Sea water using a showerline technology. The southwest evaporation pond described as part of Alternative 1 with a capacity of 68 kaf/yr, the pupfish pond, and the southeast shorebird pond/island protection with deep water habitat would also be constructed.

Effect of Alternative 4 with Current Inflow Conditions

Alternative 4 with current inflow conditions would result in a decrease of approximately 2 feet in the Sea's elevation to –229 by the end of Phase 1. The impact of this drop would be the similar to that described for Alternative 1, current inflow conditions.

South Evaporation Pond (68 kaf/yr) and an EES located at Salton Sea Test Base (100 kaf/yr – showerline technology)

Unique Geologic Features. Creation and operation of the south evaporation pond is not expected to adversely affect any of the unique geologic features in the area. The sand hills and the volcanic remnants to the southeast of the sea would be avoided during construction by ensuring that construction vehicles do not enter these sensitive areas and would not be affected by the presence of the diked evaporation pond.

The area identified for the Salton Sea Test Base EES facility does not include unique geologic features. The sand dunes to the south of the test base would be just south of the test base EES facility boundary.

Ground Rupture. As identified in Chapter 3, several fault zones extend into the Salton Basin and also could extend beneath the Sea itself. This could result in significant adverse effects on the evaporation pond. Rupture along these or previously unknown fault structures that could underlie the area of the evaporation pond, due to an earthquake along these or other nearby faults, could cause the dike that retains the pond to fail. Rupture of the dike would result in the pond contents infiltrating the Sea, which could cause a sudden large increase in salinity, with consequent deleterious effects on aquatic life.

No known fault structures extend through the test base EES site; therefore, ground rupture along known faults would not have a significant impact on this facility. However, ground rupture along previously unknown faults, given the high level of seismic activity in the area, could damage the system of interconnected towers that make up the EES, cause structural damage to the catchment basin, and rupture the intake pipe for the system. Repairs to damaged structures would be made under the long-term operation and maintenance program for the Salton Sea Restoration Project, reducing the potential for these impacts to a less than significant level.

Ground Acceleration. The peak ground acceleration for the maximum credible earthquake in the area of the proposed evaporation pond is estimated to be .60 g for a 7.0 magnitude earthquake along the Superstition Hills or Elmore Ranch Fault. An earthquake of this magnitude could have an intensity in the vicinity of the Salton Sea of IX on the Mercalli scale, which could result in significant damage to the dike retaining the evaporation pond. A single event of intense motion may contribute less to cumulative structural effect than several periods of less intense ground motion, which eventually could lead to dike failure if reinforcement against such loads were not incorporated into the design of the dike. Repeatable high ground acceleration generally is estimated at 65 percent of peak acceleration for areas within 20 miles of an earthquake epicenter and approaching 100 percent at greater distances. The repeatable high ground acceleration in the area of the Salton Sea is estimated to range from 0.15g to 0.40g.

Potentially significant ground acceleration impacts could occur to the Salton Sea Test Base EES facility if seismic shaking is not taken into account in the facility's design. Repairs to damaged structures would be made under the long-term operation and maintenance program for the Salton Sea Restoration Project, reducing the potential for these impacts to a less than significant level.

Liquefaction and Dynamic Settlement. Locating the dike structure in an area subject to liquefaction would subject the structure to damage during a major earthquake. During a strong earthquake, liquefaction could occur throughout areas underlain by a shallow water table and loose, sandy sediments. The surface sediments in the vicinity of the southern evaporation pond have a relatively low sand content and high silt content; therefore, liquefaction would be unlikely in this area. Dredging down to more stable material, which is planned as part of dike construction, would minimize the potential for liquefaction and differential settlement to less than significant levels.

Soils in the area of the test base are made up of the sands, silts, and clays of the lacustrine basin of former Lake Cahuilla and alluvial fans(US Department of Agriculture Soil Conservation Service 1979; US Department of Agriculture Soil Conservation Service 1981). These soils in general tend to be well drained except for those adjacent to the Sea, and in general the water table in the area is not high. Liquefaction and dynamic settlement therefore would not be likely to occur in the area of the Salton Sea Test Base EES.

Landsliding. In general, landsliding is not anticipated to affect the integrity of the retention dike surrounding the evaporation pond due to the level area where the evaporation pond would be constructed. However, the dike would be sloped and could be subject to seismically induced failure, which would be a less than significant possibility provided that proper design parameters, such as degree of compaction along with slope and stabilizing features, are incorporated into the design of the dike.

Landsliding is not be expected to significantly affect the Salton Sea Test Base EES area due to the absence of steep slopes.

Seiches. The potential for wave-like or oscillatory movement in the Salton Sea and in the evaporation pond from an earthquake causing dike over-topping and saline solution in the pond mixing with the Sea water would be less than significant. It would be unlikely that quantities of the shallower pond water would wash over the top of the dike into the deeper Sea water.

Earthquake-induced seiches in the Salton Sea could affect the Salton Sea Test Base EES site if the waves generated were large enough to reach the facility. The literature concerning seismic activity in the area does not indicate that there have been significant seiches in the area, and the likelihood of seismic activity producing waves large enough to affect this site is small. Therefore this would be a less than significant impact.

Disturbance of Bottom Sediments. The disturbance of bottom sediments during pond construction is not expected to have a significant impact. The dike structure and pond would be built in an area of the Sea with relatively high nickel concentrations in bottom sediments (Levine-Fricke 1999). However, high concentrations of other potentially deleterious elements have not been shown to be present in the area of the evaporation pond. The sediments containing nickel would likely be disturbed by dike construction and dredging and redistributed within the Sea during discharge of the dredged material. The dike would not disturb sediments in the areas of the highest observed selenium concentrations (Levine-Fricke 1999); therefore, remobilization of selenium into Salton Sea water for potential biological uptake would be at low levels.

Construction and operation of the Salton Sea Test Site EES would not disturb Salton Sea bottom sediments.

Compaction. The process of dredging materials from the dike foundation area would likely remove unstable material so that the dike foundation would rest on firm material, which would be less subject to compaction.

No significant impacts related to compaction are expected as a result of the proposed Salton Sea Test Site EES. However, if localized areas susceptible to compaction are identified during construction, the effects could be mitigated through standard construction techniques, such as placing more stable materials at the tower foundations and catchment basin.

Expansive Soils. The possibility of expansion due to clayey nature of material under the pond barrier would be a less than significant impact with the appropriate site-specific study and preparation prior to construction. The most recent sediment studies have indicated relatively high percentages of clays in the sediments in the northern portion of the southern evaporation pond. These sediments are currently saturated and probably would be removed during dredging for the dike foundation; however, the underlying sediments could be of a similar clay content.

Expansive soils are not expected to significantly affect the proposed EES facility at the Salton Sea Test Base. The proposed catchment basin would be lined, which would control the addition of moisture to any clayey soils.

Erosion. The effects of wind and erosion due to wave action on the evaporation pond dike would be minimized to a less than significant level by the use of proper compaction and stabilization measures in constructing the dike.

The proposed Salton Sea Test Site EES site may be subject to both wind and stream erosion. Substantial winds are common in the Salton Basin, and several stream channels cross the site. Storm runoff in these channels could erode disturbed areas unless measures are developed to protect the towers and catchment basin. Effects could be mitigated by constructing diversion structures to protect the towers and catchment basin.

Corrosive Soils. Potentially corrosive soils could damage foundations and subsurface structures, such as pipes and drainage channels, and should be identified during a geotechnical investigation for the evaporation pond. Proper design of subsurface structures would minimize this impact to a less than significant level.

Corrosive soils could have the significant impact of damaging the intake pipe. Soils along the Sea margin are highly saline, and salt resistant construction materials should be used to construct any subsurface structures in this area. In addition, soils of moderate alkalinity are found in the area of the Salton Sea Test Base site.

North Wetland Habitat

The impacts would be the same as described under Alternative 1.

Effect of Alternative 4 with Reduced Inflow Conditions (1.06 maf/yr)

The impacts of Alternative 4 with reduced inflows would be similar to those described above for Alternative 4 with current inflow conditions, with the additional effect of increased exposure of Salton Sea sediments around the perimeter of the Sea. With reduced inflows by the end of Phase 1, the Sea elevation would be 8 feet below the current elevation or –235 feet. This would result in exposure of a band of sediments and rocky substrate totaling approximately 43,000 acres that are currently submerged. This is approximately 27,000 acres more than under the No Action Alternative with reduced inflows. Sediments with elevated concentrations of zinc and copper would be exposed near the mouth of the Whitewater River. Relatively high concentrations of nickel have been identified in sediments that would be exposed along most of the Salton Sea shoreline except the southern shore. Sediments containing elevated cadmium levels would be exposed between Corvina Beach and North Shore and just south of Corvina Estates along the eastern shore (Levine-Fricke 1999). Exposure of these sediments would not represent a significant geologic resources impact. The effect would be slightly more severe under Alternative 4 with reduced inflows than under the No Action Alternative with reduced inflows.

Alternative 4 also includes the addition of impacts resulting from construction of: a displacement dike; a north shorebird and pupfish protection pond; and imported flood flows. These impacts are discussed below.

Displacement Dike

The impacts would be the same as described under Alternative 1, reduced flows.

Import Flood Flows

The impacts would be the same as described under Alternative 2, reduced flows.

4.3.8 Alternative 5

Alternative 5 with current inflow conditions includes implementation of the common actions (described in Chapter 5) plus construction of an Enhanced Evaporation System (EES) located adjacent to the Salton Sea Test Base and within the northwest evaporation pond. This EES would be capable of processing 150 kaf/yr of Salton Sea water using a ground-based, artificial snowmaking technology. The northwest evaporation pond described as part of Alternative 1 would be used to stockpile salt precipitated out using the EES. This alternative also includes the pupfish pond, the north shorebird and pupfish protection pond, and the southeast shorebird pond/island protection with deep water habitat.

Effect of Alternative 5 with Current Inflow Conditions

Alternative 5 with current inflow conditions would result in a decrease in the Sea's elevation to –233 by the end of Phase 1. This drop would result in exposure of approximately 16,000 acres of currently submerged bottom sediments and rocky substrate compared to existing conditions. Exposure of these sediments would not represent a significant geologic resources impact but could have public health and safety and air quality ramifications. The effect would be more severe under Alternative 5 with current inflow conditions than under the No Action Alternative.

EES located within the North Evaporation Pond (150 kaf/yr – groundbased snowmaking technology)

Unique Geologic Features. Creation and operation of the north evaporation pond is not expected to adversely affect any of the unique geologic features in the area. The sand hills and the volcanic remnants to the southeast of the sea would be avoided during construction by ensuring that construction vehicles do not enter these sensitive areas and would not be affected by the presence of the diked evaporation pond.

Construction of the EES within the pond would have no adverse effects on unique geologic features.

Ground Rupture. As identified in Chapter 3, several fault zones extend into the Salton Basin and also could extend beneath the Sea itself. This could result in significant adverse effects on the north evaporation pond. Rupture along these or previously unknown fault structures that could underlie the area of the evaporation pond, due to an earthquake along these or other nearby faults, could cause the dike that retain the pond to fail. Rupture of the dike would result in the pond contents infiltrating the Sea, which could cause a sudden large increase in salinity, with consequent deleterious effects on aquatic life.

Ground rupture could temporarily disrupt use of the ground-based EES but is not expected to cause significant impact to the system.

Ground Acceleration. The peak ground acceleration for the maximum credible earthquake in the area of the proposed evaporation pond is estimated to be .60 g for a 7.0 magnitude earthquake along the Superstition Hills or Elmore Ranch Fault. An earthquake of this magnitude could have an intensity in the vicinity of the Salton Sea of IX on the Mercalli scale, which could result in significant damage to the dike retaining the evaporation pond. A single event of intense motion may contribute less to cumulative structural effect than several periods of less intense ground motion, which eventually could lead to dike failure if reinforcement against such loads were not incorporated into the design of the dikes. Repeatable high ground acceleration generally is estimated at 65 percent of peak acceleration for areas within 20 miles of an earthquake epicenter and approaching 100 percent at greater distances. The repeatable high ground acceleration in the area of the Salton Sea is estimated to range from 0.15g to 0.40g.

Liquefaction and Dynamic Settlement. Locating the dike structure in areas subject to liquefaction would subject the structure to damage during a major earthquake. During a strong earthquake, liquefaction could occur throughout areas underlain by a shallow water table and loose, sandy sediments. The northern evaporation pond barrier is in an area where sediments have a relatively high sand content, making the dike for the evaporation pond subject to potential liquefaction. Dredging down to more stable material, which is planned as part of dike construction, would minimize the potential for liquefaction and differential settlement to less than significant levels.

Liquefaction and dynamic settlement is not expected to significantly affect the ground-based EES.

Landsliding. In general, landsliding is not anticipated to affect the integrity of the retention dike surrounding the evaporation pond due to the level area where the evaporation pond would be constructed. However, the dike would be sloped and could be subject to seismically induced failure, which would be a less than significant possibility provided that proper design parameters, such as degree of compaction along with slope and stabilizing features, are incorporated into the design of the dike.

Landsliding is not expected to significantly affect the ground-based EES.

Seiches. The potential for wave-like or oscillatory movement in the Salton Sea and in the evaporation pond from an earthquake causing dike over-topping and saline solution in the ponds mixing with the Sea water would be less than significant. It would be unlikely that quantities of the shallower pond water would wash over the top of the dike into the deeper Sea water.

Dike over-topping could temporarily damage the ground-based EES, however the effect is considered less than significant.

Disturbance of Bottom Sediments. The disturbance of bottom sediments during pond construction is not expected to have a significant impact. The dike structure and pond would be built in an area of the Sea with relatively high nickel concentrations in bottom sediments (Levine-Fricke 1999). However, high concentrations of other potentially deleterious elements have not been shown to be present in the area of the evaporation pond. The sediments containing nickel would likely be disturbed by dike construction and dredging and redistributed within the Sea during discharge of the dredged material. The dike would not disturb sediments in the areas of the highest observed selenium concentrations (Levine-Fricke 1999); therefore, remobilization of selenium into Salton Sea water for potential biological uptake would be at low levels.

Construction of the ground-based EES would not disturb bottom sediments.

Compaction. The process of dredging materials from the dike foundation area would likely remove unstable material so that the dike foundation would rest on firm material, which would be less subject to compaction.

Construction of the ground-based EES would not result in compaction.

Expansive Soils. The possibility of expansion due to clayey nature of material under the pond barrier would be a less than significant impact with the appropriate site-specific study and preparation prior to construction. The most recent sediment studies have indicated relatively high percentages of clays in the sediments in the southern area of the northern evaporation pond. These sediments are currently saturated and probably would be removed during dredging for the dike foundation; however, the underlying sediments could be of a similar clay content.

Erosion. The effects of wind and erosion due to wave action on the evaporation pond dike would be minimized to a less than significant level by the use of proper compaction and stabilization measures in constructing the dikes.

Erosion is not expected to affect the ground-based EES.

Corrosive Soils. Potentially corrosive soils could damage foundations and subsurface structures, such as pipes and drainage channels, and should be identified during a geotechnical investigation for the evaporation pond and EES. Proper design of subsurface structures would minimize this impact to a less than significant level.

Pupfish Pond

The impacts would be the same as described under Alternative 1, reduced flows.

North Wetland Habitat

The impacts would be the same as described under Alternative 1, reduced flows.

Effect of Alternative 5 with Reduced Inflow Conditions (1.06 maf/yr)

The impacts of Alternative 5 with reduced inflows would be similar to those described above for Alternative 5 with current inflow conditions, with the additional effect of increased exposure of Salton Sea sediments around the perimeter of the Sea. With reduced inflows by the end of Phase 1, the Sea elevation would be 10 feet below the current elevation or –237 feet. This would result in exposure of a band of sediments and rocky substrate totaling approximately 38,000 acres that are currently submerged. This is approximately 22,000 acres more than under the No Action Alternative with reduced inflows. The impact of this would be the same as described under Alternative 1, reduced inflow conditions.

Alternative 5 with reduced inflow conditions also includes the addition of impacts resulting from construction of: a displacement dike and imported flood flows. These impacts are discussed below.

Displacement Dike

The impacts would be the same as described under Alternative 1, reduced flows.

Import Flood Flows

The impacts would be the same as described under Alternative 2, reduced flows.

4.3.9 Cumulative Effects

It is probable that the on-going and proposed water quality improvement and conservation projects in the area surrounding the Salton Sea, described in Chapter 2, would result in decreased inflows to the Sea. For analysis purposes, inflow has assumed to be reduced to an average annual value of 1.06 maf during the Phase 1 planning period. The effects of such an inflow reduction on geology and soils have been discussed for each alternative.

Expansion of the Mesquite Gold Mine would remove valuable mineral resources and would disturb substantial quantities of soil. Construction of the Mesquite Regional Landfill and the Gateway of the Americas Specific Plan Area also would require substantial soil disturbance. The proposed project in combination with these projects, however, is not expected to cause significant impacts to mineral resources or to disturb substantial quantities of agricultural soils.

4.3.10 Mitigation Measures

A detailed geotechnical evaluation undertaken as part of construction activities would identify specific areas of concern, such as the location of previously unidentified fault rupture zones, areas with unstable or corrosive soils, repeatable ground acceleration, and liquefaction potential. All mitigation measures would be supplemented and refined according to the detailed geotechnical evaluation. Impacts related to geology and soils could be minimized by incorporating the recommendations of a geotechnical expert based on site-specific investigations.

The siting and final design of the proposed new structures would take into account the location of known and previously unknown faults revealed through geotechnical investigation and the frequency and level of seismic activity in the Salton Basin. The final design of these structures (evaporation ponds and displacement dikes, EES towers and system, catchment basin, habitat protection dikes, and intake pipes), would, to the extent feasible, incorporate peak ground acceleration loading values and repeatable high ground acceleration values to minimize potentially significant structural damage from seismic activity.

Depending on the findings of site-specific investigations, additional mitigation could include replacing unsuitable base materials, using moisture control, chemical, engineering, and or drainage methods to control expansive soil behavior of clay soil, if appropriate, designing slopes to minimize seismically induced landsliding, designing subsurface pipes, monitoring settlement if appropriate, designing and constructing erosion control methods and devices, and identifying appropriate wind erosion measures, if needed. Repairs to damaged structures would be made under the long-term operation and maintenance program for the Salton Sea Restoration Project, reducing the potential for these impacts to a less than significant level.

4.3.11 Potentially Significant Unavoidable Impacts

The location of dikes and EES structures on unidentified faults could result in damage to these facilities due to ground rupture during a seismic event. The potential for this could be minimized by surveying the locations of the dikes for previously unidentified faults and constructing the dikes to avoid any faults discovered. However, it may not be possible to avoid these features.

Ground acceleration impacts can be mitigated by designing the dikes and the EES system to withstand ground shaking resulting from earthquakes. In this way the effects of ground shaking could be minimized but not avoided.

Repairs to damaged structures would be made under the long-term operation and maintenance program for the Salton Sea Restoration Project; however, if damages to the evaporation pond dikes were sufficient to cause a substantial increase in salinity in the Sea prior to repair, the effects of these damages would be unavoidable.