### Geology and Soils

#### Introduction and Summary

Table 3.3-1 summarizes the geology and soils impacts for the Proposed Project and alternatives.

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</thead>
<tbody>
<tr>
<td>LOWER COLORADO RIVER</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>No impacts.</td>
<td>Continuation of existing conditions</td>
<td>No impacts.</td>
<td>No impacts.</td>
<td>No impacts.</td>
</tr>
<tr>
<td>IID WATER SERVICE AREA AND AAC</td>
<td></td>
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</tr>
<tr>
<td>GS-1: Soil erosion from construction of conservation measures: Less than significant impact</td>
<td>Continuation of existing conditions</td>
<td>A2-GS-1: Soil erosion from construction of conservation measures: Less than significant impact</td>
<td>A3-GS-1: Soil erosion from construction of conservation measures: Less than significant impact</td>
<td>A4-GS-1: Soil erosion from falling: Less than significant impact with mitigation</td>
</tr>
<tr>
<td>GS-2: Soil erosion from operation of conservation measures: Less than significant impact</td>
<td>Continuation of existing conditions</td>
<td>No impact.</td>
<td>A3-GS-2: Soil erosion from operation of conservation measures: Less than significant impact</td>
<td>No impact.</td>
</tr>
<tr>
<td>GS-4: Ground acceleration and shaking: Less than significant impact</td>
<td>Continuation of existing conditions</td>
<td>A2-GS-3: Ground acceleration and shaking: Less than significant impact</td>
<td>A3-GS-4: Ground acceleration and shaking: Less than significant impact</td>
<td>No impact.</td>
</tr>
<tr>
<td>GS-5: Soil Erosion from compliance with the IOP: Less than significant impact</td>
<td>Continuation of existing conditions</td>
<td>Same as GS-5.</td>
<td>Same as GS-5.</td>
<td>Same as GS-5.</td>
</tr>
</tbody>
</table>
### Table 3.3-1
Summary of Geology and Soils Impacts

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>HCP2-GS-7: Soil erosion from construction of HCP Approach 2 components: Less than significant impact.</td>
<td>Continuation of existing conditions</td>
<td>Same as HCP-GS-7.</td>
<td>Same as HCP-GS-7.</td>
<td>Same as HCP-GS-7.</td>
</tr>
</tbody>
</table>

**SALTON SEA**

<table>
<thead>
<tr>
<th>GS-8: Potential for increased soil erosion along exposed playa of Salton Sea: Less than significant impact.</th>
<th>Continuation of Baseline conditions.</th>
<th>A2-GS-5: Potential for increased soil erosion along exposed playa of Salton Sea: Less than significant impact.</th>
<th>A3-GS-5: Potential for increased soil erosion along exposed playa of Salton Sea: Less than significant impact.</th>
<th>A4-GS-2: Potential for increased soil erosion along exposed playa of Salton Sea: Less than significant impact.</th>
</tr>
</thead>
</table>

**SDCWA SERVICE AREA**

| No impact. | Continuation of existing conditions | No impact. | No impact. | No impact. |

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1 Programmatic level analyses of USFWS’ biological conservation measures in LCR subregion and HCP (Salton Sea Portion) Approach 1: Hatchery & Habitat Replacement in Salton Sea subregion are not summarized in the table because no significance determinations have been made. Subsequent environmental documentation will be required if potential impacts are identified.

### 3.3.2 Regulatory Framework

**Alquist-Priolo Earthquake Fault Zone Act.** The Alquist-Priolo Earthquake Fault Zone Act (Public Resources Code Sections 2621 et seq.) was passed in 1972 to prevent buildings from being constructed astride active faults. The act was prompted by damage attributable to surface faulting in the 1971 San Fernando earthquake and the lack of geologic information.

The act is designed to mitigate surface fault rupture by preventing construction of buildings for human occupancy across an active fault. It requires state zoning of active faults, and local review and regulation of development within the zones. The act does not address power lines, water lines, or roads unless there are associated structures for human occupancy that would exceed 2,000 person hours per year (Bryant 2001).
Several of the fault zones in Southern California are considered active by the California Department of Conservation Division of Mines and Geology (CDMG). Alquist-Priolo special study zones (A-P zones) have been established for the majority of these faults and fault zones in accordance with the Alquist-Priolo Special Studies Zones Act of 1972 (CDMG 1983). A-P zones are areas established along and parallel to the traces of active faults. The delineation of A-P zones on topographic maps is the responsibility of CDMG. The purpose of A-P zones is to prohibit the location of structures on the traces of active faults, thereby mitigating potential damage from fault surface rupture.

Seismic Hazards Mapping Act. The Seismic Hazards Mapping Act and related regulations establish a statewide minimum public safety standard for mitigation of earthquake hazards (CDMG 1994). According to this act, the minimum level of mitigation for a project should reduce the risk of ground failure during an earthquake to a level that does not cause the collapse of buildings for human occupancy, but, in most cases, not to a level of no ground failure at all. Nothing in the act precludes public agencies from enacting more stringent requirements, or from requiring a higher level of performance.

Local Regulations and Standards. Imperial County and Riverside County general plans contain goals and policies for protection of geologic features, soil resources, and avoidance of geologic hazards. Additionally, building codes and grading ordinances establish specific regulations for construction procedures, including erosion control measures.

3.3.3 Existing Setting

3.3.3.1 Lower Colorado River

GEOLOGY

The LCR geographic subregion exists within the Sonoran Desert of the basin and range geomorphic province, which is characterized by barren, rugged mountains separated by broad, desert alluvial basins. Landforms in the area are grouped as mountains and hills, piedmont slopes and dissected uplands, sand dunes, and river floodplains (Ratdke et al. 1988). In the LCR geographic subregion, the Colorado River channel cuts undivided Quaternary alluvium; mostly well-consolidated Oligocene sandstone, shale, and conglomerate; a variety of undivided pre-Cenozoic metasedimentary and metavolcanic rocks; Tertiary sandstone, shale, conglomerate, and breccia; Tertiary pyroclastic, volcanic flow, and volcanic mudflow deposits; Tertiary intrusives; Mesozoic and Paleozoic schists; and Precambrian basement rock (Jennings et al. 1991).

SOILS

Soils along the LCR vary from excessively-drained to well-drained fine sand loam, silty clay loam, loamy fine sand, fine sand, gravelly loamy sand, and very fine sand loam that have formed in alluvium deposited by the Colorado River, in alluvium on valley floors, and on old alluvial fans. The following soil associations are present along the LCR: Gilman-Rositas-Indio, Gunsight-Rillito-Chuckwalla, and Badlands-Rositas-Beeline (University of Redlands 1999).
SEISMICITY/GEOL OGY HAZARDS

Seismogenic sources in Imperial and Riverside Counties include the San Andreas, San Jacinto, Imperial, and Cerro Prieto fault zones and the Mojave shear zone, which are located in the western Mojave Desert (Bausch and Brumbaugh 1996, 1997).

Ground Acceleration and Ground Shaking. Ground acceleration is an estimation of the peak bedrock or ground motion associated with a specific earthquake and is expressed in terms of a percentage of gravitational acceleration. The level of destruction of an earthquake at a particular location is commonly reported using a seismic intensity scale. Because seismic intensities are based on past reports of ground shaking and damage, they are subjective classifications. The commonly used Modified Mercalli Intensity (MMI) scale has 12 levels of intensity (I through XII). The higher the number, the greater the ground-shaking intensity and/or damage. Earthquakes have only one magnitude, but they have variable intensities that generally decrease with increasing distance from the source. Additionally, other factors, such as building type, shallow groundwater, and local geology, affect the intensities of earthquakes at a particular location.

The San Andreas, San Jacinto, Imperial, and Cerro Prieto fault zones, as well as the Mojave shear zone, represent the greatest ground-shaking hazard to the LCR geographic subregion. The 1940 Imperial Valley earthquake resulted in shaking effects in La Paz County, Arizona, including MMI VI and V effects at Parker and Quartzsite, respectively. In Yuma, Arizona, MMI X effects were noted approximately 50 miles from the epicenter (Bausch and Brumbaugh 1996, 1997).

Fault Rupture. Fault rupture refers to the physical displacement of surface deposits in direct response to movement along a fault. As described above, several fault and shear zones could contribute to ground-shaking hazards along the LCR; however, the LCR is not underlain by a potentially active fault or shear zone such that fault rupture would be likely to occur (see Figure 3.3-1) (Bausch and Brumbaugh 1997).

Liquefaction. Liquefaction occurs when earthquake vibrations cause loose, granular silts or sands that are saturated with groundwater to transform from a solid into a liquid state. Areas along the LCR 100-year floodplain and stream valleys that are underlain by relatively unconsolidated soil and shallow groundwater could be susceptible to liquefaction-induced ground failure in an earthquake. Low-lying irrigated regions, such as the Parker Valley, are especially vulnerable (Bausch and Brumbaugh 1996, 1997). Bausch and Brumbaugh did not report historic liquefaction occurring within La Paz County, but they did report liquefaction in the Yuma Valley south and east of the LCR geographic subregion, buckled bridges and flumes, and rupturing of the extensive canal network.

Landslides. Potential areas of slope instability have been identified in areas along the LCR. The failure mechanism(s) are not understood at this time (Bausch and Brumbaugh 1996, 1997).
FIGURE
3.3-1 Fault Map
(B&W)
Seiches. A seiche is an earthquake-induced wave occurring in any confined body of water, such as a reservoir. No seiches occurring in the Parker Dam to Imperial Dam reach have been reported in the reservoirs (Reclamation 1997).

3.3.3.2 IID Water Service Area and AAC

GEOLOGY

The entire Imperial Valley Basin lies within the Salton Basin Region of the Salton Trough, a large, sediment-filled topographical depression and seismically active valley that is approximately 130 miles long and as much as 70 miles wide. The Salton Basin Region includes sub-basins and portions of sub-basins (i.e., Imperial Valley and other nearby sub-basins) within the Salton Trough that drain directly into the Salton Sea. The Salton Basin is bordered on the north by the Salton Sea, on the northeast by the Chocolate Mountains, on the southeast by the Sand Hills and Cargo Muchacho Mountains, on the west by the Vallecito and Jacumba Mountains, and on the south by the northern Mexicali Valley and International Boundary (see Figure 3.1-22 in Section 3.1, Hydrology and Water Quality).

Topographically, the Salton Trough is a broad, flat alluviated valley with an area of about 6,000 square miles. The entire valley lies below 500 feet above sea level, except for its rise into San Gorgonio Pass. More than 3,000 of its 6,000 square miles are below sea level (from the city of Indio to below the International Boundary). The lowest elevation point in the Salton Trough is 273 feet below sea level, which is the deepest point in the Salton Sea (Singer 1998).

The Salton Trough is filled with approximately 21,000 feet of Cenozoic sediments derived predominantly from the Colorado River, which emptied into the Gulf of California during the Cenozoic period. The sediments formed a delta that spread and eventually separated the Salton Basin Region from the Gulf of California. The Sand Hills are windblown sand deposits that form a 40-mile-long by 5-mile-wide belt of sand dunes extending along the east side of the Coachella Canal from the International Boundary. Within Coachella and Imperial Valleys, an old lake shoreline has been identified by the presence of lacustrine deposits. It is estimated that Lake Coachella covered an area approximately 117 miles long and 30 miles wide. The Imperial Formation, which is marine in origin, underlies the sequence of sedimentary layers within the Salton Basin Region. The Imperial Formation is underlain by igneous and metamorphic basement rocks.

SOILS

In the dry climate of Imperial County, soils, unless irrigated, have no potential for farming and very limited potential for wildlife habitat (County of Imperial 1997a). Lacustrine basin soils in the IID water service area formed on nearly level old lake beds in the area of ancient Lake Cahuilla. These soils generally consist of silty clays, silty clay loams, and clay loams; are deep and highly calcareous; and usually contain gypsum and soluble salts. The central areas in the IID water service area generally have fine-textured silts, which are primarily used for crops. Continued agricultural use of soils within the IID water service area required installation of subsurface tile drains to carry away water and salts that would have otherwise built up in the soils and prevented crop growth. Tile drains discharge this flow to surface drains (IID 1994). Sandy soils, typical of the deserts in the Southwest US, are
predominant at higher elevations, such as the East and West Mesas, and are generally used for recreation and desert wildlife habitat.

Detailed descriptions of the major soil associations, series, and classes in Imperial County can be obtained from the 1981 soil survey of Imperial County (Natural Resources Conservation Service [NRCS] 1981). NRCS’ soil survey identified 10 major soil associations that can be generally grouped into two categories based on landscape: well-drained to poorly-drained soils, predominantly in the lacustrine basin (irrigated area); and well-drained and somewhat excessively well-drained soils of the mesas, alluvial fans, terraces, and mountains rimming the basin (NRCS 1981). The distribution of soil associations within the Salton Trough is shown in Figures 3.3-2A and 3.3-2B.

The IID water service area is generally flat, with low levels of natural erosion. Erosion is dependent on texture (i.e., clay, sand, or silt content), moisture content, and agronomic practices (i.e., cropped, fresh-tilled, or fallow). Figure 3.3-3 illustrates erosion activity throughout Imperial County.

SEISMICITY/GEOLOGIC HAZARDS

The IID water service area is a flat, broad, alluviated area that lies partly below sea level and is located within the Salton Trough, one of the most tectonically active regions in the U.S. The San Jacinto-Coyote Creek and Elsinore-Laguna Salada fault zones form the western boundary of the Salton Trough. Branches of the San Andreas fault zone (see Figure 3.3-1) form the eastern boundary. The Salton Trough is characterized by northwest-southeast-trending transform fault zones with several crustal rift areas between them. The Salton Trough is the northern extension of the Gulf of California rift zone. Consequently, the IID water service area is subject to potentially destructive earthquakes.

Within the Salton Trough, there are numerous major and several less extensive active fault zones that contain a number of individual fault traces. The active and potentially active major faults within the Salton Trough are presented in Figure 3.3-1 and Table 3.3-2. A potentially active fault shows evidence of displacement within the last 1.6 million years; an active fault is one that has experienced surface displacement within the last 11,000 years.

The major fault zones in the area – San Andreas, San Jacinto, and Elsinore (see Figure 3.3-1) – are characterized by right lateral movement. The Brawley fault, and its associated zone of seismicity, includes much of the southeastern portion of the Salton Sea in the northern Salton Trough. During the 1979 Imperial Valley earthquake, surface rupture occurred along several miles of the Brawley fault zone. The Elmore Ranch fault is a relatively short structure that experienced minor surface rupture associated with the 1987 Superstition Hills-Elmore Ranch earthquake sequence. The Elmore Ranch fault, with a mapped length of only about 5 miles, appears to be the western end of a zone of seismicity termed the Elmore Ranch seismic zone, which extends across nearly the entire southern end of the Salton Sea.
FIGURES

3.3-2A Soil Associations, Imperial Valley
(B&W)
Figure

3.3-2B  Soil Associations, Salton Sea Area
        (B&W)
TABLE 3.3-2
Salton Trough Fault Characteristics

<table>
<thead>
<tr>
<th>Fault</th>
<th>Maximum Credible Earthquake</th>
<th>Estimated Peak Ground Acceleration</th>
<th>Estimated Repeatable High Ground Acceleration</th>
<th>Estimated Maximum Mercalli Scale Intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Active Faults</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>San Andreas</td>
<td>7.5</td>
<td>0.275</td>
<td>0.180</td>
<td>VIII</td>
</tr>
<tr>
<td>Brawley</td>
<td>7.0</td>
<td>0.290</td>
<td>0.190</td>
<td>VIII</td>
</tr>
<tr>
<td>Imperial</td>
<td>7.2</td>
<td>0.275</td>
<td>0.180</td>
<td>VIII</td>
</tr>
<tr>
<td>Superstition Hills (Elmore Ranch)</td>
<td>7.0</td>
<td>0.60</td>
<td>0.40</td>
<td>IX</td>
</tr>
<tr>
<td>San Jacinto (Coyote Creek)</td>
<td>7.2</td>
<td>0.310</td>
<td>0.20</td>
<td>VIII</td>
</tr>
<tr>
<td>Elsinore</td>
<td>7.5</td>
<td>0.210</td>
<td>0.210</td>
<td>VIII</td>
</tr>
<tr>
<td><strong>Potentially Active Faults</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calipatria</td>
<td>7.5</td>
<td>0.290</td>
<td>0.190</td>
<td>VIII</td>
</tr>
<tr>
<td>Sand Hills</td>
<td>7.5</td>
<td>0.150</td>
<td>0.150</td>
<td>VII</td>
</tr>
<tr>
<td>Superstition Mountain</td>
<td>7.0</td>
<td>0.360</td>
<td>0.234</td>
<td>VIII-IX</td>
</tr>
<tr>
<td>Laguna Salada</td>
<td>7.25</td>
<td>0.175</td>
<td>0.175</td>
<td>VII-VIII</td>
</tr>
</tbody>
</table>

Source: SSA and Reclamation 2000

Ground Acceleration and Ground Shaking. More small to moderate earthquakes have occurred in the IID water service area than along any other section of the San Andreas fault system. The IID water service area has experienced 11 earthquakes of magnitude 6.0 or greater on the Richter Scale during the past century; the strongest was a magnitude 7.1 on the Imperial fault in 1940. The 7.1 Imperial Valley earthquake on May 18, 1940 caused MMI X ground shaking in the epicenter region.

Typically, some part of Imperial County is affected by a minor earthquake (less than magnitude 3.5) every few months. Every 5 years, the county might experience a moderately damaging event (magnitude of 5.5 or greater). At least once every 50 years, there is likely to be a major earthquake (magnitude of 6.8 or greater). Microseismicity (magnitude of less than 2.0) occurs almost continuously in the county, often with dozens and sometimes hundreds of events per day (County of Imperial 1997a).

Fault Rupture. Extensive fault rupture has occurred in the past in the IID water service area. The 1940 Imperial fault earthquake ruptured the ground for 40 miles, from Volcano Lake in Baja, California, to a point near the city of Imperial, California. Horizontal displacement across the completed, but unfilled, AAC was 14 feet 10 inches, and the International Boundary was permanently changed. Earthquakes have also caused abrupt elevation changes across fault lines in excess of 1 foot (County of Imperial 1997a). Zones with mapped surface rupture are shown in Figure 3.3-4.

Liquefaction. The IID water service area is especially susceptible to liquefaction where the soil is generally saturated. Liquefaction and related loss of foundation support are common hazards (County of Imperial 1997a).

Landslides. The potential for landslides in Imperial County is low to moderate along the western edge of the county, parallel to the Coast Range Mountains. Other areas in the county subject to landslides include the IID water service area between East Highline Canal
FIGURE

3.3-3 Erosion Activity Within Imperial County
COLOR
Figure 3.3-4  Fault Rupture Hazard Zones (B&W)
and Westside Main Canal and the bluffs adjacent to the AAC, Coachella Canal, New River, Alamo River, and LCR (see Figure 3.3-5) (County of Imperial 1997a).

**Seiches.** The most likely location for a significant seiche to occur is in the Salton Sea. No record of seiches in the Salton Sea exists although there have been a number of seismic events since the formation of the Sea (County of Imperial 1997a).

**Flooding.** Imperial County is subject to various degrees of flooding in the form of flash floods or slow floods caused by heavy precipitation. Flash flooding could also occur in desert areas. Flooding could occur either in floodplains or floodways. Floodplains are generally located adjacent to rivers and other bodies of water and in low-lying areas near a water source. The boundary of a floodplain is defined by the predicted extent of inundation.

Defined by discernible drainage channels, floodways are more hazardous because of the anticipated velocities of the floodwaters and expected damage to life and property. Figure 3.3.6 illustrates the areas in the county that are at risk for flooding.

**OTHER GEOLOGIC RESOURCES**

Other geologic resources in the IID water service area and AAC geographic subregion include: mineral resources—rock and stone, sand, gravel, clay, and gypsum; metals—gold, silver, nickel, and lead; radioactive elements; and geothermal areas. Geothermal resource areas and sources of sand and gravel are generally located along the southern border of the Salton Sea; other resources are found in the surrounding hills. Six known geothermal resource areas (KGRA’s) cover approximately 254,827 acres in Imperial County: the Dunes KGRA, East Mesa KGRA, Glamis KGRA, Heber KGRA, Brawley KGRA, and Salton Sea KGRA. In both Imperial and Riverside Counties, sand and gravel are significant economic resources. Most of these materials are derived from shoreline deposits from ancient Lake Cahuilla. Additional sources of lower quality sand and gravel are found in alluvial fan deposits.

**3.3.3.3 Salton Sea**

**GEOLOGY**

The Salton Sea is in the northern portion of the Salton Trough. The geology of the Salton Trough is discussed in Section 3.3.3.2.

**SOILS**

Soil associations within the Salton Trough are discussed in Section 3.3.3.2.

**SEISMICITY/GEOLOGIC HAZARDS**

The Salton Sea regularly experiences earthquake swarms of detectable and perceptible large-scale seismic events. Situated in the Salton Trough, the Salton Sea is located in one of the most active seismic areas in the world. The seismicity and geologic hazards in Imperial and Riverside Counties, including the Salton Trough, are discussed in Sections 3.3.3.1 and 3.3.3.2.

**Ground Acceleration and Ground Shaking.** Ground acceleration and ground shaking in Imperial and Riverside Counties, including the Salton Trough, are discussed in Sections 3.3.3.1 and 3.3.3.2.
FIGURE
3.3-5 Landslide Activity within Imperial County
(Color)
FIGURE

3.3-6 Areas of Imperial County at Risk for Flooding
(Color)
Fault Rupture. Throughout the Salton Trough, a number of fault-rupture hazard zones have been identified (see Figure 3.3-4). The potential for fault ruptures is discussed in Sections 3.3.3.1 and 3.3.3.2.

Liquefaction. The geologically young, unconsolidated sediments of the Salton Trough are subject to failure during earthquakes. Liquefaction and related loss of foundation support are common hazards (County of Imperial 1997a). These seismic hazards are discussed in Sections 3.3.3.1 and 3.3.3.2.

Landslides. The potential for landslides within the Salton Trough is discussed in Sections 3.3.3.1 and 3.3.3.2.

Seiches. The potential for seiches is discussed in Sections 3.3.3.1 and 3.3.3.2.

OTHER GEOLOGIC RESOURCES
Other geologic resources in Imperial and Riverside Counties are discussed in Sections 3.3.3.1 and 3.3.3.2.

3.3.4 Impacts and Mitigation Measures

3.3.4.1 Methodology
The impact assessment methodology used to support the geology and soils analysis presented in this chapter is based on the proximity of active faults, frequency and types of seismic events, existing ground acceleration data and models, and the type of existing soils. In addition, the Project and/or Project alternatives’ susceptibility and/or contribution to geotechnical hazards are described in terms of their potential impact on the public or geological resources.

Severity of Seismic Events. Earthquakes are normally classified as to severity according to their magnitude. Magnitude is usually classified using the Richter scale, a logarithmic scale used to measure the maximum motions of the seismic waves as recorded by a seismograph. A magnitude 8 (Richter) earthquake is not twice as large as a magnitude 4 earthquake; it is $10^4$ times larger.

The level of destruction of an earthquake at a particular location is commonly reported using a seismic intensity scale. Based on reports of ground shaking and damage caused by past earthquakes, seismic intensities are subjective classifications. The commonly used Modified Mercalli Intensity scale has 12 levels of intensity; the higher the number, the greater the ground-shaking intensity and/or damage. Earthquakes have only one magnitude, but they have variable intensities that generally decrease with increasing distance from the source. Additionally, other factors, such as building type, shallow groundwater, and local geology, affect the intensities of earthquakes at a location.
Subregions Excluded From Impact Analysis. No impacts to geology and soils would occur in the LCR subregion or SDCWA service area because construction of new facilities or changes in operation of existing facilities would not occur in those subregions; therefore, those areas are not discussed in the impact discussions for each alternative below.

3.3.4.2 Significance Criteria
The Proposed Project and/or alternatives would have a significant impact on geology and soils if they:

- Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving any of the following circumstances:
  - Fault rupture
  - Strong seismic ground shaking
  - Seismic-related ground failure, including liquefaction
  - Landslides
- Result in substantial soil erosion or loss of topsoil, degradation of soils or farmland, changes in topography, or unstable soil conditions.
- Are located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off landslide, lateral spreading, subsidence, liquefaction, or collapse.
- Are located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (International Conference of Building Officials 1994), creating substantial risks to life or property.
- Place septic tanks or alternative wastewater disposal systems on soils incapable of adequately supporting these systems where sewers are not available for the disposal of wastewater.
- Result in the loss of a known mineral resource of value to the region and the residents of the state.
- Result in the loss of availability of a locally important mineral resource recovery site delineated on a local general plan, specific plan, or other land use plan.

3.3.4.3 Proposed Project

LOWER COLORADO RIVER

Biological Conservation Measures in USFWS Biological Opinion

Implementation of the biological conservation measures may result in temporary impacts to geology and soils through physical activities such as dredging, removal of salt cedar by mechanical or other means, and conversion of agricultural lands to native habitat. Reclamation will conduct subsequent environmental analysis, as appropriate, prior to implementation of the biological conservation measures.
Impacts resulting from the implementation of the biological conservation measures in USFWS’ Biological Opinion would be the same for Alternatives 2, 3, and 4; therefore, they are not discussed under each alternative.

**IID WATER SERVICE AREA AND AAC**

**Water Conservation and Transfer**

**Impact GS-1: Soil erosion from construction of conservation measures.** If methods requiring construction were implemented, construction of conservation measures could require removal of existing vegetation, excavation, regrading, and temporary soil stockpiling. The potential for soil erosion and deposition from stormwater and wind activity could increase as a result of these measures. The extent of soil erosion, however, would depend on the degree of slope, the total exposed area, and the amount of wind and rainfall. IID currently obtains a Stormwater Pollution and Prevention Plan (SWPPP) for Individual Permits issued by the CRB RWQCB, which includes best management practices (BMPs) for site-specific construction activities occurring within the IID water service area. All construction of conservation measures resulting in the disturbance of more than 5 acres would require compliance with a site-specific Individual Permit and SWPPP, which would require implementation of BMPs; therefore, the potential for erosion would be a less than significant impact. In addition, potential erosion impacts would be short-term. (Less than significant impact.)

**Impact GS-2: Soil erosion from operation of conservation measures.** Operation of the conservation measures could increase the potential for soil erosion. Wind and water erosion could occur within the new, unlined interceptor laterals/canals and the 5- to 10-acre reservoirs. The new interceptors/canals and reservoirs, however, represent minor additional components of an already extensive, existing canal/drain system within the Imperial Valley. The additional components would represent a minor extension of the existing system. (Less than significant impact.)

**Impact GS-3: Reduction of soil erosion from reduction in irrigation.** Soil erosion from irrigation water applied to the fields could be reduced upon implementation of the Proposed Project. The Proposed Project would reduce the amount of tailwater entering the drains, which could potentially diminish the amount of soil removed from each field. This decreased erosion could represent a beneficial impact to the geology and soils of the IID water service area. (Beneficial impact.)

**Impact GS-4: Ground acceleration and shaking.** The IID water service area could be subjected to seismic ground acceleration and ground shaking during the life of the Proposed Project. Large earthquakes along major faults, such as the San Andreas and Imperial faults, could produce potentially destructive ground shaking in the Salton Trough. Estimated maximum Mercalli intensities for faults within the Salton Trough range from VII to IX. At these intensities, damage could occur to specially designed structures and underground pipes. Ground acceleration as intense as 0.6 g near Westmorland has been projected for a magnitude 7.0 earthquake along one of the Superstition Hills faults (SSA and Reclamation 2000).

Additionally, extensive fault rupture along known faults within the Salton Trough (e.g., horizontal displacement of 14 feet, 10 inches along the AAC in 1940) is known to occur.
Fault rupture hazard zones within the Salton Trough are shown in Figure 3.3-4. In the IID water service area subregion, the Proposed Project could include the construction of on-farm irrigation system improvements and water delivery system improvements. These measures could be subject to seismic activity. Because these measures would be placed in underdeveloped, largely unpopulated rural areas, the public safety impacts would be less than significant impact. (Less than significant impact.)

Inadvertent Overrun and Payback Policy (IOP)

Impact GS-5: Soil erosion from compliance with the IOP. Conservation of the average 59 KAFY required for the IOP can be accomplished via fallowing or other measures. The potential for erosion from additional conservation measures would be similar to, and in addition to the erosion described in Impacts GS-1, 2 and 6. The amount of erosion would depend on the conservation measures selected to generate the average 59 KAFY required for the IOP. If fallowing is selected, about 9,800 additional acres would be required. Fallowing is not anticipated to be a source of erosion. As described in Impact GS-1, construction of conservation resulting in the disturbance of more than 5 acres would require compliance with a site-specific Individual Permit and SWPPP, which would require implementation of BMPs; therefore, the potential for erosion would be a less than significant impact. (Less than significant impact.)

Impacts resulting from compliance with the IOP in would be the same for Alternatives 2, 3, and 4; therefore, they are not discussed under each alternative.

Habitat Conservation Plan (HCP) (IID Water Service Area Portion)

Impact HCP-GS-6: Soil erosion from construction of HCP components. Construction of the ponds and managed marsh could cause minor short-term degradations in environmental values as a result of construction and operation of the HCP. Specifically, construction would result in temporary increases in soil erosion potential. Implementation of the HCP could cause temporary adverse impacts on soil resources and erosion potential as a result of construction. However, construction of the HCP would require a site-specific Individual Permit and a SWPPP to be issued by the CRB RWQCB. This permit and SWPPP would require implementation of BMPs during construction, thereby reducing this short-term, potentially significant impact to a less than significant level as part of the Project. (Less than significant impact.)

HCP (Salton Sea Portion) Approach 1 (HCP1): Hatchery and Habitat Replacement

Construction of the ponds and hatchery could cause minor short-term degradations in environmental values as a result of construction and operation of the HCP. Specifically, construction would result in temporary increases in soil erosion potential. Implementation of the HCP could cause temporary adverse impacts on soil resources and erosion potential as a result of construction. However, construction of the HCP would require a site-specific Individual Permit and a SWPPP to be issued by the CRB RWQCB. This permit and SWPPP would require implementation of BMPs during construction, thereby reducing this short-term, potentially significant impact to a less than significant level.

Approach 2 (HCP2): Use of Conserved Water as Mitigation

Impact HCP2-GS-7: Soil erosion from construction of HCP Approach 2 components. Impacts from construction of HCP Approach 2 components would be of similar nature to those
described above for the Proposed Project. The extent of potential erosion would depend on
the type of conservation measure selected to generate conserved water. Construction of
additional conservation measures would result in a greater potential for erosion, whereas
additional fallowing would minimize erosion. Impacts would be as described in Impacts
GS-1 and GS-2. (Less than significant impact.)

Impacts resulting from the implementation of the HCP would be the same for Alternatives 2, 3, and
4; therefore, they are not discussed under each alternative.

SALTON SEA
Water Conservation and Transfer

Impact GS-8: Potential for increased soil erosion along exposed playa of Salton Sea. During
operation of the Proposed Project, there might be an increased potential for impact from soil
erosion in the Salton Sea area. Implementation of the Proposed Project would result in a
decrease in the elevation of the Salton Sea, exposing up to 50,000 acres (over the life of the
project) of previously inundated area (compared to the Baseline condition). (For information
on the Baseline condition of the Salton Sea, see the discussion on the Development of the
Baseline in the Introduction to Chapter 3.0 Environmental Analysis.) The newly exposed
shoreline could be subject to wind and water erosion. However, the high salt content of the
Salton Sea and the soils underlying the Sea cause a crust to form on the soils as they dry,
which minimizes both wind and soil erosion. Additional information regarding the content
of the soils is included in Section 3.7, Air Quality. (Less than significant impact.)

3.3.4.4 Alternative 1: No Project

IID WATER SERVICE AREA
Water Conservation and Transfer

Implementation of the No Project alternative would result in the continuation of current
agricultural and water conservation practices. No additional impacts would occur.

SALTON SEA
Water Conservation and Transfer

Implementation of the No Project alternative would also result in a decline of the elevation
of the Salton Sea, resulting in a potential for impact from soil erosion in the Salton Sea area.
Baseline conditions of the Salton Sea, which are the same as the No Project alternative, are
described in the discussion on the Development of the Baseline in the Introduction to
Chapter 3.0 Environmental Analysis. The No Project alternative would result in the
exposure of 16,000 acres (over a 75-year period) of previously inundated area (compared to
the existing condition). The newly exposed shoreline could be subject to wind and water
erosion. However, the high salt content of the Salton Sea and the soils underlying the Sea
cause a crust to form on the soils as they dry, which minimizes both wind and soil erosion.
Additional information regarding the content of the soils is included in Section 3.7, Air
Quality. (Less than significant impact.)
3.3.4.5 Alternative 2 (A2): Water Conservation and Transfer of Up To 130 KAFY to SDCWA (On-farm Irrigation System Improvements as Exclusive Conservation Measure)

**IID WATER SERVICE AREA**

**Impact A2-GS-1: Potential increase in soil erosion from construction of conservation measures.** The potential for an increase in soil erosion would be similar to that for the Proposed Project, but would likely be of smaller magnitude because only 130 KAFY would be conserved in Alternative 2. However, in Alternative 2, on-farm irrigation system improvements are required to be constructed, whereas in the Proposed Project, other conservation measures, including fallowing, could be implemented instead. Nonetheless, the potential for erosion would be expected to be reduced when compared to the Proposed Project. See Impact GS-1 for more details. (Less than significant impact.)

**Soil erosion from operation of conservation measures.** Increased erosion is not anticipated from the operation of the conservation measures for Alternative 2.

**Impact A2-GS-2: Reduction of soil erosion from reduction in irrigation:** Similar to the effects of Proposed Project, soil erosion from irrigation water applied to the fields could be reduced with implementation of Alternative 2. This alternative would also reduce the amount of tailwater entering the drains, which could diminish the amount of soil removed from each field. This decreased erosion could represent a beneficial impact to the geology and soils of the IID water service area; however, the beneficial impact would be greater with the Proposed Project because the reduction in irrigation would be greater. (Beneficial impact.)

**Impact A2-GS-3: Ground acceleration and shaking:** The potential impacts from ground acceleration and shaking would be similar to those for the Proposed Project but potentially of smaller magnitude because Alternative 2 does not include construction of water delivery system based improvements. However, the Proposed Project could also exclude construction of water delivery system improvements if other conservation measures are selected for implementation. See Impact GS-4 for more details on the potential impacts associated with ground acceleration and shaking. Because these measures would be placed in underdeveloped, largely unpopulated rural areas, the public safety impacts would be less than significant. (Less than significant impact.)

**SALTON SEA**

**Water Conservation and Transfer**

**Impact A2-GS-4: Soil erosion along exposed playa of Salton Sea.** The potential for soil erosion along the exposed playa of the Salton Sea would be similar to that of the Proposed Project but would be of smaller magnitude. Implementation of Alternative 2 would result in a decrease in the elevation of the Salton Sea, exposing 22,000 acres (over the life of the Project) of previously inundated area (compared to the Baseline condition). Baseline conditions of the Salton Sea are described in the discussion on the development of the Baseline in the introduction to Chapter 3.0, Environmental Analysis. See Impact GS-6 for more details. (Less than significant impact.)
3.3.4.6 Alternative 3 (A3): Water Conservation and Transfer of Up To 230 KAFY to SDCWA, CVWD, and/or MWD (All Conservation Measures)

IID WATER SERVICE AREA AND AAC

Impact A3-GS-1: Soil erosion from construction of conservation measures. The potential impacts would be similar to those of the Proposed Project, but would likely be of lesser magnitude because only 230 KAFY would be conserved in Alternative 3. See Impact GS-1 for details. (Less than significant impact.)

Impact A3-GS-2: Soil erosion from operation of conservation measures. The potential impacts from soil erosion from the operation of the conservation measures would be similar to those of the Proposed Project but likely would be of lesser magnitude because only 230 KAFY would be conserved in Alternative 3. If water delivery system based improvements are implemented, wind and water erosion could occur within the new, unlined interceptor laterals/canals and the 5- to 10-acre reservoirs. However, the new interceptors/canals and reservoirs represent minor additional components of an already extensive, existing canal/drain system within the IID water service area. The additional components could represent a minor extension of the existing system. (Less than significant impact.)

Impact A3-GS-3: Reduction of soil erosion from reduction in irrigation: Similar to the results of Proposed Project, soil erosion from irrigation water applied to the fields could be reduced with implementation of Alternative 2. This alternative would also reduce the amount of tailwater entering the drains, which could diminish the amount of soil removed from each field. This decreased erosion could represent a beneficial impact on the geology and soils of the IID water service area. (Beneficial impact.)

Impact A3-GS-4: Ground acceleration and shaking: The potential impacts from ground acceleration and shaking would be similar to those of the Proposed Project. There is a potential that the magnitude of impact would be less with Alternative 3 because only 230 KAFY would be conserved, requiring fewer conservation measures. However, because both the Proposed Project and Alternative 3 could be implemented with any combination of conservation measures, the risk of damage from ground acceleration and shaking would be greatest for whichever alternative, when implemented, included the most constructed facilities. More importantly, because these measures would be placed in underdeveloped, largely unpopulated rural areas, the public safety impacts would be less than significant. (Less than significant impact.)

SALTON SEA

Water Conservation and Transfer

Impact A3-GS-5: Soil erosion along exposed playa of Salton Sea. The potential for soil erosion along the exposed playa of the Salton Sea would be similar to that of the Proposed Project but would be of lesser magnitude. Implementation of Alternative 3 would result in a decrease in the elevation of the Salton Sea, exposing 39,000 acres (over the life of the project) of previously inundated area (compared to the Baseline condition). Baseline conditions of the Salton Sea are described in the discussion on the development of the Baseline in the introduction to Chapter 3.0, Environmental Analysis. See Impact GS-6 for more details. (Less than significant impact.)
3.3.4.7 Alternative 4 (A4): Water Conservation and Transfer of Up To 300 KAFY to SDCWA, CVWD, and/or MWD (Fallowing As Exclusive Conservation Measure)

IID WATER SERVICE AREA AND AAC

No construction of conservation measures would occur in the IID water service area with the implementation of Alternative 4.

Water Conservation and Transfer

Impact A4-GS-1: Potential soil erosion from fallowing. Implementation of Alternative 4 would result in the fallowing of up to 50,000 acres of previously irrigated area within the IID water service area, to conserve 300 KAFY. There would be no application of water to the fallowed areas. The potential for wind erosion of these areas is discussed in Section 3.7, Air Quality. No water erosion of soils would occur. (Less than significant impact.)

SALTON SEA

Water Conservation and Transfer

Impact A4-GS-2: Potential for increased soil erosion along exposed playa of Salton Sea. The potential for soil erosion along the exposed playa of the Salton Sea would be significantly reduced in Alternative 4 compared to that of the Proposed Project. Implementation of Alternative 4 would result in a decrease in the elevation of the Salton Sea, exposing 16,000 acres (over the life of the project) of previously inundated area (compared to the Baseline condition). Baseline conditions of the Salton Sea are described in the discussion on the development of the Baseline in the introduction to Chapter 3.0, “Environmental Analysis.” See Impact GS-6 for more details. (Less than significant impact.)