Systems Conveyance and Operations Program Environmental Impact Statement

Final Draft

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BUREAU OF RECLAMATION AND NATIONAL PARK SERVICE
FINAL ENVIRONMENTAL IMPACT STATEMENT
CLEAN WATER COALITION
SYSTEMS CONVEYANCE AND OPERATIONS PROGRAM

Clark County, Nevada

Lead Agencies: National Park Service (NPS), 601 Nevada Highway, Boulder City, NV 89005; and Bureau of Reclamation (Reclamation), PO Box 61470 (LC-2621), Boulder City, NV 89006

Cooperating Agencies: U.S Army Corps of Engineers, U.S. Bureau of Land Management, Colorado River Commission of Nevada, Metropolitan Water District of Southern California

Applicant: Clean Water Coalition

Abstract: The Systems Conveyance and Operations Program (SCOP) Final Environmental Impact Statement (EIS) analyzes the potential impacts resulting from the construction and implementation of the SCOP. The City of Las Vegas, Clark County Water Reclamation District, and City of Henderson comprise the Clean Water Coalition (CWC), which proposes to implement the SCOP, which would be a system of increased treatment (as needed), and pipelines and tunnels that discharges highly treated effluent to an alternate location in Lake Mead. The SCOP would be designed to collect the treated effluent flows from the three treatment facilities, for conveyance to an area in the lower Colorado River system, while the majority of the flows bypass the lower Las Vegas Wash. This EIS analyzes the potential impacts of five alternatives including the No Action Alternative. Under the No Action Alternative the pipeline would not be constructed and highly treated effluent would continue to be discharged to the Las Vegas Wash at the existing discharge locations. Under the Boulder Islands North Alternative, a pipeline would be constructed that collects and transports highly treated effluent from the three treatment facilities to a receiving area in the vicinity of Boulder Islands. This alternative includes the generation of electricity at a hydroelectric generation facility on NPS land. Under the Boulder Islands South Alternative, a pipeline would be constructed that collects and transports highly treated effluent from the three treatment facilities to a receiving area in the vicinity of Boulder Islands, but there would be no power generation facility. Under the Las Vegas Bay Alternative, a pipeline would be constructed that collects and transports highly treated effluent from the three treatment facilities to a receiving area in the Las Vegas Bay. Under the Process Improvements Alternative, the treatment facilities would implement best available technologies to meet water quality standards, and the highly treated effluent would continue to be discharged to the Las Vegas Wash at the existing discharge locations.

For Further Information Contact: Mr. William K. Dickenson, National Park Service, 601 Nevada Highway, Boulder City, NV 89005, (702) 293-8920; or Mr. Anthony Vigil, Bureau of Reclamation, PO Box 61470 (LC-2621), Boulder City, NV 89006, (702) 293-8674.

Comments: Comments/appeals on this Final EIS must be received via e-mail (eis@cleanwatercoalition.com) or postmarked no later than 30 days after EPA publication of the Notice of Availability in the *Federal Register*.

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ES.0 Executive Summary

The Bureau of Reclamation, Lower Colorado Region (Reclamation) and the National Park Service (NPS), Lake Mead National Recreation Area (LMNRA) are preparing the EIS as joint-lead federal agencies to evaluate the potential impacts associated with the construction, operation, and maintenance of the Systems Conveyance and Operations Program (SCOP).

The Clean Water Coalition (CWC) is comprised of the three agencies currently responsible for wastewater treatment in the Las Vegas Valley: the City of Las Vegas (CLV), the City of Henderson (COH), and the Clark County Water Reclamation District (CCWRD). The CWC proposes to implement the SCOP, which would include optimization of the treatment plants, increased treatment (as needed), and a pipeline to discharge the highly treated effluent into the Lower Colorado River System via Lake Mead, while minimizing the impacts to water quality and other natural resources. The SCOP would provide an alternate discharge point for the effluent, which is currently discharged to Lake Mead through the Las Vegas Wash. The SCOP includes activities and infrastructure that would be located on lands owned or managed by private entities, the CLV, the COH, Clark County, Reclamation, NPS, and the U.S. Bureau of Land Management (BLM), all within Clark County, Nevada.

Compliance with the National Environmental Policy Act (NEPA) is required because the project would be located on lands being managed by federal agencies (42 USC 4321 et seq.; PL 91-190). This EIS was prepared in compliance with NEPA and the *Council on Environmental Quality Regulations for Implementing the Procedural Provisions of NEPA* (40 Code of Federal Regulations 1500-1508, 1993). The NEPA requires federal agencies to consider the environmental consequences of proposed actions in their decision-making process.

This EIS evaluates effects of the five project alternatives, including the No Action Alternative, on a number of resource issues including, but not limited to: surface water hydrology, groundwater, water quality, biological resources/endangered species, cultural resources, recreation, land use, air quality, noise, socioeconomics, environmental justice populations including Indian Trust Assets, and other appropriate resource issues identified during the scoping process. An impairment analysis was also conducted for the portion of the project located on land administered by the NPS. To assist the public and decision-makers review, this EIS is organized as follows:

- Chapter 1 discusses the purpose and need for the proposed project.
- Chapter 2 describes the five alternatives including the No Action Alternative. Alternatives considered but eliminated are also discussed in this section.
- Chapter 3 provides an overview of the existing (baseline) environmental conditions within the project area and the potentially affected environment.
- Chapter 4 addresses the potential environmental consequences of implementing the alternatives described in Chapter 2 when compared to baseline conditions presented in Chapter 3. Mitigation measures associated with the alternatives are also discussed in Chapter 4. In addition, as required by NPS management policy, the results of impairment analyses are presented in Chapter 4.

- Chapter 5 discusses the cumulative effects of implementing the alternatives in addition to other past, present, and reasonably foreseeable actions that may occur in the area.
- Chapter 6 addresses the potential irreversible and irretrievable affects associated with the two action alternatives.
- Chapters 7, 8, 9, 10, 11, and 12 presents Consultation and Coordination, List of Preparers, References, Distribution List, Glossary, and Index, respectively.
- Appendices provide additional technical support data.

More than 500 comments were received on the Draft EIS from approximately 70 commentors. The issues most often mentioned include: requests for the analyses of a Process Improvements alternative that includes additional wastewater treatment; concerns that additional alternatives such as reuse and water conservation were not considered; requests for additional details regarding plant optimization; concerns about changes to water quality through Hoover Dam and the potential impacts to downstream users and aquatic species; concerns regarding the potential impacts to water quality, and the potential impacts to humans and fish from exposure to endocrine disrupting chemicals (EDCs) and pharmaceuticals and personal care products (PPCPs); concerns about the methodology used throughout the water quality modeling effort such as the selection baseline data; requests for additional details regarding the Boulder Basin Adaptive Management Plan (AMP); and concerns about the impacts to the Las Vegas Wash related to the reduction in effluent flows.

ES.1 Purpose and Need

The purpose of implementing one of the action alternatives is to maintain water-quality standards and NPS recreational and resource values by operating a system that would allow for flexible management of wastewater flow from the Las Vegas Valley (Valley) to Lake Mead. Clark County, Nevada is one of the fastest growing counties in the U.S. It is projected that the population in the area will be approximately 3,130,000 by 2035 (UNLV 2004). The quantity of effluent treated and discharged in the Valley will increase as the population of the Valley increases. Forecasts indicate that a combined maximum month flow of approximately 400 million gallons per day (mgd) (619 cubic ft per second [cfs]) of municipal wastewater will need to be treated and managed in the Valley by 2050 (Black & Veatch 2004a). The year 2050 flows were extrapolated from treatment plant projections. The wastewater facilities must accommodate the additional flows while continuing to meet current or future water quality standards for the Las Vegas Wash, Las Vegas Bay, and Lake Mead.

The CWC needs a system that:

- Provides maximum flexibility for management of increasing amounts of treated effluent flows between the current discharge location at the Las Vegas Wash and Las Vegas Bay, and other locations in Lake Mead;
- Provides flexibility to meet current and future water quality standards for known pollutants, and as yet unknown standards for additional contaminants that may be regulated in the future;

- Enhances the Las Vegas Bay area of the LMNRA by protecting and maintaining the recreational and resource values of the entire LMNRA and continuing to meet beneficial uses, while more than doubling the treated effluent flows discharged to Lake Mead;
- Accommodates Lake Mead's lowering water levels because the amount of mixing and dilution available in the inner Las Vegas Bay would decrease as the Lake level decreases;
- Provides flexibility to avoid possible impacts to source-water quality at the Southern Nevada Water System intake structures; and
- Avoids the ratcheting-down effects of Nevada's requirements to maintain existing higher quality (RMHQ) anti-degradation system that happens in effluent-dominated waterways such as the Las Vegas Wash, by removing the effluent to a natural, non-effluent dominated waterway in which the existing water quality is set by the natural flow conditions, not the effluent itself.

ES.2 Summary of Alternatives

This EIS evaluates the potential environmental impacts associated with three pipeline alternatives, a Process Improvements Alternative (no pipeline), and the No Action Alternative (no pipeline). All of the alternatives include plant optimization. The three pipeline alternatives include, the Boulder Islands North Alternative, the Boulder Islands South Alternative, and the Las Vegas Bay Alternative. The three pipeline alternatives analyzed have a common element, the Effluent Interceptor (EI). However, the EI alignment for the Boulder Islands North Alternative is slightly different than the EI alignment for the Boulder Islands South and Las Vegas Bay alternatives. Therefore, the designations of EI-Alignment A and EI-Alignment B are used throughout the EIS to describe the EI portion of the alternatives. Regardless of the EI alignment, the EI would collect and convey the highly treated effluent from the three treatment facilities to Lake Mead via the Lake Conveyance System (LCS).

All of the alternatives in this EIS include the use of conventional treatment processes and plant optimization to attempt to meet water quality standards. In addition to the use of conventional treatment processes and plant optimization, the three pipeline alternatives include additional treatment, as needed, and construction and operation of a pipeline that would transport highly treated effluent from the three treatment facilities to a receiving area underwater, within the Colorado River system. The Process Improvements Alternative adds microfiltration/ultrafiltration (MF/UF) membranes to plant optimization processes.

The pipeline alternatives would allow for flexible management of the highly treated effluent. A controlled amount of effluent would continue to be discharged to the Las Vegas Wash at each facility. The discharge amount, velocity, and direction from the LCS diffuser would also be flexibly operated depending on the conditions of Lake Mead and the objectives identified in the Boulder Basin AMP.

ES.2.1 No Action Alternative

Under the No Action Alternative the CWC would not construct pipelines to transport effluent from the treatment facilities. Current, conventional treatment processes and plant optimization would be used to attempt to meet the requirements set by the Nevada Division of Environmental Protection (NDEP) through the National Pollutant Discharge Elimination System (NPDES) permitting program. Total phosphorus (TP) from the combined effluent of the treatment facilities is currently treated to 0.2 milligrams per liter (mg/L). Each of the three treatment plants is unique in their design, processes, facility improvement schedules, and varying capabilities of phosphorus removal. Nonetheless, the three agencies responsible for municipal wastewater treatment would continue to coordinate treatment and discharges to achieve combined TP levels of 0.14 mg/L during plant optimization.

ES.2.2 Boulder Islands North Alternative (Preferred Alternative)

The three treatment agencies would expand their facilities to handle the increasing quantities of wastewater through 2050, while using current, conventional treatment processes, plant optimization, and increased treatement (if needed) to meet water quality requirements. A pipeline to convey highly treated effluent from the three treatment facilities to an alternate discharge location in Lake Mead would be constructed. The first segment of the pipeline, EI-Alignment A, extends from the CLV treatment facility to the EI Terminus site west of Lake Las Vegas. The effluent discharged from the CLV and CCWRD's treatment facilities would bypass the lower Las Vegas Wash via the EI. The treated effluent from the COH Water Reclamation Facility would be introduced to the EI via the COH Forcemain, which crosses beneath the Las Vegas Wash in the vicinity of the Pabco Road Erosion Control Structure (ECS). The three flows would be combined north of the Pabco Road ECS and be transported to the vicinity of the Boulder Islands in Lake Mead via the LCS. The majority of the Boulder Islands North LCS would be installed in a tunnel through the River Mountains. A hydroelectric power generation facility would be located on NPS land. The Boulder Basin AMP would be implemented as part of the Boulder Islands North Alternative.

ES.2.3 Boulder Islands South Alternative

The three treatment agencies would expand their facilities to handle the increasing quantities of wastewater through 2050, while using current, conventional treatment processes, plant optimization, and increased treatment (if needed) to meet water quality requirements. A pipeline to convey highly treated effluent from the three treatment facilities to an alternate discharge location in Lake Mead would be constructed. The first segment of the pipeline, EI-Alignment B, extends from the CLV treatment facility to the EI Terminus location west of Lake Las Vegas. The effluent discharged from the CLV and CCWRD's treatment facilities would bypass the upper Las Vegas Wash via the EI. The South Lateral Pipeline would convey the treated effluent from the COH Water Reclamation Facility. The three flows would be combined at the EI Terminus and be either returned to the Las Vegas Wash at a point upstream of Lake Las Vegas, or be transported to the vicinity of the Boulder Islands in Lake Mead via the LCS. The majority of the

Boulder Islands LCS would be installed in a tunnel through the River Mountains. The Boulder Basin AMP would be implemented as part of the Boulder Islands South Alternative.

ES.2.4 Las Vegas Bay Alternative

The three treatment agencies would expand their facilities to handle the increasing quantities of wastewater through 2050, while using current, conventional treatment processes, plant optimization, and increased treatement (if needed) to meet water quality requirements. In addition, EI-Alignment B, including the South Lateral Pipeline as described for the Boulder Islands South Alternative, is included in the Las Vegas Bay Alternative. The three flows would be combined at the EI Terminus and be either returned to the Las Vegas Wash at a point upstream of Lake Las Vegas, or be transported to the Las Vegas Bay in Lake Mead via the LCS. The majority of the Las Vegas Bay LCS would be installed in a tunnel through the River Mountains. The Boulder Basin AMP would be implemented as part of the Las Vegas Bay Alternative.

ES.2.5 Process Improvements Alternative

Under the Process Improvements Alternative, a pipeline would not be constructed. Highly treated effluent would continue to be discharged to the Las Vegas Wash at the existing discharge locations, and effluent flows would continue to enter the Las Vegas Bay for mixing and diffusion in an uncontrolled fashion.

In addition to current, conventional treatment processes and plant optimization, best available technologies would be implemented to maintain an acceptable TP loading. Microfiltration/ultrafiltration membranes are described as an example of the type of technology that may be implemented to achieve the target TP levels of 0.05 mg/L.

ES.2.6 Alternatives Considered but Eliminated from Further Analyses

A potential alternative might be eliminated from detailed consideration for many reasons including, but not limited to, if the alternative does not meet the purpose and need for the project, would take too long to implement, would be prohibitively expensive, or would be highly speculative in nature and thus is considered unreasonable. The alternatives considered but eliminated from further analyses include:

- Alternate Alignments for the EI,
- Off-channel wetlands,
- Floating wetlands,
- Impoundment for creation of wetlands,
- North shore pipeline and wetlands,
- North shore pipeline and outfalls,

- Aeration,
- Discharge downstream of Hoover Dam,
- Discharge upstream of Hoover Dam,
- Discharge in the vicinity of Callville Bay,
- Discharge effluent near the Narrows, and
- Implementation of reverse osmosis (RO).

ES.3 Environmental Consequences

A brief summary of the potential impacts associated with the four action alternatives is presented in the following paragraphs. The No Action Alternative (no pipeline) is also discussed in the following paragraphs. The environmental consequences resulting from the construction, maintenance, and operation of EI-Alignment B, including the South Lateral Pipeline, would be the same for each resource under the Boulder Islands South and Las Vegas Bay alternatives. The analysis of the alternatives focuses on identifying types of impacts and estimating their potential significance. A brief summary of the potential impacts is presented in the following paragraphs.

ES.3.1 Water Resources

ES.3.1.1 No Action Alternative

Under the No Action Alternative, an increase in the volume of water conveyed in the Las Vegas Wash during dry-weather flows would not significantly increase erosion and channel degradation. The Southern Nevada Water Authority's (SNWA) ongoing construction of ECSs and bank protection reduces the potential for future erosion in the Las Vegas Wash. Therefore, significant impacts related to erosion in the Las Vegas Wash resulting from the discharge of increased quantities of effluent are not expected.

Under the No Action Alternative, there would be an increase in effluent flows, but no expected increase in base flows in the Las Vegas Wash. There would be increased dilution of groundwater and urban runoff constituents such as perchlorate, total dissolved solids (TDS), and selenium, because effluent flows would increase. The concentrations of these non-effluent related constituents would be less than baseline concentrations due to dilution from the increased effluent flows. This would be considered a beneficial impact to the Las Vegas Wash.

The combined TP loading for the model runs associated with the No Action Alternative was 334 pounds per day (lbs/day), which is the waste load allocation (WLA) for the Las Vegas Wash. It is important to note that increases in the TP that would result from flow increases were not modeled for the No Action Alternative because the WLA in the Las Vegas Wash cannot be exceeded. Using current, conventional treatment processes and plant optimization, flows of 300 mgd (462 cfs) would have a TP loading of 467 lbs/day, which exceeds the TMDL. Therefore, the 2030 effluent flows in the Las Vegas Wash would exceed regulatory limits for TP.

Most of the parameters modeled in Lake Mead for 2030 effluent flows and a Lake level of 1,178 feet (ft) (359 meters [m]) are not significantly affected by the No Action Alternative. However, the No Action Alternative does not improve existing elevated chlorophyll concentrations in the inner Las Vegas Bay. Phosphorus loadings entering Lake Mead through the Las Vegas Wash would continue to flow into the epilimnion, as they are under baseline conditions, and would continue to produce elevated chlorophyll concentrations in the inner Las Vegas Bay. In addition, total inorganic nitrogen (TIN) would continue to exceed water-quality standards in the Las Vegas Bay near the Las Vegas Wash.

Under the No Action Alternative, as defined in Section 2.1 of the Final EIS, with 2050 effluent flows and a Lake level of 1,000 ft (305 m), chlorophyll levels in Boulder Basin would be at the water-quality standard of 5 micrograms per liter (µg/L), and chlorophyll levels at Boulder Beach would exceed the 5 µg/L water-quality standard for open water.

Overall, impacts to Lake Mead (in 2030 with a modeled Lake level of 1,178 ft [359 m]) from the No Action Alternative would be insignificant and minor. However, impacts to the Las Vegas Bay and Boulder Basin (in 2050 with a modeled Lake level of 1,000 ft [305 m]) from the No Action Alternative would be significant and major. Exceedances of water-quality standards would not necessarily result in impairment of LMNRA resources. However, continued exceedances for extended periods of time may result in impairment.

ES.3.1.2 Boulder Islands North Alternative (Preferred Alternative)

The impacts of EI-Alignment A on surface water associated with construction activities would be temporary. The EI-Alignment A would cross perpendicular to several existing ephemeral washes. During a major rainfall runoff event, the open trench could act as a diversion channel.

Impacts of constructing EI-Alignment A would not significantly impact erosion in the Las Vegas Wash, because erosion would be controlled by the SNWA ECSs and bank protection activities.

It is likely that groundwater would be encountered and intercepted during excavation, especially along the COH Forcemain. The construction of the tunnel and pipeline may inadvertently form a permeable pathway along which groundwater may flow. Therefore, the appropriate backfill would be used to prevent a permeable pathway. Perchlorate-contaminated groundwater may be encountered during construction activities. If contaminated groundwater is exposed, it would be handled according to NDEP requirements. The CWC member agencies and/or their designated design and construction contractors would contact NDEP early in the project schedule to review information and identify permit requirements.During dredging, higher turbidity and suspended solids concentration would be produced in the area being dredged. This would result in a short-term reduction in water quality. A sediment curtain would be installed around the dredging area to contain the sediments and minimize the impact. Dredging is a regulated activity controlled by a permit review process administered by the U.S. Environmental Protection Agency (EPA) and the U.S. Army Corps of Engineers (USACE). All dredging operations would be conducted in compliance with the stipulations of the SCOP Section 404 Permit.

Reducing the flow in the Las Vegas Wash to 50 mgd (77 cfs) would result in higher concentrations of substances associated with groundwater and urban runoff such as perchlorate,

TDS, and selenium, because of less dilution by effluent flows. The reduction of effluent flows to the Las Vegas Wash may result in an increase in selenium concentration in the Las Vegas Wash to a level slightly higher than the EPA-recommended water quality criterion for bioaccumulation in aquatic life of 5 µg/L. Effluent flows would continue to enter the inner Las Vegas Bay from the Las Vegas Wash. Therefore, the constituents in effluent that provide a nutrient source for aquatic life would be present, but at reduced levels. Similarly, because less effluent is entering the inner Las Vegas Bay, the presence of constituents such as EDCs and other emerging compounds of concern that are associated with effluent would also be reduced.

Under the Boulder Islands North Alternative, effluent-related constituents would undergo more dilution than under existing conditions or the No Action Alternative. Chlorophyll levels in the inner Las Vegas Bay would be reduced because of lowered phosphorus loadings. Water quality would remain the same or improve in the Las Vegas Bay and Boulder Basin, and standards for Lake Mead would continue to be met using current, conventional treatment processes, plant optimization, and increased treatment (if needed). Phosphorus concentrations at Hoover Dam would increase from 0.005 to 0.006 mg/L (5 to 6 ppb). This increase would not exceed the water-quality standard of 0.050 mg/L (50 ppb) below Hoover Dam (NAC 445A.193). Data from the U.S. Geological Survey (USGS); University of Nevada, Las Vegas (UNLV); and Reclamation extending back to 1974 indicates that the TP concentration through Hoover Dam has historically been far higher than in recent years. The predicted TP concentration of 6 ppb through Hoover Dam for the Boulder Islands alternatives is lower than historical levels over an extended period of time. No data have been received identifying impairment of water uses in the Colorado River downstream of Hoover Dam, either in the present or past. Therefore, an increase of 1ppb TP through Hoover Dam would not have a significant impact downstream of Hoover Dam. Implementation of the Boulder Basin AMP would ensure that the existing high water quality in Boulder Basin and through Hoover Dam is maintained. Impacts to Lake Mead (in 2050 at a Lake elevation of 1,000 ft) from the Boulder Islands North Alternative would be insignificant and minor.

ES.3.1.3 Boulder Islands South and Las Vegas Bay Alternatives

The impacts of EI-Alignment B on surface water associated with construction activities would be temporary. The EI-Alignment B would cross perpendicular to several existing ephemeral washes. During a major rainfall runoff event, the open trench could act as a diversion channel.

Impacts of constructing EI-Alignment B would not significantly impact erosion in the Las Vegas Wash, because erosion would be controlled by the SNWA ECSs and bank protection activities.

It is likely that groundwater would be encountered and intercepted during excavation, especially along the western segment of the South Lateral Pipeline. The construction of tunnels and pipelines inadvertently forms permeable pathways along which groundwater may flow. Therefore, the appropriate backfill would be used to prevent a permeable pathway. Perchlorate-contaminated groundwater may be encountered during construction activities. If contaminated groundwater is exposed, it would be handled according to NDEP requirements.

For the Boulder Islands South LCS, if the trench was left open during a flood event, the flow from the upstream channel would potentially be diverted through the open trench and discharge

into the downstream channel. This increases the flows in the downstream channel causing flooding at the Boulder Beach Campground area and the proposed Pressure Regulating Station (PRS) site near the shore. During dredging, higher turbidity and suspended solids concentration would be produced in the area being dredged. This would result in a short-term reduction in water quality. A sediment curtain would be installed around the dredging area to contain the sediments and minimize the impact. Dredging is a regulated activity controlled by a permit review process administered by the EPA and the USACE. All dredging operations would be conducted in compliance with the stipulations of the SCOP Section 404 Permit.

Under the Boulder Islands South and Las Vegas Bay alternatives, reducing the flow in the Las Vegas Wash to 50 mgd (77 cfs) would result in the same impacts described for the Boulder Islands North Alternative in Section ES.3.1.2.

Under the Boulder Islands South and Las Vegas Bay alternatives, effluent-related constituents would undergo more dilution than under existing conditions or the No Action Alternative. Chlorophyll levels in the inner Las Vegas Bay would be reduced because of lowered TP loadings. Water quality would remain the same or improve in the Las Vegas Bay and Boulder Basin, and standards for Lake Mead would continue to be met using current, conventional treatment processes, plant optimization, and increased treatment (if needed). Phosphorus concentrations at Hoover Dam would increase from 0.005 to 0.006 mg/L (5 to 6 ppb). This increase would not exceed the water-quality standard of 0.050 mg/L (50 ppb) below Hoover Dam (NAC 445A.193). The predicted TP concentration of 6 ppb through Hoover Dam for the Boulder Islands South and Las Vegas Bay alternative is lower than historical levels over an extended period of time. No data have been received identifying impairment of water uses in the Colorado River downstream of Hoover Dam, either in the present or past. Therefore, an increase of 1ppb TP through Hoover Dam would not have a significant impact downstream of Hoover Dam. Implementation of the Boulder Basin AMP would ensure that the existing high water quality in Boulder Basin and through Hoover Dam is maintained. Impacts to Lake Mead (in 2050 at a Lake elevation of 1,000 ft) from the Boulder Islands South and Las Vegas Bay alternatives would be insignificant and minor.

ES.3.1.4 Process Improvements Alternative

Under the Process Improvements Alternative, an increase in the volume of water conveyed in the Las Vegas Wash during dry-weather flows would not significantly increase erosion and channel degradation. The SNWA's ongoing construction of ECSs and bank protection reduces the potential for future erosion in the Las Vegas Wash. Therefore, significant impacts related to erosion in the Las Vegas Wash resulting from the discharge of increased quantities of effluent are not expected.

Under the Process Improvements Alternative, there would be an increase in effluent flows, but no expected increase in base flows in the Las Vegas Wash. There would be increased dilution of groundwater and urban runoff constituents such as perchlorate, TDS, and selenium, because effluent flows would increase. The concentrations of these non-effluent related constituents would be less than baseline concentrations due to dilution from the increased effluent flows. This would be considered a beneficial impact to the Las Vegas Wash.

The Process Improvements Alternative would not reduce the amount of EDCs and PPCPs entering Lake Mead and would not significantly improve water quality within Lake Mead. Although the concentrations within the effluent would be less than baseline concentrations in Boulder Basin, this alternative is not expected to reduce the concentrations of water quality parameters within Lake Mead.

ES.3.2 Biological Resources

ES.3.2.1 No Action Alternative

Under the No Action Alternative, effluent flows to the Las Vegas Wash would increase over time as the wastewater treatment facilities expand in response to urbanization in the region. Increased effluent flows would likely widen the saturated substrate zone in the Las Vegas Wash because ongoing construction of ECSs that serve to arrest headcutting would also cause the low-flow channel to become wider at some locations. A larger saturated area would encourage the expansion of riparian plant and wetlands communities. It is likely that these communities would steadily expand in area as effluent flows to the Las Vegas Wash increase. An increase in water surface area correspondingly would increase habitat for birds such as the southwestern willow flycatcher (*Empidonax traillii extimus*) and Yuma clapper rail (*Rallus longirostris yumanensis*).

Water-quality monitoring in the Las Vegas Bay concludes that the current rate of nutrient loading has not caused adverse environmental conditions. However, the nutrient loading in conjunction with the lowering water levels in Lake Mead may create less than favorable conditions for aquatic fauna because dilution of effluent-related constituents would be reduced.

Flows from the Las Vegas Wash may create eutrophic conditions in the Las Vegas Bay that would not be ideal conditions for spawning razorback suckers or sucker larvae, because eutrophic conditions promote population outbreaks of scavenger and predator species that prey on razorback suckers and their larvae. However, the increased littoral and edge vegetation may benefit the razorback larvae survival by providing protective habitat. In addition, increased quantities of effluent in the Las Vegas Bay would increase the presence of constituents such as EDCs and other emerging compounds of concern that may impact the razorback sucker. Effluent-related nutrients would continue to enter the Las Vegas Bay via the Las Vegas Wash. Therefore, nutrients for sport fish would be plentiful.

No special status plant species, desert tortoise (*Gopherus agasizii*), bald eagles *(Haliaeetus leucocephalus*), federal candidate species and species of concern, Nevada State-protected species, and Clark County Multiple Species Habitat Conservation Plan (MSHCP)-covered species would be directly affected by the No Action Alternative.

ES.3.2.2 Boulder Islands North, Boulder Islands South, and Las Vegas Bay Alternatives

The reduction of effluent flows in the Las Vegas Wash under the three pipeline alternatives would likely decrease the saturated substrate, and may result in the transition of emergent wetland communities to drier riparian communities. A review of the estimated water budget for the

Las Vegas Wash indicates that riparian and wetlands vegetation communities would be supported at their current level, but the composition and diversity of those communities would likely change.

No federally listed threatened or endangered plants were observed in the project area. Low population densities of cactus species and no yucca species were observed in the study area during spring 2003 and 2004.

Construction of EI-Alignment A under the Boulder Islands North Alternative would result in the temporary disturbance of approximately 202 acres (82 hectares) of potential desert tortoise habitat. Approximately 53 acres (21 hectares) would be permanent disturbance. Construction of EI-Alignment B under the Boulder Islands South and Las Vegas Bay alternatives would result in the temporary disturbance of approximately 224 acres (91 hectares) of potential desert tortoise habitat. Approximately 82 acres (33 hectares) would be permanent disturbance. However, much of this area is already disturbed from previous unrelated construction activities or public use. Following project construction and site restoration, desert tortoises would likely reoccupy restored portions of the project area.

Any disturbance near the Las Vegas Wash during the breeding and nesting season for migratory birds (typically February to July in southern Nevada), including the southwestern willow flycatcher and Yuma clapper rail, would temporarily disturb nesting and foraging activity in the area. Surveys for active nests would be conducted by a qualified biologist prior to land-clearing activities to avoid destruction of live birds.

Ground-disturbing activities have the potential to directly affect the southwestern toad (*Bufo microscaphus*) through direct mortality or displacement. The physical disturbance associated with pipe installation into Lake Mead may impact razorback sucker populations dispersal, migration, and ability to forage.

Under the three pipeline alternatives, dredging would disturb the benthic and littoral habitat in Lake Mead. Aquatic vegetation and habitat would be destroyed in the construction areas. Invertebrate species with limited home ranges would be lost due to direct mortality. Common fish and amphibian species are not likely to be impacted through mortality because of their ability to move away from the dredging operations.

The reduction of effluent flows to the Las Vegas Wash would reduce the dilution of non-effluent related constituents such as TDS, selenium, and perchlorate. Although the concentration of these constituents would increase and potentially impact Las Vegas Wash species, the total mass entering the Las Vegas Bay would remain the same or decrease. These constituents would be diluted by the water in the Las Vegas Bay. However, the potential impacts to aquatic and bird species in the Las Vegas Wash and Las Vegas Bay from exposure to these constituents are not entirely known.

The mass of selenium in the Las Vegas Wash would decrease due to the reduction of effluent-based selenium. Although, the concentration of selenium in the Las Vegas Wash and inner Las Vegas Bay would increase, the decreased mass exiting the Las Vegas Wash is expected to be diluted by the water in the Las Vegas Bay. However, based on preliminary consultation with the USFWS as required under Section 7 of the ESA, adverse impacts to the endangered razorback

sucker may occur under the Boulder Islands North Alternative. Minimization measures, and mitigation and monitoring plans are being developed through consultation to alleviate potential impacts to the razorback sucker. The increase in concentrations of selenium poses a bioaccumulation hazard to aquatic and bird species. It is expected that the abundance of some species may be slightly reduced, but the populations would continue to inhabit the Las Vegas Wash. Water quality data from monitoring stations along the Las Vegas Wash are collected and analyzed on a monthly basis. These data would be used as part of the Boulder Basin AMP to evaluate current concentrations of constituents in the Las Vegas Wash and adjust effluent delivery accordingly. The AMP Core Management Team, in coordination with associated committees and workgroups, may direct the wastewater treatment agencies to increase effluent flows to dilute elevated constituent concentrations.

No direct impacts to the razorback sucker would result from construction of EI-alignment A or B because the razorback sucker is not present in the Las Vegas Wash.

Construction of the LCS would directly impact aquatic habitat and fauna starting with the riparian corridor on the edges of Lake Mead. Fish species are not likely to be impacted through direct mortality because of their ability to move away from the dredging operations. Construction impacts would be temporary. However, the physical disturbance associated with pipe installation activities in Lake Mead may directly impact the razorback sucker population's dispersal, migration, and ability to forage. The razorback sucker may be displaced from its normal forage range and normal community behavior may be disrupted. These construction activities may interrupt dispersal corridors with physical barriers and may block seasonal migration to known breeding locations.

Impacts from construction activities of the LCS may indirectly affect the razorback sucker populations in the area of the diffuser. Indirect mortality to the razorback suckers created by stress-induced fitness reduction may occur. This reduced fitness condition may decrease the razorback suckers' natural immune system and invite secondary infections such as columnaris, fungus, and parasites. Under abnormal immunity conditions, the razorback sucker's ability to combat these infections may be reduced, thus lowering the ability for its survival.

The discharge of highly treated effluent into Lake Mead near the Boulder Islands or in the Las Vegas Bay may directly affect the razorback sucker populations by changing the water quality in the dispersal area and in the inner Las Vegas Bay. The effluent and base flows that would continue to enter the inner Las Vegas Bay from the Las Vegas Wash would still provide a nutrient source for aquatic species, but at reduced quantities. Similarly, because less effluent is entering the inner Las Vegas Bay, the presence of constituents such as EDCs and other emerging compounds of concern would also be reduced. In addition, water-quality modeling indicates that parameters such as conductivity, density, dissolved oxygen content, and temperature of the water near the diffuser would be within the ranges preferred by razorback suckers.

ES.3.2.3 Process Improvements Alternative

Under the Process Improvements Alternative, effluent flows to the Las Vegas Wash would increase over time as the wastewater treatment facilities expand in response to urbanization in the region. Increased effluent flows would likely widen the saturated substrate zone in the Las Vegas

Wash because ongoing construction of ECSs that serve to arrest headcutting would also cause the low-flow channel to become wider at some locations. A larger saturated area would encourage the expansion of riparian plant and wetlands communities. It is likely that these communities would steadily expand in area as effluent flows to the Las Vegas Wash increase. An increase in water surface area correspondingly would increase habitat for birds and bats along the Las Vegas Wash.

The Process Improvements Alternative would not directly affect the fish communities in the Las Vegas Wash or the Las Vegas Bay. Nutrients essential to support the sport fishery industry would continue to enter the Las Vegas Bay. However, the nutrient loading in conjunction with the lowering water levels in Lake Mead may create less than favorable conditions for aquatic species. Algal blooms may create eutrophic conditions that would promote population outbreaks of scavenger and predator species. Competition by these species for prey on eggs, larvae, and benthic invertebrates could have negative impacts to other aquatic fauna populations including the razorback sucker.

No special status plant species, desert tortoise, bald eagles, federal candidate species and species of concern, Nevada State-protected species, and Clark County MSHCP-covered species would be directly affected by the Process Improvements Alternative.

ES.3.3 Cultural Resources

ES.3.3.1 No Action Alternative

Under the No Action Alternative, no direct or indirect disturbance to any cultural resources would occur. There would be no impacts to identified National Register of Historic Places (NRHP) sites.

ES.3.3.2 Boulder Islands North, Boulder Islands South, and Las Vegas Bay Alternatives

Portions of both the proposed EI alignments would follow the south edge of the road that is part of Site 26CK6150 (Telephone Line Road). The existing powerline and associated poles are considered contributing elements to the overall eligibility of the site to the NRHP. Construction of the EI would not affect the integrity of location or setting for the eligible powerline. The historic value of the powerline would not be diminished by EI construction activities.

The proposed pipeline would be located within 100 ft (30 m) of three identified sites along the EI alignment. However, this portion of the pipeline would be constructed using tunneling techniques, which would minimize surface disturbance. Therefore, direct and indirect impacts to the sites are not expected.

No cultural resources were located within the proposed Boulder Islands North LCS terrestrial area of potential effect (APE). The underwater segment of the Boulder Islands North Diffuser Pipeline would intersect with three contributing elements of Site 26CK4046B, the Six Companies Inc. Railroad (SCIRR). The three contributing elements include track sidings, raw aggregate storage piles, and unpaved service roads.

The South River Mountains Tunnel #3 (SRMT3) East working shaft, which is part of the Boulder Islands South LCS, would potentially impact three elements of Site 26CK7115. Site 26CK7115 is recommended to be eligible for the NRHP under Criterion A, association with events or broad patterns important in history (HRA, Inc. 2005). Avoidance of these site elements would minimize the potential for impacts.

The use of the alternate access route to the SRMT3-East working shaft would have significant impacts to Site 26CK6247, the remains of Hemenway Wash Road (or Old Lake Highway). Use of the existing pavement would result in extensive damage and remove the only intact section of this site. The alternate access route to the SRMT3-East working shaft would not be used during construction activities.

The submerged sections of the Boulder Islands Diffuser Pipeline would cross the SCIRR within areas not previously evaluated for their eligibility to NRHP (HRA Inc. 2005). Five contributing elements of Site 26CK4046B are located within the BISDP APE.

No archaeological sites were identified during the survey of the LCS portion of the Las Vegas Bay Alternative.

ES.3.3.3 Process Improvements Alternative

Under the Process Improvements Alternative, no direct or indirect disturbance to any cultural resources would occur. There would be no impacts to identified NRHP sites.

ES.3.4 Recreation

ES.3.4.1 No Action Alternative

The expansion of riparian and wetlands communities would increase habitat for birds and bats along the Las Vegas Wash. This would have a beneficial effect on recreation because there would be increased opportunities for nature observation, such as bird watching, which is a primary recreational activity in the Clark County Wetlands Park (Wetlands Park).

However, water quality modeling indicates that the No Action Alternative would result in exceedances of the water quality standard for chlorophyll and TIN in the Las Vegas Bay and would also increase chlorophyll levels in the open waters of Boulder Basin at lower Lake levels. An increase of chlorophyll increases the potential for algae growth, which may discourage recreational visitors in those areas. Exceedances of water quality standards would not necessarily result in impairment of LMNRA resources. However, continued exceedances for extended periods of time may result in impairment.

ES.3.4.2 Boulder Islands North, Boulder Islands South, and Las Vegas Bay Alternatives

Under the three pipeline alternatives, visitors to the area may experience minor inconveniences during construction activities such as increased noise, dust, localized traffic, and altered scenic or aesthetic values of the landscape. These impacts would be temporary.

Recreational activities at the LMNRA would be temporarily unavailable in construction areas. However, construction would be limited to October through March, which is considered the low-tourist season. Therefore, the impacts would be temporary and minor.

Water quality modeling indicates that under the three pipeline alternatives, water quality standards would continue to be met for 2050 flows using conventional treatment processes, plant optimization, and increased treatment (if needed). Therefore, long-term impacts to most recreational activities in Lake Mead would not be impacted by these alternatives. However, the reduction in nutrients discharged to the Las Vegas Bay may adversely impact sport fishing in that area. It is unknown whether the fish would relocate to the new discharge location.

Under the Boulder Islands North Alternative dredging activities would occur in close proximity to the Lake Mead Resort Marina. Access to the Marina may be impacted during construction activities. However, construction would occur during the winter (October through March) when boating use is lower. To minimize the impacts to Marina and Lake users, Notices to Mariners will be published and posted prior to construction activities. Aids to Navigation for Inland Waterways will be implemented, and a minimum-width construction corridor will be used to ensure that at least one-way boat traffic is maintained throughout the construction period.

Under the Boulder Islands South and Las Vegas Bay alternatives, trail improvements and the pedestrian bridge across the C-1 Channel within the Wetlands Park would be beneficial impacts to Wetlands Park visitors.

ES.3.4.3 Process Improvements Alternative

It is likely that riparian and wetlands communities would steadily expand in area as effluent flows to the Las Vegas Wash increase. An increase in water surface area correspondingly would increase habitat for birds and bats along the Las Vegas Wash. This would have a beneficial effect on recreation because there would be increased opportunities for nature observation, such as bird watching, which is a primary recreational activity in the Wetlands Park.

Water-quality modeling indicates that under the Process Improvements Alternative, effluent-related parameters would be reduced to levels well below baseline levels. This would result in less TP and nutrients entering the inner Las Vegas Bay. Therefore, the Process Improvements Alternative would have an adverse impact on sport fishing in the Las Vegas Bay.

ES.3.5 Hazardous Materials

ES.3.5.1 No Action Alternative

Under the No Action alternative, hazardous materials used for wastewater treatment would continue to be handled, stored, and disposed of properly. Therefore, no impacts would occur.

ES.3.5.2 Boulder Islands North, Boulder Islands South, and Las Vegas Bay Alternatives

During construction of the EI, the perchlorate contaminated groundwater may be encountered. Dewatering of contaminated groundwater may impact overall project costs during construction. Perchlorate-contaminated groundwater would be handled according to the requirements of the NDEP discharge permit.

Under the Boulder Islands South and Las Vegas Bay alternatives, portions of the South Lateral Pipeline would cross near the Henderson Landfill a known metal contamination area. The proposed project alignment does not enter the boundaries of the landfill. However, contaminated soils may be encountered during construction. The sampling and analyses required to determine the presence and extent of contamination would be conducted in accordance with NDEP guidance and directions. In addition, all required permits for handling potential soil contamination would be acquired before construction and any required mitigation measures would be implemented in accordance with NDEP and EPA guidelines.

Potentially hazardous materials used for construction include diesel fuel, gasoline, lubricants, and coolants. The contractor would comply with applicable regulations relating to handling, storage, and disposal of hazardous substances.

Under the Boulder Islands South LCS, hazardous materials may occur in the vicinity of two historical recognizable environmental conditions (RECs,) the Three Kids Mine and Henderson Landfill. Construction of the SRMT3 would pass near the Three Kids Mine and the Henderson Landfill, which have known metal and petroleum contamination from historical mining and landfill operations respectively. The Boulder Islands North and Las Vegas Bay alternatives are located further from these two REC's; therefore the possibility of encountering contaminated soils would be lessened.

The proposed LCS alignments would not block the use of paved roadways, and thus, is not expected to interfere with adopted emergency response plans.

ES.3.5.3 Process Improvements Alternative

Under the Process Improvement Alternative, pipelines to transport treated effluent would not be constructed. The facilities would treat the effluent using the best available technology and continuously upgrade their treatment process as technology changes and improves. The current discharge locations would not change. Hazardous materials would continue to be stored, handled, and disposed of appropriately at the three treatment facilities.

In addition to the MF/UF membranes, additional alum would be added to remove TP to a concentration of 0.05 mg/L on an annual average basis. This would generate additional chemical sludge that would be transported to the Apex Landfill for disposal.

No impacts would occur downstream of Hoover Dam.

ES.3.6 Noise

ES.3.6.1 No Action Alternative

Under the No Action Alternative, construction activities during expansion of facilities at each wastewater treatment plant would have short-term noise effects on receptors in the immediate vicinity of the construction site. However, the area that would be subjected to construction noise would be relatively small.

ES.3.6.2 Boulder Islands North, Boulder Islands South, and Las Vegas Bay Alternatives

Under the pipeline alternatives, construction activities would be subject to county statutes. It is anticipated that short-term sound levels from construction activities would be less than the "normal suburban residential" guidelines. During construction, it is not anticipated that heavy earth-moving equipment would operate within 100 ft (30 m) of residential or industrial structures. Therefore, construction noise and vibration from equipment is not expected to significantly impact residential communities near the proposed project.

The Hydroelectric and PRS facilities would be underground. A building would fully enclose all piping and electrical equipment thus creating a long-term noise barrier during regular operation. Therefore, long-term operational noise impacts would be minimal and not significantly impact residential communities.

Construction activities in the Wetlands Park would be temporary and would be at a distance such that visitor experiences would not be adversely impacted by noise.

Construction activities on Lake Mead in the vicinity of the Boulder Islands would involve barges and boats. Noise from these vessels is not anticipated to be greater than that already created from jet skis and motorboats. Noise on the beach from the construction boats and barges may impact LMNRA visitor experiences. However, construction would be done during the winter season when there are less LMNRA visitors and people on the beach and impacts would be temporary.

ES.3.6.3 Process Improvements Alternative

Under the No Action Alternative, construction activities during expansion of facilities at each wastewater treatment plant would have short-term noise effects on receptors in the immediate vicinity of the construction site. However, the area that would be subjected to construction noise would be relatively small.

ES.3.7 Air Quality

ES.3.7.1 No Action Alternative

Under the No Action alternative there would be no construction emissions. No air quality impacts would result. Emissions associated with construction activities from the expansion of existing facilities would be subject to National Ambient Air Quality Standards (NAAQS) and would require a permit from the Clark County Department of Air Quality and Environmental Management.

ES.3.7.2 Boulder Islands North, Boulder Islands South, and Las Vegas Bay Alternatives

During construction, minor, short-term impacts to air quality resources are anticipated as a result of construction equipment exhaust emissions under the three pipeline alternatives. Impacts are classified as minor because there would be a temporary, but detectable, change in ambient air pollutant concentrations. However, the change is not projected to cause or contribute to an exceedance of the NAAQS, would not produce objectionable odors, and would not exceed recommended exposure standards. The impact is also classified as a short-term impact because it would occur only during construction.

ES.3.7.3 Process Improvements Alternative

The potential impacts to air quality from the Process Improvements Alternative would be the same as those described for the No Action Alternative.

ES.3.8 Earth Resources

ES.3.8.1 No Action Alternative

Under the No Action alternative, new construction would occur on property owned by the CLV, CCWRD, or COH. Therefore, mineral resources would not be impacted. The treatment facilities are not located on lands that experience geologic hazards or expansive soils.

ES.3.8.2 Boulder Islands North, Boulder Islands South, and Las Vegas Bay Alternatives

Construction of the project components would have short-term environmental effects that are not considered significant. Short-term uses of the environment would not affect the maintenance and enhancement of long-term productivity. The project would not significantly affect the availability of mineral resources in the area because of the relatively small area that would be affected.

There would be no significant impacts on earth resources from the pipeline alternatives. Due to the relatively small size of the disturbance, the large size of the LMNRA, and the large amount of

protected geologic resources and desert soils, no impairment to soils or geologic resources would occur from the impact resulting from this alternative. For this reason, there would be no impairment of earth resources located within the LMNRA.

ES.3.8.3 Process Improvements Alternative

The potential impacts to earth resources from the Process Improvements Alternative would be the same as those described for the No Action Alternative.

ES.3.9 Land Use

ES.3.9.1 No Action Alternative

Under the No Action Alternative, no impacts to land use would occur.

ES.3.9.2 Boulder Islands North, Boulder Islands South, and Las Vegas Bay Alternatives

Overall, the potential impacts to land use that may result from the construction and operation of the three pipeline alternatives would be short-term and limited to the immediate construction areas. There would be no conflicts with land use plans, community goals, established uses, existing utilities or public rights-of-way, mining claims or patents, or with access to public facilities or private businesses. The pipeline alternatives would not cause a disruption or division of an established community.

Boulder Beach is one of the most heavily visited portions of the LMNRA and supports a wide range of recreational uses. Construction in this area under the Boulder Islands South Alternative would occur during low-use periods, therefore, impacts to land use in the Boulder Beach area would be temporary and insignificant.

Under the Boulder Islands North Alternative, dredging activities would occur in close proximity to the Lake Mead Resort Marina. Access to the Marina may be impacted during construction activities. However, construction would occur during the winter (October through March) when boating use is lower. To minimize the impacts to Marina and Lake users, Notices to Mariners will be published and posted prior to construction activities. Aids to Navigation for Inland Waterways will be implemented, and a minimum-width construction corridor will be used to ensure that at least one-way boat traffic is maintained throughout the construction period.

ES.3.9.3 Process Improvements Alternative

The potential impacts to land use from the Process Improvements Alternative would be the same as those described for the No Action Alternative.

ES.3.10 Visual Resources

ES.3.10.1 No Action Alternative

No impacts to visual resources would result from the No Action Alternative.

ES.3.10.2 Boulder Islands North, Boulder Islands South, and Las Vegas Bay Alternatives

The majority of the EI and ancillary facilities have been classified as Class IV Visual Resource Management (VRM) areas based on the type of user (commuter or work-related) and the dominance of numerous dirt roads throughout the area. Class IV VRM areas are considered the least in value in terms of visual resources, and major modifications to viewscapes are acceptable.

The Wetlands Park has previously been designated as a Class III VRM area. The views within the Wetlands Park would be temporarily obstructed during construction activities, but the impact would be minor. No impacts associated with the operation of the pipeline would occur. The proposed chat trail and pedestrian bridge included as part of the Boulder Islands South and Las Vegas Bay alternatives would be consistent with management objectives of a Class III VRM area and are expected to be beneficial to the casual recreational viewer.

Visual resources at the LMNRA beaches have been classified as a Class II VRM, and activities should retain the existing character of the landscape. None of the LCS alternatives would significantly affect or cause impairment to visual resources in the LMNRA.

ES.3.10.3 Process Improvements Alternative

No impacts to visual resources would result from the Process Improvements Alternative.

ES.3.11 Socioeconomics

ES.3.11.1 No Action Alternative

Employment increases as a result of the proposed treatment facilities' expansions would be less than 1 percent of total employment in Clark County during project construction. The treatment plant expansions that would be implemented under the No Action Alternative are included in existing plans for each plant. It is estimated that current, conventional treatment processes would cost approximately $361 million. Optimization of the three treatment facilities would cost an additional $29 million.

ES.3.11.2 Boulder Islands North, Boulder Islands South, and Las Vegas Bay Alternatives

The estimated construction cost for the Boulder Islands North Alternative is $594 million. In addition, optimization of the three treatment facilities would cost an additional $29 million. An

additional 8,906 jobs would be generated. The jobs would be in the construction industry to work specifically on the proposed project, and in other industries that would provide services or products for the proposed project.

The estimated construction cost for the Boulder Islands South Alternative is $590 million. An additional 6,299 jobs would be generated. The jobs would be in the construction industry to specifically work on the proposed project, and in other industries that would provide services or products for the proposed project.

The estimated construction cost for the Las Vegas Bay Alternative is $540 million. An additional 5,870 jobs would be generated in Clark County.

ES.3.11.3 Process Improvements Alternative

The estimated capital costs for the Process Improvements Alternative is $205,483,592. The total annual operation and maintenance (O&M) cost for implementing MF/UF membranes is estimated to be $29,751,688. It is assumed that most of the capital and O&M expenditures associated with the Process Improvements Alternative would be made to firms located outside of Clark County. Therefore, a negligible increase in Clark County employment is expected as a result of capital- and O&M-related expenditures for the MF/UF improvements at the treatment plants throughout the life of the project.

ES.3.12 Environmental Justice

No environmental justice populations were found, and no disproportionately affected populations were identified that would be affected by any of the alternatives.

No impacts to ITAs would result from implementation of the alternatives.

ES.3.13 Transportation and Traffic

ES.3.13.1 No Action Alternative

There would be no adverse impacts to transportation and traffic conditions under the No Action Alternative.

ES.3.13.2 Boulder Islands North, Boulder Islands South, and Las Vegas Bay Alternatives

Under the Boulder Islands South Alternative, Approved Road 76 may need to be closed during construction activities. Maintenance access to existing facilities would be allowed, but there may be temporary delays due to road use by heavy equipment. No other road closures are expected for the Boulder Islands North, Boulder Islands South, or Las Vegas Bay alternatives. However, short-term impacts may include periodic restrictions to one lane to allow access for construction vehicles. Traffic on roadways in the vicinity of the project may increase for short periods of time

during construction activities. However, the number of vehicles using these roadways would not increase enough to change the level of service. Additional construction-related vehicles in the LMNRA may create short-term inconveniences. However, most of the construction activities within the LMNRA would occur during the winter months when Park visitation is low.

ES.3.13.3 Process Improvements Alternative

There would be no adverse impacts to transportation and traffic conditions under the Process Improvements Alternative.

ES.3.14 Paleontological Resources

ES.3.14.1 No Action Alternative

Under the No Action Alternative, no direct or indirect impacts to any potential paleontological resources within the proposed project area would occur.

ES.3.14.2 Boulder Islands North, Boulder Islands South, and Las Vegas Bay Alternatives

The EI and ancillary facilities would be constructed primarily on lands that have been disturbed by previous activities. Paleontological resources that may have previously existed have presumably been destroyed through prior construction activities. In addition, only a small segment of the EI would cross areas of high paleontologic sensitivity.

None of the LCS alternatives are located in an area designated as having high paleontologic sensitivity. Therefore, no impacts to potential paleontological resources would occur from tunneling activities.

ES.3.14.3 Process Improvements Alternative

Under the Process Improvements Alternative, no direct or indirect impacts to any potential paleontological resources within the proposed project area would occur.

Chapter 1

Purpose and Need for the Action

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1.0 Purpose and Need for the Action

1.1 Introduction

The Bureau of Reclamation, Lower Colorado Region (Reclamation)[1] and the National Park Service (NPS), Lake Mead National Recreation Area (LMNRA), propose to prepare an Environmental Impact Statement (EIS). Reclamation and the NPS are preparing the EIS as joint-lead federal agencies to evaluate the potential impacts associated with the construction, operation, and maintenance of the Systems Conveyance and Operations Program (SCOP).

Wastewater generated in the Las Vegas Valley (Valley) is currently treated and discharged by three agencies: the City of Las Vegas (CLV), the Clark County Water Reclamation District (CCWRD), and the City of Henderson (COH). These agencies discharge highly treated municipal wastewater (effluent) into the Las Vegas Wash, which flows into the Las Vegas Bay of Lake Mead. Treated wastewater has been discharged to the Las Vegas Wash since 1956. The Las Vegas Wash is a tributary to the Colorado River, and the Las Vegas Bay and Lake Mead are part of the Colorado River System. The quantity of the effluent treated and discharged in the Valley will increase as the population increases. The CLV, CCWRD, and COH comprise the Clean Water Coalition (CWC), which was created to address the management of the increasing wastewater flows in the Valley. The CWC's mission is to:

> Determine the most feasible method(s) to return that effluent not being reused (including future flows) to the Colorado River System, that is consistent with the CAMP (*Comprehensive Adaptive Management Plan for the Las Vegas Wash*); that includes strategies for a flexible program to address the water quality issues of the Las Vegas Wash, the Las Vegas Bay and Boulder Basin; that includes strategies to enhance the protection of the municipal drinking water source; and that is implementable, reasonably cost effective, environmentally sound, and publicly and politically acceptable.

The CWC proposes to implement the SCOP. The SCOP would be located in Clark County, Nevada (Figure 1.1-1). The SCOP includes activities and infrastructure that would be located on lands owned and/or managed by the CLV, COH, Clark County, United States (U.S.) Bureau of Land Management (BLM), Reclamation, and NPS (Figure 1.1-2).

[1] A list of the acronyms used in this document is provided in **Appendix O**. The List of Acronyms is printed on the right side of 11X17 paper. This allows the reader to unfold the List of Acronym pages and have the list visible while reading the EIS. The glossary in Chapter 11 provides definitions of words and terminology that the reader may need.

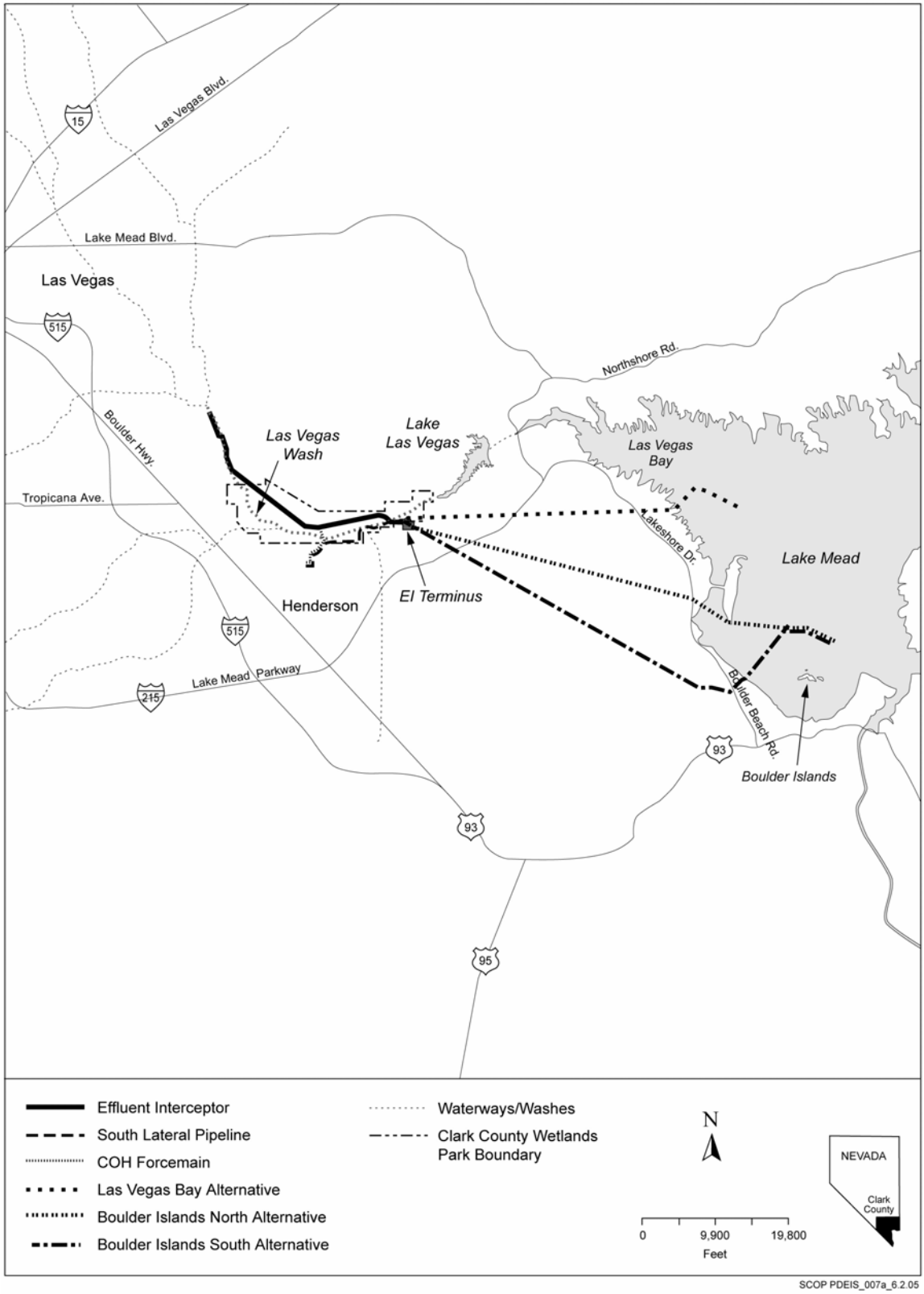


Figure 1.1-1 Project Location.

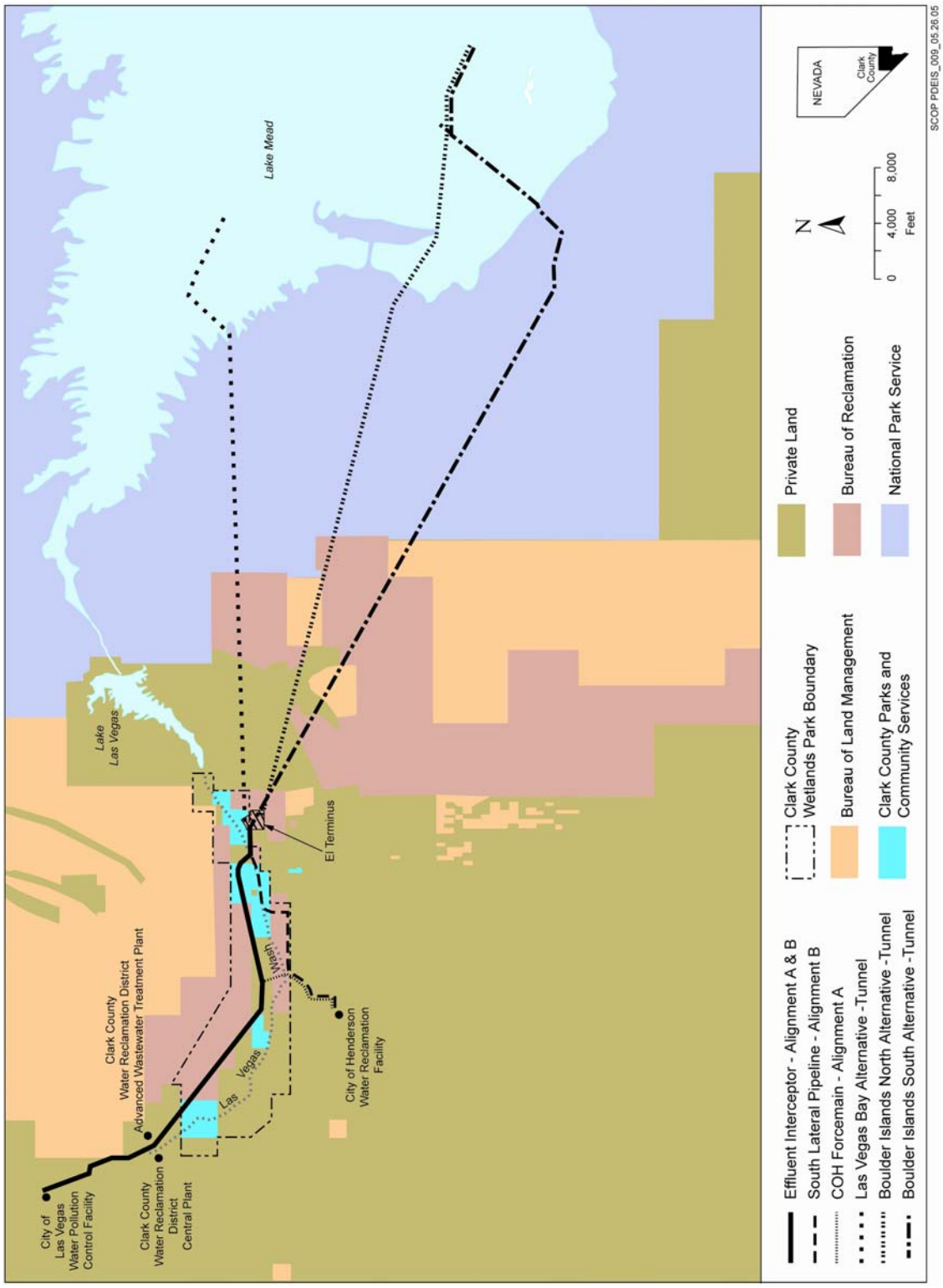


Figure 1.1-2 Land Ownership.

The SCOP would be a combination of plant optimization, increased treatment processes (as needed) and a system of pipelines and tunnels that discharges highly treated effluent to an alternate location. The pipeline and tunnels would be designed to collect the treated effluent flows from the CLV, CCWRD, and COH treatment facilities, for conveyance to an area in the lower Colorado River system, while the majority of the flows bypass the Las Vegas Wash.

The SCOP would be located on lands managed by the NPS, Reclamation, and BLM. Therefore, the federal agencies would be required to issue permits. Issuance of a permit is a federal action that requires National Environmental Policy Act (NEPA) of 1969 documentation, which in this case is an EIS (42 United States Code [USC] 4321 et seq.; Public Law [PL] 91-190). The EIS is prepared in compliance with NEPA (42 USC 4321 et seq. PL 91-190, 1969, as amended), the *Council on Environmental Quality (CEQ) Regulations for Implementing the Procedural Provisions of NEPA* (40 Code of Federal Regulations [CFR] 1500-1508), and NPS and Reclamation implementing regulations and guidance.

1.2 Lead and Cooperating Agencies

The NPS and Reclamation are the lead federal agencies for the preparation of this EIS. The NPS and Reclamation have land-management responsibilities for much of the land that would be traversed for the proposed project. Numerous federal, state, and local agencies were invited to participate in the preparation of this EIS as cooperating agencies. Four agencies expressed an interest in being a cooperating agency for this project. The cooperating agencies involved in the preparation of this EIS include the BLM, U.S. Army Corps of Engineers (USACE), Metropolitan Water District of Southern California (MWD), and Colorado River Commission of Nevada. The NPS and Reclamation sought cooperation and expertise from these agencies to help identify potential impacts as a result of implementing one of the proposed alternatives. The CEQ regulations recommend that a lead federal agency cooperate with other federal, state, and local governments with jurisdiction by law or special expertise (40 CFR 1501.6). The benefits of cooperating agency participation include:

- Disclosing relevant information early in the process;
- Applying available technical expertise and staff support;
- Avoiding duplication with other federal, state, tribal, and local procedures; and
- Establishing a mechanism for addressing intergovernmental issues (Connaughton 2002).

1.3 Project History

Currently, the three wastewater treatment agencies in the Valley are the CLV, CCWRD, and COH. The CLV, CCWRD, and COH are members of the Southern Nevada Water Authority (SNWA). The three treatment facilities are shown in Figures 1.3-1, 1.3-2, and 1.3-3.



Figure 1.3-1 City of Las Vegas Water Pollution Control Facility.



Figure 1.3-2 Clark County Water Reclamation Central Plant.



Figure 1.3-3 City of Henderson Water Reclamation Facility.

The *Las Vegas Valley Watershed Needs Assessment Study* (*Needs Assessment Study*) was commissioned by the three wastewater treatment agencies in 1995. The goal of the study was to develop a 30-year plan to address the long-term needs of these agencies and to identify alternative methods to accommodate existing and projected wastewater flows of the Valley. A continuation of this effort was to expand the findings to provide guidance regarding the engineering, scientific, and environmental solutions for effluent disposal, and to provide a plan that will be acceptable to the wastewater treatment agencies and stakeholders (Las Vegas Wash Coordination Committee [LVWCC] 2000).

The *Needs Assessment Study* resulted in a series of recommendations to improve water quality throughout the Las Vegas Wash, Las Vegas Bay, and Lake Mead. One recommendation addressed the increasing volume of highly treated effluent discharged into the Las Vegas Wash by calling for a feasibility study of alternate discharge locations (CWC 2001). The study identified and developed potential long-term solutions for the increasing flows. The *Needs Assessment Study* was completed and was incorporated into the *Las Vegas Valley 208 Water Quality Management Plan* (Montgomery Watson 1997a) in July 1997.

In 1999, the three wastewater treatment agencies again teamed and started work on the recommendations presented in the *Needs Assessment Study*. Working together, the three wastewater treatment agencies informally created the CWC (CWC 2001). The CWC became a legal entity in November 2002.

The CWC's member agencies are also members of the LVWCC, which consists of approximately 27 agencies and organizations with various Las Vegas Wash responsibilities. The LVWCC serves to help coordinate activities of the member agencies in regard to controlling erosion,

restoring vegetation, and meeting water quality standards. The LVWCC formed and assigned the Alternate Discharge Study Team (ADST) with the task of assisting the CWC with the first phases of the Alternate Discharge Study.

Phases I and II of the Alternate Discharge Study began in October 1999 and included a series of workshops; stakeholder interviews; and technical, regulatory, and engineering analyses. Working from the list of alternatives developed by the ADST, the CWC members began the process of studying, and eventually reducing, the number of alternatives. A stakeholder group of 33 parties was formed. The stakeholder group was composed of members representing local, state, and federal agencies, along with representatives of businesses, citizens, and downstream users. A formal workshop was held in March 2000. Based on that workshop, a second round of interviews and technical analysis was performed. A second workshop was held in November 2000. Nationally recognized technical experts participated in the second workshop, which resulted in an implementation plan that recommended the following actions:

- Construct the Effluent Interceptor (EI),
- Conduct the Lake Mead water-quality modeling,
- Analyze Colorado River Outfall locations,
- Conduct the Colorado River Outfall water-quality modeling, and
- Prepare a Water Quality Criteria Assessment.

In July 2000, the CWC member agencies and other agencies charged with the stewardship of water resources in the Valley completed an *Area Wide Reuse Study* (COH et al. 2000). The *Area Wide Reuse Study* is the first area wide compilation of water-reuse demands and effluent-discharge supplies, including both existing and future scenarios. This study identified potential water reuse within the Las Vegas Basin through the year 2020. Additional reuse includes the use of reclaimed water for industrial purposes and irrigation of golf courses, parks, and other landscaping.

In June 2001, Phase IIIA of the Alternate Discharge Study was initiated. At this time, the project began to be known as the "Systems Conveyance and Operations Program" to indicate the broader implications of the project beyond the initial studies. The major work throughout the Phase IIIA studies was to:

- Perform predictive water quality modeling of the Las Vegas Wash, Boulder Basin of Lake Mead, and Lake Mohave;
- Assess water quality impacts of various alternatives;
- Prepare preliminary designs of alternatives; and
- Estimate costs for improved treatment processes at the existing treatment facilities and for pipelines to alternate locations in Lake Mead.

1.4 Additional Background Information

Water is an essential and limited resource in the Valley. It is important to understand the water cycle and the water quality issues as they relate to southern Nevada and the SCOP.

1.4.1 Las Vegas Valley Water Cycle

The Valley acquires water from groundwater and surface water. Groundwater accounts for 12 percent of the total annual water supply and is obtained from the principal aquifer located beneath the Valley. Water collects in the aquifer from rain and melted snow filtering down through the mountains. The other 88 percent comes from the Colorado River.

The Las Vegas water cycle illustrated in Figure 1.4-1 begins with precipitation in the form of snowmelt and rain in the Rocky Mountains of Colorado. The precipitation in the Rocky Mountains flows into Lake Mead via the Colorado River. Water is removed from Lake Mead and treated to meet drinking water standards at the Southern Nevada Water System (SNWS) treatment plants. The COH also treats and provides drinking water to homes and businesses. Following treatment by the SNWS, the water is sold by SNWA to the Las Vegas Valley Water District (LVVWD), Nellis Air Force Base, City of North Las Vegas (CNLV), COH, and Boulder City for distribution to homes and businesses. Wastewater is generated then collected in municipal sewer systems and transported to the wastewater treatment facilities. A portion of the reclaimed water is used for urban irrigation of golf courses, dust control, landscapes, and wildlife habitat.

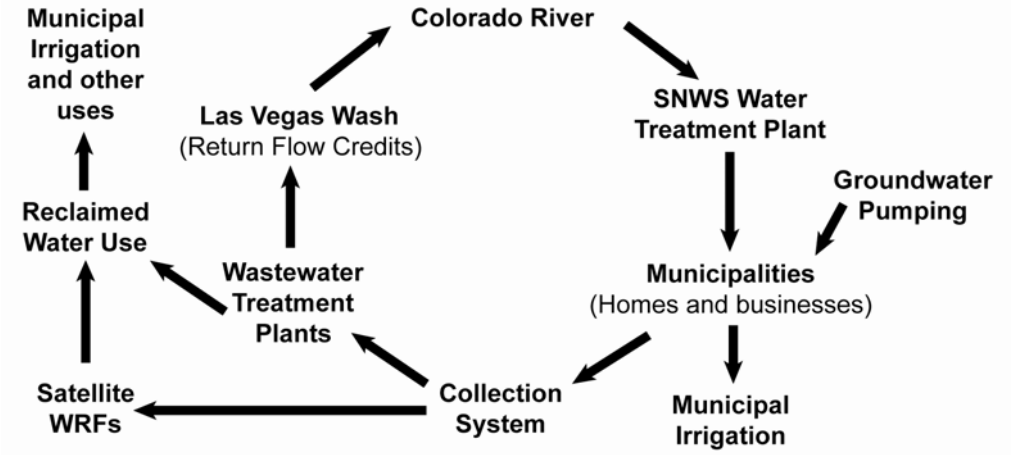


Figure 1.4-1 Las Vegas Water Cycle.

A series of laws and court cases known as the “Law of the River” governs how and where Colorado River water is used. The 1922 Colorado River Compact and the 1928 Boulder Canyon Project Act defined all apportionments of Colorado River water in “consumptive use” units. Consumptive use is defined as water diversions minus any water that is returned to the river (the latter is referred to as “return-flow credits”). This means that southern Nevada can actually divert more water than its apportionment, as long as the water is returned to the river. When water is used indoors or at a commercial car-wash facility, the unused water flows into the sanitary sewer. This sewer water travels to a wastewater treatment facility, where it is treated. The highly treated wastewater is returned to the Colorado River via the Las Vegas Wash, which flows into Lake Mead. The water returned earns the Valley return-flow credits. By treating Colorado River water after it is used and returning it to Lake Mead, southern Nevada is able to expand its Colorado River resources. Because water that is "wasted" indoors flows into the sanitary sewer, it has an opportunity to be treated and used again. It has not been "consumed" but recycled, and provides the opportunity for return-flow credits. Water that is wasted outdoors evaporates and cannot be used again (SNWA 2006a).

Return flow credits are important to Nevada because Colorado River water usage in the state cannot be sustained without return flow credits. Therefore, it is important to protect Nevada’s return flow credits. The components of the Valley water cycle are described further in the following subsections.

1.4.1.1 Lake Mead

Lake Mead, America’s largest man-made reservoir, was formed in 1935 after the completion of Hoover Dam. Lake Mead has the capacity to store up to 28.5 million acre-feet (AF) of water. An AF is the amount of water it would take to cover 1 acre of land to a depth of 1 foot (ft). Nearly 97 percent of the water flowing into Lake Mead comes from the Colorado River. The remaining 3 percent of the water in Lake Mead comes from the Muddy and Virgin rivers and the Las Vegas Wash.

1.4.1.2 Las Vegas Wash

The Valley is drained by the Las Vegas Wash, which is a tributary of the Colorado River. The Las Vegas Wash drains 1,600 square miles (4,160 square kilometers [km]) of the Valley and channels urban runoff and stormwater, shallow groundwater, and reclaimed water into the Las Vegas Bay at Lake Mead. Urban runoff is considered a non-point source of pollution and is generally attributed to irrigating of landscapes and golf courses, draining pools to streets, washing vehicles in streets, and hosing down driveways. Rainwater flows to the Las Vegas Wash and Lake Mead through gutters, storm drains, channels, and washes.

Shallow groundwater located less than 30 ft (9 meters [m]) below land surface in the central and southeast parts of the Valley flows towards and seeps into the Las Vegas Wash. The shallow groundwater system is primarily created from landscape irrigation runoff that is trapped near the land surface by impermeable clay and caliche.

Highly treated effluent is the largest and most predictable contribution of water to the Las Vegas Wash. Currently, a large portion of the indoor water used in the Valley goes to the wastewater treatment facilities at the CCWRD Central Plant (CP), the CLV Water Pollution Control Facility (WPCF), or the COH Water Reclamation Facility (WRF). The wastewater is highly treated to meet federal and state water quality regulations and is then reused for irrigation or is released into the Las Vegas Wash.

1.4.1.3 Treatment and Distribution of Drinking Water

Water is withdrawn from Lake Mead via two shafts located at 1,000 ft (305 m) above mean sea level (msl) near Saddle Island (SNWA 1996). This water is pumped to the SNWS Alfred Merritt Smith Water Treatment Facility (AMSWTF) on the shore of Lake Mead and to the River Mountains Water Treatment Facility in Henderson. The water is treated and delivered to Boulder City, the COH, the CNLV, the LVVWD, and Nellis Air Force Base. Each of these entities is responsible for storing and distributing water to users in their jurisdictions.

In addition to drinking water provided by SNWA, the COH purchases raw water from Basic Management, Inc (BMI). The BMI raw water intake is located near Saddle Island in Lake Mead. The raw water is treated at the COH Water Treatment Plant, then distributed for use in the COH.

Water is then used by homes and businesses and again enters the sanitary sewer system or gutters and storm drains and flows back into the Valley water cycle.

In response to severe drought conditions affecting the entire Colorado River Basin, the SNWA Board of Directors adopted the *Drought Plan* on February 20, 2003. The plan identified drought response measures that can be taken by the community to reduce water demand during drought conditions. The measures were intended to spread the burden of drought response as much as possible across all sectors of the community while targeting those water uses with the greatest potential for water savings (SNWA 2004). The *Drought Plan* is evaluated periodically to reflect current conditions and levels of action required. The tools and techniques implemented to reduce water use include:

- Landscape watering restrictions for residential and non-residential properties;
- Surface, building, equipment, and vehicle washing restrictions;
- Landscape development code restrictions for ornamental turf;
- Commercial use of mist systems restrictions – limited to June, July, and August;
- Irrigation restrictions on golf courses, schools, parks, and government facilities;
- Operation of ornamental fountain and water feature restrictions;
- Drought surcharges and rate incentives;
- Water waste enforcement;
- Incentive programs; and
- Public involvement and awareness (SNWA 2004).

1.4.1.4 Reuse of Highly Treated Effluent

The three member agencies of the CWC acknowledge the benefits of substituting reclaimed wastewater for potable water, when feasible and economical, as all three agencies currently produce and distribute reclaimed water. The *Area-Wide Reuse Study* (COH et al. 2000) was developed to assess a regional wastewater reclamation system plan to economically meet future demands and develop a phased implementation of this plan through the year 2020 in the Valley. The *Area-Wide Reuse Study* reviewed the regulatory requirements of reclaimed water treatment and use, compiled existing and proposed facility information, analyzed reclaimed water demand and wastewater supply, recommended systems that could service the existing as well as the high probability future demands, and suggested an implementation plan for sequencing the systems.

The recycling of treated wastewater is not a new concept in this country or in Nevada. Direct wastewater reuse began in southern Nevada in 1931 when the CLV built its first wastewater treatment plant (WWTP). The reclaimed water from this facility was used by the Stewart family to irrigate their ranch (COH et al. 2000).

The Valley currently reuses treated effluent for golf courses, cemeteries, parks, landscape medians, and cooling water for power plants. However, the amount of area available to reuse the treated effluent represents only about 20 percent of the effluent that is produced. The other 80 percent of the treated effluent is sent to the Colorado River, where it produces return flow credits for Nevada.

1.4.2 Water Quality Issues

The water in the Las Vegas Wash and Lake Mead must meet water quality standards conforming to the Clean Water Act (CWA) (Federal Water Pollution Control Act of 1972 as amended 33 USC 1251-1387; PL 92-500) and established by the Nevada Division of Environmental Protection (NDEP). The CWA requires that water quality standards be adopted by individual states and authorized tribes and territories, and then be approved by the U.S. Environmental Protection Agency (EPA). The three major components of the water quality standards program are designated uses, water quality criteria, and the anti-degradation policy. Designated uses include, but are not limited to, drinking water, water-based recreation, aquatic life, and agricultural and industrial water supplies. Water quality criteria are the set of conditions to be met in order to safely fulfill designated uses. Water quality standards are usually expressed quantitatively such as scientific measurements of pollutant concentrations, toxicity, or temperature. Anti-degradation policies are focused on maintaining water bodies that already have high water quality.

1.4.2.1 Total Maximum Daily Loads

The state, tribe, or territory responsible for a water body that is on the *303(d) Impaired Waters List* is required to develop a plan that would result in the attainment of the required water quality standards. The plan should include the establishment of a total maximum daily load (TMDL) for the water body, which is the maximum amount of pollutant(s) that can be discharged while still meeting water quality standards. The TMDLs provide a way to integrate the management of

point sources and non-point sources of pollution through the establishment of waste load allocations (WLAs) for point source discharges, and load allocations for non-point sources of pollution (NDEP 2003a, EPA 2003a). One or more TMDLs must be assigned to each impaired water body or segment of the water body. The TMDLs are set for individual pollutants such as clean sediments, nutrients, heat, acids/bases, synthetic organic chemicals, and metals. Responsible entities are required to submit all TMDLs to the EPA for approval.

The allowable load of any one pollutant is called the "cap." Loading caps are calculated using a margin of safety. Once a loading cap for a specific pollutant is set, the load is then allocated among all of the contributing point sources in the water body. The EPA does not specify how the pollutant cap of the TMDL should be allocated, only that the sum of the amount allocated does not exceed the amount of the loading cap.

In 1987, the NDEP established water quality standards for chlorophyll *a* and un-ionized ammonia (NH_3) for the Las Vegas Bay. Monitoring data showed that the Las Vegas Bay did not achieve these standards in 1986 and 1987. In order to address the water quality problems in the Las Vegas Bay, TMDLs for phosphorus and ammonia were developed for the Las Vegas Wash and established in 1989. These TMDLs became fully effective in 1994 and 1995, respectively. The three treatment facilities underwent upgrades throughout the late 1980s into the mid-1990s to provide treatment for these two constituents. The COH was not discharging into the Las Vegas Wash when the original TMDLs were established so the original WLAs were divided between the CLV WPCF and CCWRD plants. In 1994, the COH received a discharge permit including WLAs for total phosphorus (TP) and ammonia (NDEP 2003b).

1.4.2.2 Stormwater and Urban Runoff

The stormwater and urban runoff that flows to the Las Vegas Wash are considered sources of pollution because they carry pollutants found on the ground. These pollutants include pesticides from lawns and golf courses, bacteria from pet waste, and oil and chemicals from cars, driveways, and roadways (LVWCC 2003a).

1.4.2.3 Erosion and Sediments

The flows in the Las Vegas Wash have increased dramatically because of the increasing urban runoff and effluent flows in the Valley. The quantity of sediments and total suspended solids (TSS) has increased as the flows have increased (LVWCC 2003a). The TSS are solid fragments of inorganic or organic material that come from the erosion (or wearing away) of the earth's surface and are carried and deposited by natural processes such as water, wind, or ice (Houghton Mifflin Company 2000; MICRA, Inc. 1998). The TSS in the Las Vegas Wash are primarily inorganic material eroded from the bottom and sides of the channel (LVWCC 2003a).

Eleven of 26 planned erosion control structures (ECS) in the Las Vegas Wash have been built by SNWA and the NPS. The ECSs are designed and constructed to reduce the impacts of storm flows on the Las Vegas Wash. Bank stabilization activities are also occurring in the Las Vegas Wash. The ECSs have reduced erosion by aiding in the stabilization of the Las Vegas Wash.

Additional ECSs are planned and will further reduce the impacts of erosion in the Las Vegas Wash and Inner Las Vegas Bay.

1.4.2.4 Perchlorate, N-nitrosodimethylamine, and Pathogens

Perchlorate has been detected in shallow groundwater that seeps into the southeast end of the Las Vegas Wash. Perchlorate was manufactured for use in rocket fuel in the southeast part of the Valley for many years. This pollutant is a concern because it has been potentially linked to adverse effects on the thyroid gland and metabolism (EPA 1999, 2003). On February 18, 2005, EPA issued a safety standard of 24.5 parts per billion (ppb) for perchlorate. The SNWA uses the perchlorate concentration of 18 ppb as a public notification level.

Another chemical of potential concern is N-nitrosodimethylamine (NDMA). N-nitrosodimethylamine is a contaminant that is an inadvertent by-product of some industrial processes such as rubber manufacturing, organic chemical manufacturing, food processing, dye manufacturing, and municipal wastewater treatment (Government of Canada 2002). N-nitrosodimethylamine is also present in many other products such as tobacco smoke and a variety of foods such as cheeses, soybean oil, canned fruit, various meat products, bacon, various cured meat, cooked ham, milk, fish and fish products, apple brandy, and other alcoholic beverages including beer (Calgon Carbon 2003). The EPA has classified NDMA as a probable carcinogen. However, EPA has not yet established a regulation, or "Maximum Contaminant Level" for NDMA. This is because NDMA is just now being detected and understood. There is not enough information yet for EPA to set an appropriate Maximum Contaminant Level. At the present time, there are very few laboratories that can detect NDMA at these low levels, and there is no laboratory method that has been approved by EPA. Samples from the Las Vegas Wash have been analyzed for NDMA. Analysis results for one sample indicated the presence of NDMA at the very lowest measurable concentration of 2 nanograms per liter.

Pathogens, which are living microorganisms such as a bacterium or fungus, are found in raw sewage. Based on EPA Guidelines, wastewater in the U.S. that will be used for landscape and golf course irrigation, toilet flushing, unrestricted recreational impoundment, or indirect potable reuses such as reservoir augmentation requires advanced or tertiary treatment (BMZ 2000). The three facilities currently responsible for wastewater treatment in the Valley implement tertiary treatment. Destruction of pathogens occurs during the disinfection process at the wastewater treatment facilities. The CLV and COH use sodium hypochlorite for disinfection. The CCWRD uses ultraviolet light.

1.4.2.5 Pharmaceuticals and Personal Care Products, and Endocrine Disrupting Chemicals

The use and disposal of consumer chemicals have become a global issue in recent years. In the last 10 to 12 years, a more concerted effort has been made to research the multitude of pollutants, including contaminants of emerging concern such as pharmaceuticals and personal care products (PPCPs) and endocrine disrupting chemicals (EDCs), in the environment. The presence of PPCPs and EDCs in water is not a new phenomenon. It is reasonable to assume that PPCPs have been discharged to groundwater and surface waters for as long as people have been using them.

Likewise, endocrine disrupting steroid hormones were reported to occur in surface water as early as 1965 (Stumm-Zollinger and Fair 1965). However, recent advances in analytical chemistry methods and instrumentation have allowed the detection of progressively smaller concentrations of some EDCs and PPCPs in the environment, and particularly in surface water and effluents from municipal and industrial WWTPs.

A literature review of studies and reports addressing EDCs and PPCPs was conducted as part of this EIS. The results of the review are presented in Appendix K. The focus of the report presented in Appendix K is the potential risk to humans and ecological receptors (primarily fish) as a result of exposure to EDCs and PPCPs in surface waters of the Las Vegas Wash and Boulder Basin of Lake Mead. Additionally, the report addresses the potential risks related to exposure of humans to these same chemicals through drinking water drawn from the Boulder Basin as a source.

The conclusions drawn upon completion of the literature review are presented in Section 5 of Appendix K. In summary, the toxicological relevance of the occurrence of EDCs and PPCPs in Lake Mead is under study at this time to determine whether these chemicals are capable of producing adverse effects in the aquatic environment at environmentally relevant concentrations. There is little evidence to suggest that EDCs and PPCPs in wastewater are having an effect on human populations anywhere. Substantial evidence from laboratory studies and from field studies in other locations indicates that EDCs at concentrations that occur in some municipal WWTP effluents can adversely affect fish. However, no causative chemical agents or specific sources have been identified.

1.4.2.6 Selenium

Selenium is a chemical element found almost everywhere on earth. It is a naturally occurring element found in rocks, soil, and water. Its original source was probably volcanic activity. Selenium is nutritionally essential, but can be toxic to aquatic life at certain concentrations. Selenium enters the Las Vegas Wash through tributaries, shallow groundwater, and treated wastewater effluent. The EPA-recommended water quality criterion for bioaccumulation (accumulation in the tissues of organisms) in aquatic life is 5 micrograms per liter (µg/L). However, the appropriate concentration for protecting birds is complex and outside the scope of EPA's recommended aquatic life criterion (EPA 2006).

1.5 Purpose of and Need for the Action

The purpose of implementing one of the action alternatives is to maintain water quality standards and NPS recreational and resource values throughout the LMNRA by operating a system that would allow for flexible management of wastewater flow from the Valley to Lake Mead while protecting and maximizing Nevada's return flow credits and future augmentation credits.

Clark County, Nevada is one of the fastest growing counties in the U.S. It is projected that the population in the area will be approximately 3,130,000 by 2035 (University of Nevada, Las Vegas [UNLV] 2004). The quantity of effluent treated and discharged in the Valley will increase as the population of the Valley increases. Forecasts indicate that a combined maximum

month flow of approximately 400 million gallons per day (mgd) (619 cubic feet per second [cfs]) of municipal wastewater will need to be treated and managed in the Valley by 2050 (Black & Veatch 2004a). The year 2050 flows were extrapolated from the treatment plant projections. The treatment and conveyance facilities must accommodate the additional flows while continuing to meet current or future water quality standards for the Las Vegas Wash, Las Vegas Bay, and Lake Mead.

The CWC needs a system that:

- Provides maximum flexibility for management of increasing amounts of treated effluent flows between the current discharge location at the Las Vegas Wash and Las Vegas Bay, and other locations in Lake Mead;
- Provides flexibility to meet current and future water quality standards for known pollutants, and as yet unknown standards for additional contaminants that may be regulated in the future;
- Enhances the Las Vegas Bay area of the LMNRA by protecting and maintaining the recreational and resource values of the entire LMNRA and continuing to meet beneficial uses, while more than doubling the treated effluent flows discharged to Lake Mead;
- Accommodates Lake Mead's lowering water levels because the amount of mixing and dilution available in the inner Las Vegas Bay would decrease as the Lake level decreases;
- Provides flexibility to avoid possible impacts to source-water quality at the SNWS intake structures; and
- Avoids the ratcheting-down effects of Nevada's requirements to maintain existing higher quality (RMHQ) anti-degradation system that happens in effluent-dominated waterways such as the Las Vegas Wash, by removing the effluent to a natural, non-effluent dominated waterway in which the existing water quality is set by the natural flow conditions, not the effluent itself.

In addition to protecting water quality in the Las Vegas Wash and Las Vegas Bay, and the need for effluent-management flexibility, a number of additional factors have been identified as relevant to this project. These factors include:

- Adapting to potential changes in the Las Vegas Wash resulting from development of ECSs and Clark County Wetlands Park (Wetlands Park) facilities;
- Integrating with southern Nevada's overall water resource plan, including return-flow credits, direct effluent reuse, credits for water from new in-state sources (augmentation credits), and protection of the environment while augmenting southern Nevada's water resources;
- Protecting water quality for downstream users;
- Addressing public perception issues regarding the location of the drinking water intakes in relation to the wastewater discharge location;
- Maintaining and managing effluent flows through the Las Vegas Wash to allow others to maintain wildlife habitat and recreational values in the Wetlands Park; and
- Reducing flows in the Las Vegas Wash that would make treatment of non-point source flows more feasible.

In 1986 and 1987, the Las Vegas Bay was found to be impaired for chlorophyll *a* and NH_3. In 1989, the NDEP established TMDLs for TP and total ammonia in the Las Vegas Wash at Northshore Road as needed to meet the Las Vegas Bay water quality standards. By 1994-95, the treatment plants were upgraded to remove ammonia and additional phosphorus, and the Las Vegas Bay achieved compliance with its water quality standards. Although the Las Vegas Bay has since been removed from the impaired waters list, the TMDLs and WLAs have remained in effect. Since the establishment of TMDLs in 1989, wastewater flows to the three treatment plants have doubled and are expected to double again over the next 25 years. These increased flows have resulted in decreasing concentrations of allowable TP and total ammonia.

In 2002, the Las Vegas Wash was listed as impaired for iron and TSS. The TSS impairment was related to erosion of the streambed due to increasing combined effluent and non-point source flows in the Las Vegas Wash. The TSS levels have improved following the construction of ECSs, and the Las Vegas Wash has been delisted for TSS. Elevated iron levels are believed to be attributable to the iron naturally present in soil. Iron levels decreased following the construction of ECSs, and delisting for iron is in progress.

A re-listing of impairment in the Las Vegas Bay could result in a further reduction of the existing TMDLs for phosphorus and ammonia. Additionally, water quality standards for total inorganic nitrogen (TIN) and iron in the Las Vegas Wash and Las Vegas Bay were exceeded in 2001, 2002, and 2003. Therefore, exceedances in the future would be expected with the absence of additional initial mixing and dilution at the point of discharge.

The current decrease in Lake elevation from 1,200 ft (366 m), which was the approximate water level when the 1989 TMDLs were set, to 1,125 ft (343 m) has reduced the volume of available water for mixing and dilution in the Las Vegas Bay to approximately 35 percent. This is a decrease from 1 million AF to 350,000 AF. Further expected decreases in water levels to approximately 1,050 ft (320 m) would result in a volume in the Las Vegas Bay of 200,000 AF, or 20 percent of its former level. The 1,000-ft (305-m) Lake level is used for planning purposes in this EIS because it is the level that has been discussed by the Colorado River states to be "protected" in future drought conditions, and has most recently been agreed to in the *Seven Basin States' Preliminary Proposal Regarding the Colorado River Interim Operations.* Estimates of 1,000-ft (305-m) Lake levels would result in the volume of the Las Vegas Bay being 10 percent of its former volume.

Currently, the treatment plants are able to remove phosphorus down to a combined level near 0.14 milligrams per liter (mg/L), and TIN down to a level between 14 and 20 mg/L with existing or reasonably foreseeable improvements to their current technologies. The TIN standards are already being occasionally exceeded in the Las Vegas Wash and Las Vegas Bay. In addition, computer modeling results indicate exceedances of water quality standards for chlorophyll *a* in the Las Vegas Bay is highly probable at Lake levels near 1,000 ft (305 m). In 2001, an algal bloom occurred in the Las Vegas Bay when existing TMDL requirements were being met, and the Lake level was at 1,180 ft (360 m). These conditions are not nearly as severe as those predicted for the next several years. Although the 2001 algal bloom did not result in water quality standard violations, the bloom caused tremendous public concern because of its highly visible propagation at the water surface.

The SCOP was initiated to address the need to provide discharge location alternatives in open, well-mixed areas of Lake Mead. These discharge locations would replace or augment the existing discharge to the Las Vegas Wash to protect current and future water quality in the Las Vegas Wash and Las Vegas Bay. The effects at the new discharge locations would be analyzed and monitored regularly to ensure that no significant degradation of water quality is occurring in those areas. The SCOP was initiated as a proactive effort to improve and protect the water resources of southern Nevada, and to prevent possible re-listing of the Las Vegas Bay as impaired under Nevada's 303(d) listing process. An impairment listing could lead to construction of additional facilities under mandatory compliance schedules, instead of a more efficient planning timeframe.

1.6 Scoping and Public Participation Relating to the EIS

The CEQ regulations require that "agencies shall make diligent efforts to involve the public in preparing and implementing their NEPA procedures" (40 CFR 1506.6). Scoping is the first opportunity in the NEPA process for the public to provide input regarding a proposed action. Scoping is the process used to identify the proposed alternatives and significant issues to be addressed in the EIS. Comments and suggestions received as a result of the scoping process are used to prepare the Draft and Final EIS.

Additionally, public involvement occurs throughout the NEPA process. A common method for soliciting public input is to form a citizen's advisory committee such as the committee discussed in Section 1.6.2. Public input is also solicited when the Draft EIS is made available for public and agency review and comment. Comments regarding the Draft EIS will be addressed in the Final EIS.

1.6.1 Scoping

The *CEQ Regulations for Implementing the Procedural Provisions of NEPA*, 40 CFR 1501.7 states that:

> There shall be an early and open process for determining the scope of issues to be addressed and for identifying the significant issues related to a proposed action. This process shall be termed scoping. As soon as practicable after its decision to prepare an environmental impact statement and before the scoping process the lead agency shall publish a notice of intent in the *Federal Register*.

The Notice of Intent (NOI) to prepare an EIS for the SCOP was published in the *Federal Register*/Vol. 67, No. 144 on July 26, 2002 (Appendix A). The NOI contains:

- A brief description of the proposed project;
- The location, date, and time of the scoping meetings;
- Mailing addresses for submittal of written comments; and
- The deadline for submittal of comments.

Notices were also published in local and regional newspapers including the Las Vegas *Review Journal*, Henderson *Home News*, Arizona *Republic*, *Desert Sun*, Los Angeles *Times*, and San Diego *Union-Tribune*. Postcards were mailed to residents in southern Nevada, Arizona, and California notifying them of the scoping meetings. The information provided in the newspaper notices and on the postcards included the meeting locations, dates, and times, as well as a brief description of the proposed project.

Scoping meetings were conducted to give the public an opportunity to review the possible project alternatives, identify significant environmental and other issues, and to provide comments and suggestions on the proposed SCOP for consideration in the associated EIS.

Scoping meetings were held in eight locations in Nevada, Arizona, and California. The meeting locations included:

- Henderson Convention Center, 200 S. Water St., Henderson, NV – August 12, 2002,
- Winchester Community Center, 3130 S. McLeod Dr., Las Vegas, NV – August 13, 2002,
- West Flamingo Senior Center, 6255 W. Flamingo Rd., Las Vegas, NV – August 14, 2002,
- West Sahara Library, 9600 W. Sahara Ave., Las Vegas, NV – August 15, 2002,
- Tempe Mission Palms Resort, 60 E. 5 St., Tempe, AZ – August 19, 2002,
- Black Canyon Conference Center, 9440 N. 25th Ave., Phoenix, AZ – August 20, 2002,
- Radisson in Mission Valley, 1433 Camino del Rio So, San Diego, CA – August 22, 2002, and
- Hyatt Regency Conference Center, 285 N. Palm Canyon Dr., Palm Springs, CA – August 23, 2002.

Appendix B contains the comments that were received during the scoping process. Some of the issues and concerns that were identified during the scoping process included:

- Identification of funding sources for the project;
- Impacts on the Wetlands Park including the impacts resulting from construction and operation of the EI and the amount of effluent and flood waters that will flow through the wetlands on a daily, seasonal, and annual basis;
- Sediment flows into Lake Mead;
- Discharge of effluent below Hoover Dam;
- Water quality including salinity loads, turbidity levels, phosphate levels, and the presence (or absence) of metals, endocrine disruptors, personal care products, and pharmaceuticals;
- Water quantity;
- Indirect environmental impacts;
- Impacts to Las Vegas drinking water;
- Impacts to downstream users;
- Impacts to recreation at Lake Mead and downstream of Hoover Dam;
- Return flow credits; and
- Visual impacts.

1.6.2 Clean Water Coalition Citizens Advisory Committee

The governing board of the CWC, on December 5, 2002, established the CWC Citizens Advisory Committee (CWCCAC) to gather public input on water- and wastewater-related issues impacting the southern Nevada watershed and parts of the lower Colorado River. On December 19, 2002, the CWC Board appointed members to serve on the CWCCAC. The CWCCAC was asked to provide guidance to the CWC in their effort to identify and implement acceptable long-term solutions for the treatment, discharge, and reuse of the community's wastewater. During 11 meetings and a facilities tour, CWCCAC members received educational information regarding water quality, regulatory limits, effects to the Las Vegas Wash, water quality modeling results, local and downstream water supply concerns, effluent reuse, drought effects, and the integration of all of the watershed issues.

The CWCCAC is composed of three CWC Board members and 24 stakeholders and community representatives who have worked to address the interests of the southern Nevada public, businesses, environmental and political leaders, and concerns of downstream users of the Colorado River water in Arizona and California.

The CWCCAC process included:

- Identification of the CWCCAC objectives;
- Development of understanding regarding the regional wastewater and water resource systems;
- Identification of the CWCCAC's Areas of Concern;
- Development of the CWCCAC's Problem Statement;
- Development of understanding regarding the potential solutions to the problem;
- Development of evaluation criteria based on the areas of concern;
- Application of weights and rating of alternative discharge locations against evaluation criteria; and
- Preparation and presentation of CWCCAC recommendations to the CWC.

The CWCCAC is part of the larger public input procedure required in any EIS. The CWCCAC interfaced with the public and provided an opportunity for open discussion and public participation in the overall process. After evaluation of the issues, the CWCCAC formulated potential solutions and made critical recommendations to the CWC Board regarding the alternatives that should be carried forward in the EIS. The CWCCAC ultimately assisted with the development of alternatives that would be analyzed in this EIS. The CWCCAC members assisted the CWC with alternatives development by providing knowledge, technical expertise, and the public's point of view. The CWC's selection of alternatives to be carried forward in the EIS was influenced by the CWCCAC's recommendations, as well as input from other stakeholders in the process. The alternatives development process is described in Section 2.6.

1.6.3 Coordination with Native Americans

Department of Interior (DOI), Secretarial Order (SO) 3175 (Departmental Responsibilities for Indian Trust Resources, 1993) established the policies, responsibilities, and procedures for

operating on a government-to-government basis with federally recognized Native American tribes for the identification, conservation, and protection of Native American and Alaska Native trust resources to ensure the fulfillment of the Federal Indian Trust Responsibility. Indian Trust Assets (ITA) are legal interests in property held in trust by the U.S. for federally recognized Native American Tribes. Among other directives of SO 3175, it is the DOI requirement to consult with Native American tribes when trust property may be affected. The ITA identification should be considered early in the NEPA process and involve consultation with tribes, Native American organizations, and the Bureau of Indian Affairs (BIA).

Letters notifying tribal members of the proposed project and upcoming Scoping Meetings were mailed on August 9, 2002, to 31 individual members representing 19 Native American Tribes located near and downstream of the proposed project. Attached to the letter was a copy of the Federal Register NOI to prepare an EIS. No tribal members attended the Scoping Meetings that were held in August 2002.

A Native American Coordination Meeting was held on March 31, 2004. Invitations were sent to the same tribal members mentioned previously. Three individuals representing the Ft. Mojave, Las Vegas Paiute Tribal Council, and Colorado River Indian Tribe (CRIT) attended the meeting. The tribal members were encouraged to provide comments. Appendix C contains the comments received from the Native American Tribes. Some of the issues and concerns that were identified included:

- Discharge of effluent below Hoover Dam;
- Water quality including salinity loads, turbidity levels, phosphate levels, and the presence (or absence) of metals, endocrine disruptors, personal care products, and pharmaceuticals;
- Water quantity; and
- Impacts to downstream users.

1.6.4 Draft EIS Public Hearings and Public Comment Period

The CEQ regulations (40 CFR 1503.1) invite the public to review and comment on the Draft EIS. A Notice of Availability (NOA) was published by the NPS/Reclamation in the *Federal Register* on October 5, 2005 (Vol. 70, No.192) and by the EPA on October 7, 2005 (Vol. 70, No. 194) announcing the availability of the Draft EIS for public review and comment.

The notices announcing the Draft EIS public hearings were published in the following newspapers on the following dates.

- Henderson *Home News*: September 29 and October 13, 2005.
- Las Vegas *Review Journal*: October 2 and 16, 2005.
- Kingman *Daily Miner*, Arizona *Republic*, Los Angeles *Times*, San Diego *Tribune*, and *Desert Sun*: October 9 and 23, 2005.

The NPS and Reclamation hosted nine public hearings in Nevada, Arizona, and California. The meeting locations included:

- Henderson Convention Center, 200 S. Water Street, Henderson, NV – October 17, 2005;
- West Las Vegas Library, 951W. Lake Mead Drive, Las Vegas, NV – October 18, 2005;
- West Flamingo Senior Center, 6255 W. Flamingo Road, Las Vegas, NV – October 19, 2005;
- Summerlin Library, 1771 Inner Circle Drive, Las Vegas, NV – October 20, 2005;
- Powerhouse Visitors Conference Center, 120 W. Route 66, Kingman, AZ – October 24, 2005;
- Westside Multi-Gen Center, 715 West 5th Street, Tempe, AZ – October 25, 2005;
- Hilton Suites, 10 E. Thomas Road, Phoenix, AZ – October 26, 2005;
- Radisson in Mission Valley, 1433 Camino Del Rio South, San Diego, CA – October 27, 2005;
- Hyatt Regency Conference Center, 285 N. Palm Canyon Drive, Palm Springs, CA – October 28, 2005.

The public meetings were held to provide the public an opportunity to comment on the potential environmental impacts as described in the Draft EIS. The meeting format included a 15-minute open house followed by a presentation. The presentation included a brief description of the NEPA process, the proposed alternatives, and the results of the impacts analyses documented in the Draft EIS. Following the presentation, public participants were encouraged to submit oral or written comments regarding the Draft EIS. A court recorder was in attendance at several of the meetings to record comments received from members of the public. Written comments were accepted at the public hearings, via email, U.S. mail, and the CWC website. The official close of the comment period was December 7, 2005, but comments were accepted through January 30, 2006. All comments received and the associated responses are provided in Appendix L of this Final EIS.

1.7 Regulatory Requirements

This EIS is prepared in compliance with the NEPA and the CEQ *Regulations for Implementing the Procedural Provisions of NEPA.* Portions of the SCOP alignment traverse lands administered by the NPS, Reclamation, and BLM. Therefore, the CWC would need to obtain federal permits that allow the construction and operation of the SCOP on federal lands. The issuance of federal permits is a federal action and requires NEPA compliance. As previously stated, the NPS and Reclamation are the co-lead agencies for the preparation of this EIS. The NEPA requires federal agencies to consider the environmental consequences of all proposed actions in their decision-making process. The CEQ was established under NEPA to implement and oversee federal policy in this process.

A segment of the SCOP alignment would be located within the LMNRA. Therefore, compliance with the National Park Service Organic Act of 1916 is required (16 USC 1). The Organic Act of 1916 directs the NPS to manage units "to conserve the scenery and the natural and historic objects and the wildlife therein and to provide for the enjoyment of the same in such a manner as will leave them unimpaired for the enjoyment of future generations." The Organic Act prohibits actions that permanently impair park resources unless a law directly and specifically allows for

the actions. An action constitutes an impairment when its impacts "harm the integrity of park resources or values, including the opportunities that otherwise would be present for the enjoyment of those resources and values" (NPS 2001a).

The NPS Management Policies (NPS 2001a) require the analysis of potential effects under each alternative to determine if actions would impair park resources. The NPS must always seek ways to avoid or minimize, to the greatest degree practicable, adverse impacts on park resources and values. However, the laws give the NPS management discretion to allow impacts on park resources and values when necessary and appropriate to fulfill the purposes of a park, as long as the impact does not constitute impairment to the affected resources and values (NPS 2001a). This EIS analyzes the potential for resource impairment, as required by Director's Order 12: *Conservation Planning, Environmental Impact Analysis and Decision Making* (NPS 2000).

The proposed alternatives are in conformance with BLM management objectives and directions of the Las Vegas *Resource Management Plan* (RMP) for rights-of-way (ROW). The BLM will continue to meet public demand for ROW access for transportation, utilities, and flood control facilities as specified in RW-1, RW-1-d, and RW-1-h. The Record of Decision (ROD) for the Las Vegas RMP was approved on October 5, 1998. The BLM standard stipulations for issuance of a ROW are included in Appendix J.

The following subsections provide a brief description of the laws, regulations, executive orders (EO), and other guidelines that may be applicable to the SCOP. Table 1.7-1 provides a summary of the permits and approvals that may be required for this project.

1.7.1 Environmental Policy

The NEPA of 1969 establishes national policy, sets goals, and provides the means to prevent or eliminate damage to the environment. The NEPA procedures ensure that information about environmental impacts is available to public officials and citizens before decisions are made on major federal actions that may significantly affect the environment. The CEQ regulations implement the procedural provisions of NEPA. In accordance with 40 CFR 1506.5, a disclosure statement is presented in Appendix N stating that PBS&J, as a third-party consultant, has no conflict of interest relating to this project.

The CEQ regulations require that a concise public ROD be prepared by the lead agency (ies). The ROD shall:

- State what the decision was.
- Identify all alternatives considered by the agency in reaching its decision, specifying the alternative or alternatives which were considered to be environmentally preferable.
- State whether all practicable means to avoid or minimize environmental harm from the alternative selected have been adopted, and if not, why they were not. A monitoring and enforcement program shall be adopted and summarized where applicable for any mitigation (40 CFR 1505.2).

Table 1.7-1 Permit/Approval Summary.

Issuing Agency & Contact	Permit/Approval Required
Federal	
U.S. Bureau of Reclamation (Reclamation)	National Environmental Policy Act Decision Document (Record of Decision [ROD])
	Reclamation Right-of-entry Permit
	Reclamation Land Use License
U.S. Bureau of Land Management (BLM)	BLM Right-of-way (ROW) Temporary Use Permit
	BLM ROW Grant
U.S. Army Corps of Engineers (USACE)	Section 404 of the Clean Water Act (CWA) Permit
	Section 10 of the Rivers and Harbors Act
U.S. Fish and Wildlife Service (USFWS)	Endangered Species Act Section 7 Consultation with USFWS and Biological Assessment If it is determined that the project may adversely affect an endangered species, an incidental take permit may be required
National Park Service (NPS)	NPS ROW Grant
	National Environmental Policy Act Decision Document (ROD)
State	
State of Nevada Historic Preservation Office	National Historic Preservation Act of 1966, Section 106
Nevada Department of Wildlife	Scientific Collection of Wildlife Permit
Nevada Division of Forestry	Native cacti and yucca commercial salvaging permit and shipping or transportation permit
Nevada Division of Environmental Protection (NDEP), Bureau of Water Pollution Control	CWA, Section 401 Water Quality Certification
	National Pollutant Discharge Elimination System (NPDES) General Stormwater Permit for Construction
	NPDES Permanent Discharge Permit
	NPDES Temporary Discharge Permit
	Temporary Permit for Working in Waterways (formerly known as a "Rolling Stock Permit")
NDEP, Nevada Division of Water Resources	Waiver (dewatering well, monitoring well, and/or testing well waiver)
Nevada Department of Transportation (NDOT) District I	NDOT ROW Encroachment Permit
	Traffic Barricade Plan Approval

Table 1.7-1 Permit/Approval Summary (continued).

Issuing Agency & Contact	Permit/Approval Required
Nevada Department of Motor Vehicles and Public Safety, Nevada State Fire Marshall Division	Hazardous Material Permit or Roving Permit.
Clark County	
Air Quality & Environmental Management	Authority to Construct Certificate or Operating Permit Modification
	Dust Control Permit
Department of Public Works Community Development Division	Off-site Construction Permit
	Encroachment Permit
	Encroachment Permit (discharge water)
Department of Public Works Traffic Operations	Traffic Barricade Plan Approval
Development Services	Grading Permit
	Conditional Grading Plan
	Temporary Sign Permit
	Soils Report Submittal & Examination Declaration
	Block Wall/Fence Permit
	Pad Certification for Grading and Earthwork
Department of Comprehensive Planning	Multiple Species Habitat Conservation Plan Compliance Desert Tortoise "Take" Permit and collection of tortoise habitat remuneration fees.
Regional Flood Control District	Capital Improvement Program Coordination/Drainage Study Review (also check of Federal Emergency Management Agency Maps)
Fire Department	Above-ground Generator Permit
	Fire Department Permit
	Blasting Permit
City of Henderson	
Department of Public Works, Land Development	Excavation Permit/Grading Permit
	Barricade Plan Approval
	Revocable Permit and Encroachment Plan Approval
	Plans Check
Department of Building and Safety	Grading (Floodplain) Permit
Fire Prevention Division	Blasting Permit
	Above-ground storage tank permit for flammable liquid

Table 1.7-1 Permit/Approval Summary (continued).

Issuing Agency & Contact	Permit/Approval Required
City Council Notification	Interlocal Contract
City of Las Vegas	
Department of Building and Safety	Plans check
	Excavation Permit
Utility Services Coordination	
AT&T	Coordination only. No permit required.
Cal-Nev Pipeline	Coordination only. Occupancy Permit if required.
Nevada Power	Coordination only. No permit required.
Sprint	Coordination only. No permit required.
Southwest Gas	Coordination only. No permit required.

The *Protection and Enhancement of Environmental Quality* EO 11514 sets the policy for directing the federal government in providing leadership in protecting and enhancing the quality of the nation's environment (1977).

1.7.2 Air Quality

The *Clean Air Act* (CAA) of 1970 establishes federal policy to protect and enhance the quality of the nation's air resources to protect human health and the environment (42 USC 7401 et seq.; 42 USC 1857h-7 et seq; PL 91-604). The CAA sets national primary and secondary ambient air quality standards as a framework for air pollution control.

The CAA Amendments of 1977 initiated the association of federal department activities with a State Implementation Plan (SIP). The 1977 provisions stated that no federal agency could engage in, support in any way, or provide financial assistance for, license, permit, or approve any activity which did not conform to a SIP after its approval or promulgation. Two SIPs for Clark County were approved by EPA in early 2004: *Clark County Serious Area Carbon Monoxide Plan for the Las Vegas Metropolitan Nonattainment Area*, and *Clark County Serious Area PM-10 Plan for the Las Vegas Metropolitan Nonattainment Area*.

Section 176(c) of the CAA Amendments of 1990 expanded the scope and content of the conformity provisions by defining conformity to an implementation plan. Specifically, the language asserts that a federal agency cannot approve or support an action that causes or contributes to new violations of any National Ambient Air Quality Standard (NAAQS), increases the frequency or severity of existing violations of any NAAQS, or, delays the timely attainment of any NAAQS or any required interim emission reductions or milestones.

1.7.3 Water Quality

The CWA establishes federal limits, through the National Pollutant Discharge Elimination System (NPDES), on the amounts of specific pollutants that are discharged to surface waters in order to restore and maintain the chemical, physical, and biological integrity of the water as established by ambient water quality standards. A NPDES permit, or modification to an existing permit, would be required for any change from the present parameters in the quality or quantity of wastewater discharge and/or stormwater runoff. The NDEP establishes water quality standards in accordance with the CWA, and has authority over the NPDES program in Nevada. A general description of the NPDES process is presented in Appendix M. The current wastewater discharge permit for the three wastewater treatment agencies in southern Nevada is also presented in Appendix M.

The *Safe Drinking Water Act* of 1974 sets primary standards for the quality of public drinking water supplies and establishes a program to prevent contamination of underground drinking water sources (42 USC 300f et seq.; PL 93-523). The *National Primary Drinking Water Regulations* define the maximum allowable concentrations of specified contaminants in public water systems (42 USC 300g; 40 CFR 143).

The *Floodplain Management* EO 11988 (1977) requires federal agencies to evaluate the potential effects of actions on floodplains and to consider alternatives to avoid adverse effects and incompatible development wherever possible.

1.7.4 Biological Resources

The *Endangered Species Act* (ESA) of 1973 requires federal agencies that authorize, fund, or carry out actions to avoid jeopardizing the continued existence of endangered or threatened species, and to avoid destroying or adversely modifying their critical habitat (16 USC 1531 et seq; PL 93-205). Federal agencies must evaluate the effects of their actions on endangered or threatened species of fish, wildlife, and plants, and their critical habitats, and take steps to conserve and protect these species. All potentially adverse impacts to endangered and threatened species must be avoided or mitigated.

Special status plant species are those that are federally listed threatened or endangered, proposed for listing, or candidates for listing under the ESA. Federal land management agencies are mandated to protect and manage threatened, endangered, candidate, proposed, and sensitive plant species and their habitat. The federal agencies are also required to protect and manage sensitive species jointly identified with the appropriate state agency. A *Scientific Collection Permit* issued by the Nevada Department of Wildlife would be required prior to handling of any state sensitive species (Nevada Revised Statutes [NRS] 503.597 and 503.650).

The *Migratory Bird Treaty Act* of 1918, as amended [16 USC 703 et. seq.], provides for the protection of migratory birds and prohibits their unlawful take or possession. In addition, EO 13186, *Responsibilities of Federal Agencies to Protect Migratory Birds*, was signed by President Clinton in 2001. This EO directs federal agencies to include impacts to migratory birds in their NEPA analyses.

The *Protection of Wetlands* EO 11990 requires federal agencies to take action to minimize the destruction, loss, or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands (1977). It is the commitment of the USACE to:

- Achieve the goal of no net loss of our nation's wetlands, and
- Improve guidance to ensure effective, scientifically based restoration of wetlands impacted by development activities.

1.7.5 Cultural Resources

The *National Historic Preservation Act* (NHPA) of 1966, as amended, requires federal agencies to take into account the effects of their undertakings on historic properties, and to afford the Advisory Council on Historic Preservation an opportunity to comment with regard to such undertaking (16 USC 470a et seq. 80 Stat. 915; PL 89-665). Implementing regulations for Section 106 of the NHPA are found at 36 CFR 800 and outline the process agencies are to follow when evaluating the effects of their undertakings on historic properties and when resolving effects to such properties. Historic properties are defined in the *Protection of Historic Properties Act of 1986* (36 CFR 800.16[1][1]) as "… any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Register of Historic Places…."

The *Archaeological Resources Protection Act* (ARPA) of 1979, as amended, and its implementing regulations establish a procedure for permitting the recovery of information from archaeological sites, and authorize and establish civil and criminal penalties for intentionally or inadvertently damaging an archaeological site without a permit (16 USC 470aa-470mm. 93 Stat. 721; 43 CFR 7; PL 96-65).

The *Native American Graves Protection and Repatriation Act* (NAGPRA) of 1990 and its implementing regulations address the rights of lineal descendants and members of Native American tribes to certain Native American human remains and cultural items with which they are affiliated (25 USC 3001-30013. 104 Stat. 3042; 43 CFR 10; PL 101-601). The NAGPRA's implementing regulations at 43 CFR 10.3 and 10.4 address federal agencies' responsibilities when such items may be discovered during intentional permitted excavations, or the unintentional discovery of such items during the course of construction work, and those exposed as a result of erosion. When working on state, county, or private lands, both state and federal agencies are required to comply with NRS 383.150 through 383.190, *Historic Preservation and Archaeology: Protection of Indian Burial Sites* NRS 383.150-383.190 which address the inadvertent discovery of human remains on such lands.

The *American Indian Religious Freedom Act* (AIRFA) of 1978 established the policy of the United States "…to protect and preserve for American Indians their inherent right of freedom to believe, express, and exercise [their] traditional religions…including but not limited to access to sites…and the freedom to worship through ceremonials and traditional rites" (42 USC 1996 et seq. PL 95-341) Section 1(a) of the *Protection and Accommodation of Access to "Indian Sacred Sites"* (EO 13007 1996) further directs federal agencies "…to the extent practicable, permitted by law, and not clearly inconsistent with essential agency functions to, (1) accommodate access to

and ceremonial use of Native American sacred sites by Native American practitioners, and (2) avoid adversely affecting the physical integrity of such sacred sites." Compliance with AIRFA is thus achieved through consulting with tribal governments and tribal traditional religious practitioners.

1.7.6 Noise

The *Noise Control Act of 1972* establishes a policy to promote an environment free from noise that is harmful to the health or welfare of people (42 USC 4901; PL 92-574). Federal agencies comply with state and local requirements for the control and abatement of environmental noise, where applicable.

1.8 Related Documents

The following documents address ongoing actions, issues, or baseline data in the project area and are used as background information or incorporated by reference into this EIS as appropriate.

Area Wide Reuse Study (COH et al. 2000). The *Area Wide Reuse Study* examines potential reclaimed water demands and associated agencies' improvement plans through the year 2020.

Las Vegas Wash Stabilization Project Environmental Assessment (NPS 2001b). The runoff in the Las Vegas Wash has caused the channel to cut deeper into the landscape and grow wider, threatening the stability of the Northshore Road Bridge. The *Las Vegas Wash Stabilization Project Environmental Assessment* analyzes the potential impacts of placing three ECSs within the Las Vegas Wash at intervals downstream of the Northshore Road Bridge (within the LMNRA) to protect it from erosion.

Las Vegas Wash Comprehensive Adaptive Management Plan (LVWCC 2000). The *Las Vegas Wash Comprehensive Adaptive Management Plan* encompasses the 12-mile (19 km) long Las Vegas Wash from its headwaters northwest of the Las Vegas metropolitan area to its mouth at Las Vegas Bay, an arm of the western portion of Lake Mead. This document serves as the basis from which to implement actions recommended by LVWCC study teams and provides a roadmap for the long-term stabilization, enhancement, and management of the Las Vegas Wash.

Programmatic Biological Assessment for Clark County Wetlands Park Master Plan Las Vegas, Nevada (SWCA 2000a). This Biological Assessment specifies the development planned within the Wetlands Park and its potential effects to federally listed species. The species considered include the southwestern willow flycatcher (*Empidonix traillii extimus*), Yuma clapper rail (*Rallus longirostris yumanensis*), desert tortoise (*Gopherus agassizii*), and razorback sucker (*Xyrauchen texanus*).

Clark County Wetlands Park Trail Corridors and Guidelines Plan (Clark County Parks and Community Services 2002). Development of a trail system within the Wetlands Park is a component identified in the *Clark County Wetlands Park Master Plan* (Clark County 1995). The W*etlands Park Trail Corridors and Guidelines Plan* is based upon public participation and considers recreational needs by multiple user groups, the maintenance and biological monitoring

needs of the Las Vegas Wash stabilization and restoration projects, accessibility, safety, and overall maintenance and enforcement of the trail system. The *Wetlands Park Trail Corridors and Guidelines Plan* serves as a guide for the design, permitting, and development of the Wetlands Park trail corridors.

The Sunrise Management Area Interim Management Plan and Environmental Assessment (BLM 2000). The *Sunrise Management Area Interim Management Plan and Environmental Assessment* covers 21,578 acres (8,732 hectares) within the Sunrise Mountain Special Recreation Management Area. The purpose of this plan is to provide management guidance for the Sunrise Management Area (SMA) that is consistent with the BLM RMP. The goal of this plan is to provide recreation opportunities and to protect biological, geological, hydrological, and cultural resources within the SMA.

Final Program Environmental Impact Statement of the Clark County Wetlands Park (Reclamation and Clark County Department of Parks and Recreation 1998). In 1991, a $13.3 million bond was approved for the construction and operation of a wildlife and wetlands park to control erosion in the Las Vegas Wash. The *Final Program Environmental Impact Statement of the Clark County Wetlands Park* evaluates potential impacts from the construction and operation of the 8-square mile (21 square km) Wetlands Park located along 7 miles (11 km) of the Las Vegas Wash.

Las Vegas Wash Off-channel Wetlands Draft Report (Reclamation 2002). Since 1970, more than 1,800 acres (725 hectares) of wetlands along the Las Vegas Wash have been lost due to erosion caused by increased flows of highly treated effluent and urban runoff. The *Las Vegas Wash Off-channel Wetlands Draft Report* summarizes Reclamation's preliminary investigation of constructing off-channel wetlands around the Las Vegas Wash. This report identifies wetland designs and the potential effects of wetland development in the Las Vegas Wash as it relates to water supply, costs, and environmental, cultural, geological, and hydrological resources.

US 93 Hoover Dam Bypass Project Final Environmental Impact Statement and Section 4(f) Evaluation and Record of Decision (U.S. Federal Highway Administration 2001). The increasing congestion caused by the switchbacks leading to Hoover Dam and the restrictions at the dam crossing have led to the development of the Hoover Dam Bypass Project. The Hoover Dam Bypass Project is a 3.5-mile (6-km) corridor consisting of a bridge and highway access across the Colorado River in the vicinity of Hoover Dam. The ROD identified the Sugarloaf Mountain Alignment as the selected alternative.

Lake Mead National Recreation Area General Management Plan 1986 and 2002 Lake Management Plan and Final Environmental Impact Statement (NPS 1986, 2002). The 1986 *General Management Plan* and 2002 *Lake Management Plan and Final Environmental Impact Statement* (NPS 1986, 2002) are specific to the LMNRA, which includes two reservoirs (Lakes Mead and Mohave) along 140 miles (225 km) of the Colorado River from the southern tip of Nevada to the northwest corner of Arizona. The 1986 *General Management Plan* is the management document for Lakes Mead and Mohave. The 2002 *Lake Management Plan* tiers from the 1986 *Final Environmental Impact Statement / General Management Plan* and proposes additional management of recreational use for the waters of LMNRA. The objectives of executing the Management Plans are to improve the management of Lake Mead and

Lake Mohave and provide for the long-term protection of LMNRA resources, while allowing a range of recreational opportunities to support visitor needs.

Las Vegas Resource Management Plan and Final Environmental Impact Statement (BLM 1998). This RMP provides management guidance for approximately 3.3 million acres (1.3 million hectares) of public land administered by the BLM. The RMP was prepared in compliance with the *Federal Land Policy and Management Act of 1976*. The RMP identifies and analyzes alternatives for long-term management of public lands and resources administered by BLM in the planning area, which is defined as the Las Vegas District excluding Red Rock Canyon National Conservation Area, and the Nellis Range.

Lower Colorado River Multi-species Conservation Program Final Environmental Impact Statement/Environmental Impact Report (Reclamation et al. 2004). The Lower Colorado River Multi-Species Conservation Program (LCR MSCP) was developed to protect the lower Colorado River environment as well as the interests of water users and hydropower demands, protect threatened and endangered species, and prevent the listing of additional species in the lower Colorado River. The MSCP comprehensive, long-term, multi-agency effort is to work towards the recovery of several endangered species.

1.9 Organization of the Environmental Impact Statement

This EIS is organized into 12 Chapters and 15 Appendices. Chapter 1 describes the purpose and need for the proposed project and provides project history and background information. Chapter 2 provides a description of the five alternatives analyzed in depth, and the alternatives eliminated from further considerations. Chapter 2 also provides a comparative summary of the impacts of the alternatives to the local communities and the natural environment. Chapter 3 contains a description of the affected environment and provides a baseline for analyzing the impacts of the alternatives. The results of the environmental impact analysis are presented in Chapter 4. Chapter 5 presents the cumulative impacts that may result from the alternatives. Chapter 6 discusses the irreversible and irretrievable commitments of resources that may result from the action. The list of individuals and organizations consulted during the preparation of this EIS is provided in Chapter 7. Chapter 8 contains the list of SCOP EIS preparers and contributors. The references that are cited through-out the document are presented in Chapter 9. Chapter 10 contains the list of repositories and libraries that received a copy of this EIS and the public distribution list. A Glossary and an Index are presented in Chapters 11 and 12, respectively.

In addition to the body of this EIS, the following appendices are included:

Appendix A - Notice of Intent

Appendix B - Scoping Comments

Appendix C - Native American Scoping Comments

Appendix D - Water Resources

Appendix E - Biological Resources

Appendix F - Noise Assessment

Appendix G - Air Quality

Appendix H - Visual Resources

Appendix I - Socioeconomics

Appendix J - BLM Standard Stipulations for Rights-of-way

Appendix K – Endocrine Disrupting Chemicals and Pharmaceuticals and Personal Care Products

Appendix L - Comments and Responses

Appendix M - National Pollutant Discharge Elimination System Permit Process

Appendix N - No Conflict-of-interest Disclosure Statement

Appendix O - Acronyms and Abbreviations.

The List of Acronyms, Appendix O, is printed on the right side of 11x17 paper. This allows the reader to unfold the List of Acronym pages and have the list visible while reading the EIS. The glossary in Chapter 11 provides definitions of words and terminology that the reader may need.

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Chapter 2

Description of Alternatives

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2.0 Description of the Alternatives

Chapter 2.0 contains the descriptions of the alternatives that are being evaluated. Five alternatives are evaluated in this EIS: No Action Alternative (no pipeline), Boulder Islands North Alternative, Boulder Islands South Alternative, Las Vegas Bay Alternative, and the Process Improvements Alternative (no pipeline). The three pipeline alternatives have a common element, the EI. However, the EI alignment for the Boulder Islands North Alternative is slightly different than the EI alignment for the Boulder Islands South and Las Vegas Bay alternatives. Therefore, the designations of EI-Alignment A and EI-Alignment B are used throughout the EIS to describe the EI portion of the alternatives. The description of impacts resulting from EI-Alignment B is presented once under the Boulder Islands South Alternative then a reference to that section is used in the EI impacts discussions for the Las Vegas Bay Alternative. The series of pipelines and diffusers that would comprise the three pipeline alternatives ensure that the integrity of the combined effluent would be maintained throughout the pipeline. Therefore, the effluent discharged from the pipeline would meet the "end of pipe" requirements stipulated in the treatment facilities' NPDES permits and any water-quality-based effluent limits imposed by NDEP at the point of diffusion. The process used to develop the SCOP alternatives and the alternatives considered but eliminated from further analysis are presented in sections 2.6 and 2.7 of this chapter, respectively.

There are many actions occurring in the vicinity of the Las Vegas Wash and Lake Mead that are not part of the proposed SCOP alternatives. These activities include, but are not limited to, the construction and operation of SNWA's ECSs in the Las Vegas Wash, operation of the Wetlands Park, Water Conservation implemented by SNWA, and Reclamation's operation of the dam systems along the Colorado River System. These activities and other past, present, and reasonably foreseeable actions are addressed in Section 5.0, Cumulative Impacts.

2.1 No Action Alternative

The CWC would not construct pipelines to transport effluent from the treatment facilities. Highly treated effluent would continue to be discharged to the Las Vegas Wash at the existing discharge locations, and effluent flows would continue to enter the Las Vegas Bay for mixing and diffusion in an uncontrolled fashion.

The three agencies currently responsible for municipal wastewater treatment and discharge would expand their facilities to handle the increasing quantities of wastewater through 2050 (Table 2.1-1). Facility expansions and modifications would occur on lands currently owned by the CLV, Clark County, and COH.

The existing facilities and processes at each plant are described in Sections 2.1.1, 2.1.2, and 2.1.3. Even though the three treatment plants are designed and operated differently, the three agencies coordinate treatment and discharges to meet the combined effluent WLAs. Although one plant may be able to achieve lower concentrations of certain constituents,

Table 2.1-1 Wastewater Discharge Projections.[1]

Annual Average Flow (mgd)						
	Flow Increase Rate (%)[2]	2010	2020	2030	2040	2050
CLV WPCF	2.13	75	96	117	139	160
CCWRD CP	1.97	98	117	137	156	176
COH WRF	0.87	25	34	43	51	60
Total		**198**	**247**	**297**	**346**	**396**
Peak Month (mgd)						
	Peaking Factor	2010	2020	2030	20405	2050
CLV WPCF	1.16	87	111	136	161	186
CCWRD CP	1.15	112	135	157	180	202
COH WRF	1.08	27	37	46	55	65
Total		**226**	**283**	**339**	**396**	**453**
Peak Day (mgd)						
	Peaking Factor	2010	2020	2030	2040	2050
CLV WPCF	1.33	99	128	156	184	213
CCWRD CP	1.40	137	164	192	219	247
COH WRF	1.30	33	44	55	66	77
Total		**269**	**336**	**403**	**469**	**537**
Peak Hour (mgd)						
	Peaking Factor	2010	2020	2030	2040	2050
CLV WPCF	1.50	112	144	176	208	240
CCWRD CP	1.60	156	188	219	250	282
COH WRF[3]	1.30	33	44	55	66	77
Total		**301**	**376**	**450**	**524**	**599**

Notes:

[1] The table does not account for reuse because the quantity of effluent used for reuse varies depending on the season. The SCOP system would be designed to handle the largest projected effluent flows.

[2] Projected rate of annual increase.

[3] COH employs flow equalization; therefore, peak hour flow rates are equal to peak day flow rates.

the other plants may not be able to achieve the same performance. At some of the plants, older trains of tertiary equipment are operating in parallel with newer, not necessarily identical trains. Where additional tertiary capacity is required at a given plant, it was assumed that it would be provided by expanding the newer existing tertiary train. In the discussion of existing facilities, the term "existing" is used to describe facilities that meet one of the following criteria:

- The facilities are physically present on the site;
- The facilities are being constructed on the site; or
- The facilities are in the detailed design stage, with construction about to commence in the very near future.

Facilities that will be abandoned within the next few years are not considered “existing”, since they will not be part of the treatment scheme in the year 2030 or 2050.

Current, conventional treatment processes and plant optimization would be used to attempt to meet the requirements set by the NDEP through the NPDES permitting program. However, under this alternative the permitted WLA for phosphorus would be exceeded before the end of the planning period. Total phosphorus (TP) from the combined effluent of the treatment facilities is currently treated to 0.2 mg/L. Optimization of the plants would continue to be implemented to treat wastewater to levels needed to attempt to meet water quality objectives. Each of the three treatment plants is unique in their design, processes, facility improvement schedules, and varying capabilities of phosphorus removal. Nonetheless, the three agencies responsible for municipal wastewater treatment would continue to coordinate treatment and discharges to achieve combined TP levels of 0.14 mg/L during plant optimization.

Additions or modifications to treatment facilities would be implemented to accommodate the anticipated increase in effluent quantity. As flows increase in the future, effluent loadings of TP would eventually exceed the TMDL limitations for the Las Vegas Bay, and effluent TIN loadings could cause exceedances of the concentration-based standards for the Las Vegas Wash, Las Vegas Bay, and Lake Mead.

Conventional treatment processes that would continue to be used include secondary and tertiary treatment. Secondary treatment is defined here to include removal of organic loading, and may also include partial removal of phosphorus and nitrogen through biological processes. Tertiary treatment may include nitrification, biological nutrient removal (BNR), chemical addition, and conventional filtration. In all cases, effluent would receive disinfection prior to discharge to the Las Vegas Wash. Processes to optimize the treatment plants’ operations would vary based on the existing infrastructure and current processes implemented at each plant (Black & Veatch 2004b). Optimization of treatment facilities may include, but is not limited to:

- Maximizing the volatile fatty acids in biological phosphorus removal (BPR) processes;
- Optimizing aeration basin configuration;
- Optimizing operational criteria – dissolved oxygen concentration, chemical addition;
- Managing overall plant-wide strategies phosphorus in recycle flows;
- Optimizing filtration efficiency through chemical addition and/or media selection; and

- Managing secondary phosphorus release.

Descriptions of the existing facilities at the three WWTPs and the infrastructure and expansions needed to optimize the processes at each plant are provided in the following sections.

2.1.1 City of Las Vegas

2.1.1.1 Existing Facilities and Processes

The CLV WPCF has been located in the vicinity of Vegas Valley Drive and the Las Vegas Wash since the mid 1950s. The CLV WPCF currently occupies 105.5 acres of the 169 acres owned.

The CLV WPCF is designed to treat 91 mgd. Preliminary liquid stream treatment consists of bar screening and vortex grit removal. Following preliminary treatment, the liquid flow is divided into two different treatment streams. About 54 percent of the current flow receives approximately 45 mg/L of ferric chloride and 0.3 mg/L of anionic polymer (for soluble phosphorus removal and odor control) before it is directed to primary clarification. This flow continues to rock-media trickling filters and intermediate clarifiers, followed by activated sludge for nitrification and final clarifiers. The remaining 46 percent of the current flow receives approximately 5 mg/L of ferric chloride (for odor control) before it is directed to primary clarification. This flow continues on to a Bardenpho enhanced BPR activated sludge system for nutrient removal and then to final clarifiers.

Effluent from the final clarifiers of both flow streams is combined and about 25 mg/L of alum is added ahead of the dual media effluent filters with a combined capacity of 78 mgd (121 cfs) (annual average flow). Tri-media type filters (anthracite over sand over gravel) are used. The final effluent is then disinfected with sodium hypochlorite and dechlorinated with sodium bisulfite. Odor control is used at many of the processes throughout the plant.

Primary and trickling filter sludges are gravity thickened. Waste activated sludge from the two activated sludge processes is centrifuge thickened before all sludges are combined in anaerobic digestion. Digested sludge is dewatered by centrifuge, biosolids are taken to a landfill, and solids-processing sidestreams are recycled back to the plant influent. The facility currently produces approximately 170 tons of sludge per day.

The CLV WPCF discharges treated effluent to the Las Vegas Wash from an open channel located at the intersection of Desert Inn Road and the Las Vegas Wash.

Table 2.1-2 summarizes the existing tertiary treatment facilities at the CLV WPCF (Black & Veatch 2004b).

Table 2.1-2 City of Las Vegas Existing Tertiary Treatment Facilities.

Unit Operation	No. Units	Size/Dimensions	Total Annual Average Capacity (mgd)	Notes
Tri-media Filters	30	504 square ft (ft^2) per filter; dimensions: 18 ft wide x 28 ft long	78	4.5 gallons per minute/ ft^2 (gpm/ ft^2) at maximum month flow (all units in service); 6.5 gpm/ ft^2 at peak hour flow (1 unit out of service)

Source: Black & Veatch 2004b

2.1.1.2 Optimization Facilities and Processes

The CLV WPCF could be optimized for phosphorus removal by increasing the alum dose, and implementing polymer dosing at filtration. However, phosphorus removal that is significantly greater than what is currently being achieved would not likely be possible through this method because the solids concentration onto the filters may exceed the reasonable threshold for direct filtration.

It is also possible to remove some additional phosphorus for short periods by increasing ferric chloride at the primary clarifiers. The CLV has used this option successfully in the past. However, the typical ferric dose is already very high, at the point of diminishing returns. Furthermore, the formation of iron scales and sludges precludes the long-term application of higher ferric dosages.

No major addition of infrastructure would be necessary to optimize the CLV WPCF. Equipment to add polymer at filtration is already in place. However, fine-tuning of polymer feeding equipment at filtration would likely be necessary since the system is not in use.

No new waste streams would be generated, but approximately 1,940 pounds per day (lbs/day) of additional alum chemical sludge may be generated at times throughout the year. Disposal of the sludge would continue as described in Section 2.1.1.1.

The estimated costs to optimize the CLV WPCF would be more than $260,000 per year. The costs would occur over time and not all costs would occur simultaneously. These costs would include approximately:

- $150,000 per year for additional alum;
- $38,000 per year for polymer at filtration;
- $10,000 per year for additional sludge disposal; and
- $62,000 per year for increased backwashes.

In addition, there would be unknown costs for increased maintenance resulting from scaling and sludge clogging.

2.1.2 Clark County Water Reclamation District

2.1.2.1 Existing Facilities and Processes

The CCWRD CP and Advanced Wastewater Treatment (AWT) facilities have been located in the vicinity of East Flamingo Road and Hollywood Boulevard since 1956. The CCWRD facilities currently occupy 360 acres of the 640 acres owned.

The existing plant has a capacity of 110 mgd and consists of the following treatment processes: screening, grit removal, primary clarifiers, aeration basins, final clarifiers, dual media conventional filters, ultraviolet disinfection, waste-activated sludge thickening using dissolved air flotation, and dewatering of both the primary sludge and the thickening waste-activated sludge using a plate and frame press with ferric chloride and polymer addition. All solids processing sidestreams are returned to the liquid stream. Historically, the liquid stream has achieved complete nitrification, partial denitrification, and phosphorus removal using a combination of BPR and chemical polishing. The aeration basins combine a pre-anoxic zone, an anaerobic zone, and an aerobic zone to achieve BPR.

The CP is considered the main plant where the majority of the treatment occurs. The AWT provides tertiary treatment and disinfection using ultraviolet light. The CCWRD's CP and AWT have an annual average capacity of 110 mgd (169 cfs). The next CCWRD expansion is planned to increase the total plant capacity to 150 mgd (232 cfs). Facility expansions and modifications would occur on lands currently owned by Clark County. The CCWRD delivered 5.35 mgd (8.2 cfs) of treated reuse water to customers in 2003 (CCWRD 2004).

The CCWRD's CP includes bar screens, grit basins, primary clarifiers, sludge thickeners, and sludge dewatering facilities. The AWT plant includes chemical feed/mixing/flocculation basins, clarifiers, filters, and disinfection (COH et al. 2000).

The total existing secondary treatment capacity at the CCWRD facility is 110 mgd (169 cfs) (annual average basis). Treatment is currently divided between two trains, with the activated sludge process constituting the main treatment for the removal of carbon, ammonia, and phosphorus. Each train also includes provisions for chemical addition for precipitation of phosphorus in the primaries and at the filters (for use during process upsets). The new basins would be divided into aerobic, anoxic, and anaerobic zones and will emphasize BPR (Black & Veatch 2004b).

Tertiary treatment at the CCWRD facilities consists of effluent filters with a combined capacity of 97.5 mgd (151 cfs) (annual average basis). The effluent filters treat the clarified effluent from secondary treatment. The system is designed for direct filtration in which the secondary effluent would be dosed with coagulant and polymer, and applied directly to the filters for enhanced removal of phosphorus and particulates. Table 2.1-3 summarizes the existing tertiary treatment facilities at the CCWRD facility (Black & Veatch 2004b).

Table 2.1-3 Clark County Water Reclamation District Existing Tertiary Treatment Facilities

Unit Operation	No. Units	Size/Dimensions	Total Annual Average Capacity (mgd)	Notes
Filters	24 with an additional 8 under construction	1,200 ft^2/filter; dimensions: 20 ft wide x 60 ft long	97.5 with an additional 32.5 under construction	4.4 gallons per minute per square ft (gpm/ft^2) at peak hour flow (all units in service); 5.0 gpm/ ft^2 at peak hour flow (1 unit out of service)

Source: Black & Veatch 2004b

Waste activated sludge at the CCWRD facilities is dewatered by centrifuge, biosolids are taken to a landfill, and solids-processing sidestreams are recycled back to the plant influent. The facility currently produces approximately 540 wet tons of sludge per day.

The CCWRD discharges treated effluent to the Las Vegas Wash in two locations. The AWT facility discharges to the Las Vegas Wash northeast of Telephone Line Road near the intersection of Telephone Line Road and the AWT access road. The CP discharges to the Las Vegas Wash just downstream of the AWT discharge location.

During the past few years, CCWRD has optimized their phosphorus removal operations by implementing both operating changes as well as physical changes. Since the CCWRD is currently optimizing their facilities and processes, their "existing facilities and processes" and their "optimization facilities and processes" are the same. However, for consistency in the Final EIS, the description of the CCWRD facilities and processes are broken into two sections, 2.1.2.1 and 2.1.2.2.

2.1.2.2 Optimization Facilities and Processes

Optimization of phosphorus reduction at the CCWRD is described in this section. The operation of the primary clarifiers, with respect to the sludge wasting practice, was modified to build up solids in the bottom of the clarifier. This practice resulted in the production of volatile fatty acids (VFAs) and allowed the solids to thicken to approximately 5 percent. The increased VFAs enhance the capability of the secondary treatment process to remove phosphorus biologically.

Modifications to the aeration basins and the final clarifiers were implemented to optimize the performance and process control of these facilities. Additional baffling was provided in the aeration basins to optimize the plug flow pattern and minimize the potential for backflow between the various zones. This is especially critical between the aeration zone and the anaerobic zone. In the final clarifiers, the conventional plow scrappers were replaced with rapid sludge removal equipment, which allowed the solids to be removed more efficiently and prevent the buildup of a sludge blanket. The change in the sludge removal system also allowed for a reduction in the return activated sludge flow that minimized nitrate (NO_3) carryover to the anaerobic zone, again optimizing the BPR process.

Several operational changes were implemented that enhanced the BPR process. Within the aeration basins, the aeration system was operated to maximize the oxygen concentration in the first portion of the aerobic zone to optimize phosphorus uptake. A second operating change was to operate at the minimum sludge (or solids) retention time (SRT) that would allow stable nitrification in order to optimize phosphorus uptake and minimize phosphorus release via endogenous respiration. The recycle flows were closely scrutinized to identify changes in operation to reduce the release of phosphorus. Minimizing bottom sludge in the DAFs, minimizing waste-activated sludge holding time, and quickly returning backwash flows to the aeration basins has further enhanced phosphorus removal.

The final optimization step involves the final clarifiers. To reduce secondary release across the filters, the time between backwashes was reduced and chemical addition using alum was provided to the filters.

The combination of the described steps has allowed CCWRD to optimize their treatment facilities with respect to effluent TP at the 110 mgd (169 cfs) capacity. The results of the optimization modifications have resulted in an effluent TP of less than 0.08 mg/L. This is a combination of an ortho-phosphorus concentration of less than 0.02 mg/L and a particulate phosphorus concentration of less than 0.06 mg/L.

No new infrastructure or additional land was necessary to optimize the CCWRD.

No new waste streams would be generated. However, there would be a slight increase in the chemical component of the primary and waste-activated sludge. Based on an increased dosage of approximately 5.0 mg/L of alum, the estimated additional chemical sludge quantities would be approximately 460 lbs/day of additional sludge. The increased disposal cost would be approximately $5,000 per year.

The estimated costs to optimize the CCWRD facilities would be $446,000 per year. The costs would include capital costs in the form of equipment and structural modifications, power costs due to increased aeration, and chemical costs to reduce phosphorus across the primary clarifiers and to trim phosphorus across the filters. Total additional estimated costs would include:

- $126,000 per year for electrical costs;
- $315,000 per year for additional alum; and
- $5,000 per year for additional sludge disposal.

2.1.3 City of Henderson

2.1.3.1 Existing Facilities and Processes

The COH's WWTP has been located on Athens Road just south of the Las Vegas Wash in Henderson, NV since the 1950s. Wastewater Treatment Plants No.1 and No. 3 comprised the original plant. The current COH WRF began operation in 1994. The COH WRF currently occupies 72 acres of the 132 acres owned.

The COH WRF is expanding to increase the annual average capacity to 32 mgd (49 cfs) in order to treat the flows projected through the year 2016. Facility expansions and modifications would occur on lands currently owned by the COH. The treated effluent from the COH WRF is returned to the Las Vegas Wash near the Pabco Road ECS. The COH facility delivered 5.74 mgd (8.8 cfs) of treated reuse water to customers in 2003 (COH 2004).

The existing secondary facilities at the COH WRF are composed of the 24 mgd (37 cfs) WRF train and a new 7.4 mgd (11 cfs) train, based on annual average flow rates. Flow equalization is provided for the entire flow, and the entire facility operates in BNR mode for reduction of nitrogen and phosphorus (Black & Veatch 2004b).

The AWT system treats the clarified secondary effluent for further removal of phosphorus and particulates. The older 22 mgd (34 cfs) (annual average flow) AWT tertiary train includes solids contact clarifiers (SCCs) followed by filters. Each SCC includes a mixing zone, a flocculation center well, and a settling zone, with alum and polymer fed upstream. Deep-bed monomedia sand filters operated in declining rate mode to polish the clarified effluent. The new 7.4 mgd (11 cfs) (annual average flow) supplemental phosphorus removal (SPR) train includes a two-stage rapid mix basin, a three-stage flocculation basin, and a plate settler-aided sedimentation basin, followed by four continuously backwashed filters. Alum and polymer can be fed to either the first or the second stage of the rapid mix basin. The upflow, deep-bed, granular-media filters consist of six 50-square ft (ft^2) modules per cell. Table 2.1-4 summarizes the existing tertiary treatment facilities at the COH WRF (Black & Veatch 2004b).

2.1.3.2 Optimization Facilities and Processes

Optimization of the COH WRF would require reduction of the total solids. This could be accomplished by modifying the existing monomedia filters to dual or multimedia filters and increasing the application of treatment chemicals. This modification would likely require new backwashing equipment to facilitate cleaning of the media. In addition, the existing media, underdrains, and appurtenances within 16 filters would require modifications to optimize the new filters for solids removal.

Additional waste streams would be generated as a result of the additional chemical dosing and higher backwashing rate required. The estimated increase in backwash waste flow is approximately 1 mgd at the design flow of 24 mgd. This is an additional 4 percent of filter throughput. The backwash waste flow would continue to be returned to the system for additional secondary and tertiary treatment.

The annual estimated cost to optimize the COH WRF is unknown. However, it would cost approximately $1.8 million for replacement of underdrains and filter media, and modifications to piping and controls.

Table 2.1-4 City of Henderson Existing Tertiary Treatment Facilities

Unit Operation	No. Units	Size/Dimensions	Total Annual Average Capacity (mgd)	Notes
WRF SCC	4	80-ft diameter, 16-ft Side Water Depth	22	Hydraulic loading rate range = 0.7 to 1.0 gpm/ft^2
WRF Filters	16	225 ft^2 each, 4.6-ft depth	22	Declining rate operation
New two-stage rapid mix basin	1	1,370 cubic ft (cf) per stage	22	Sized for 30 second hydraulic retention time (HRT)/stage at buildout equalized peak day flow of 28.8 mgd
New three-stage floc basin	1	17,780 cf/train	7.4	Sized for 20 minute HRT/train at equalized peak day flow
New plate settler-aided clarifier	1	20,000 ft^2 projected plate area (w/90 percent derating); 1,250 ft^2 basin footprint	7.4	0.37 gpm/ ft^2 projected derated plate area based on maximum month flow
New continuous backwash filters	4	300 ft^2/filter cell; 1,200 ft^2/train	7.4	4.6 gpm/ ft^2 at maximum month flow

Source: Black & Veatch 2004b

2.2 Boulder Islands North Alternative, Preferred Alternative

The Boulder Islands North Alternative includes plant optimization, increased treatment (as needed), and a pipeline that would collect the highly treated effluent discharged from each of the treatment facilities and transport the effluent to an alternate receiving area in the vicinity of the Boulder Islands (Figure 2.2-1). Effluent would be discharged between 120 and 340 ft below the Lake surface, depending on Lake elevation. The discharge would mix rapidly with the surrounding Lake water, and would continue mixing with Lake water as it rises toward the surface and disperses laterally. Additional mixing and dispersion would result from winds blowing on the Lake. Mixing could also be enhanced by controlling the velocity of the discharge, the number and choice of outfall ports, and the division of flow between the pipeline and direct discharge to the Las Vegas Wash. The management of the effluent using these controls would be incorporated into project operations through the Boulder Basin Adaptive Management Plan (AMP), which is described in Section 2.2.2.6. The effluent would be discharged at depth to minimize the loading of phosphorus that reaches the epilimnion and the euphotic zone where there is enough light for algal growth.

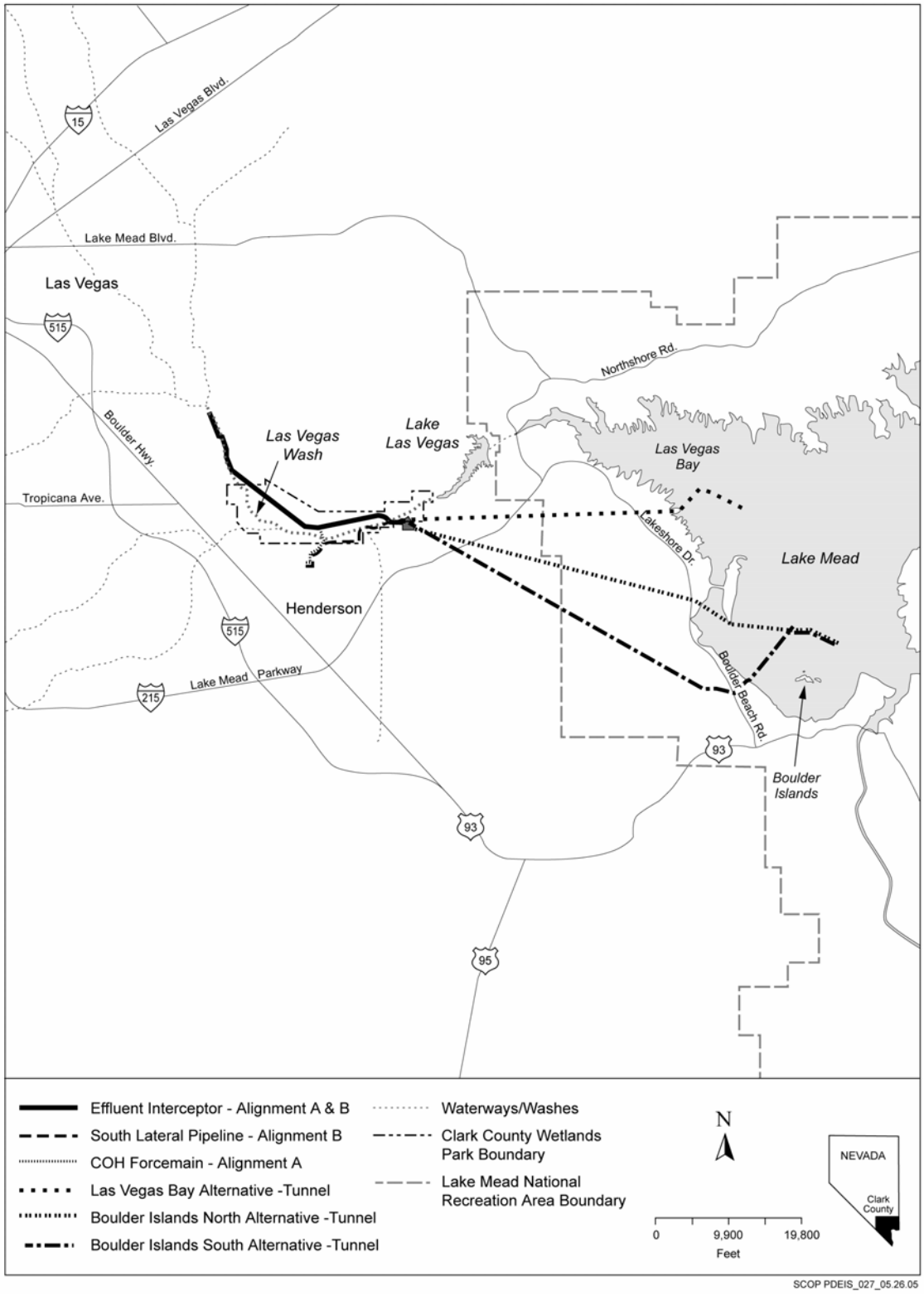


Figure 2.2-1 Alternatives.

Discharge limits for releases near the Boulder Islands would not be subject to the TMDLs, which apply to the flow in the Las Vegas Wash, and in turn protects water quality in the Las Vegas Bay.

The TMDL limits would still apply to Las Vegas Wash discharges. Although the WLAs would not apply to discharges through the Lake Conveyance System (LCS), the TP loading from effluent discharged through the LCS and the Las Vegas Wash into the Boulder Basin would not exceed the current WLA on an average annual basis during ordinary conditions. Although it is difficult to predict if and when extraordinary circumstances may occur, they may arise if regulatory agencies impose requirements that result in increased phosphorus discharges, if an increase results from the achievement of an appropriate environmental benefit, or if reasonable optimization of conventional treatment processes does not consistently achieve the level. In all circumstances, however, the discharge would be regulated by NDEP, who would ensure compliance with all NPDES permit provisions and federal and Nevada water quality requirements.

Current, conventional treatment processes, plant optimization, and increased treatment (as needed) would be used to meet the requirements set by the NDEP through the NPDES permitting program. Current, conventional treatment processes and plant optimization are described in Section 2.1. The Boulder Islands North Alternative is divided into two main pipeline segments, the EI-Alignment A and the Boulder Islands North LCS. In addition, there are ancillary facilities associated with this alternative including connection structures to the treatment plants, a wash return structure at the CCWRD plant, the EI Terminus site, a pressure regulating station (PRS) and hydroelectric power generation facility near the end of the LCS in the vicinity of AMSWTF, Boulder Islands North Diffuser pipeline (BINDP), and a diffuser.

The EI, COH Forcemain, LCS, and related facilities have been designed for year 2050 peak hour flows, which comply with typical design standards. The projected flows are based in part on extrapolations of the flow projections given in the *Needs Assessment Study* (Montgomery Watson 1997b), which covered a 30-year planning period. The flows discharged by the CLV, CCWRD, and COH were projected for an additional 20 years to year 2050 (Table 2.1-1) based on the annual increases indicated in the *Needs Assessment Study*. The projected annual increases in flows were compared with the results of a recently completed population analysis by the Center for Business and Economic Research at UNLV (UNLV 2004) and found to be close in agreement. The flow-rate projections for COH were compared with data from recent plant expansion studies and build-out forecasts. The design capacity of the pipeline includes total flows, reclaimed flows, plus plant discharge flows.

Through collaboration with SNWA, it was determined that the wetlands and riparian vegetation along the upper Las Vegas Wash could be sustained if 30 to 50 mgd (46 to 77 cfs) of effluent flows continue to be discharged to the Las Vegas Wash. Therefore, the EI diversion structures were designed to allow a controlled discharge of 30 to 50 mgd (46 to 77 cfs) to the Las Vegas Wash. The local agencies responsible for water quality management in the Las Vegas Wash have agreed to meet at least once a year and review the need for flow augmentation in the Las Vegas Wash. The SCOP facilities, managed through the Boulder Basin AMP, would be able to accommodate flow adjustments as determined by this management group. The 30 to 50 mgd (46 to 77 cfs) of effluent carried forward in the EIS is for a minimum base flow. Additional

Table 2.2-1 Effluent Interceptor – Alignment A, Total Dimensions of Construction Techniques.

Reach	Length (ft)	Inner Diameter (inches)	Construction Technique	Depth to Invert (ft)
1	7,100	96	Cut-and-Cover	19 – 29
1	420	96	Tunnel	25 – 42
2	13,650	114	Cut-and-Cover	18 – 32
3	11,450	114	Tunnel	128 – 178
COH Forcemain	4,800	54	Cut-and-Cover	11 – 25
COH Forcemain	1,700	54	Tunnel	175

effluent discharged to the Las Vegas Wash considers ecosystem needs and the continuing requirement to meet water quality standards in the Las Vegas Bay and Boulder Basin. The 30 to 50 mgd (46 to 77 cfs) flows would result in a total dissolved solid (TDS) concentration of 2,500 mg/L. One-hundred percent of the effluent flows may be discharged to the Las Vegas Wash during emergencies or maintenance of the pipeline. Regular maintenance at the treatment facilities would be scheduled and coordinated to ensure that all three plants are not discharging 100 percent of their flows to the Las Vegas Wash at the same time.

The Boulder Islands North Alternative would cost approximately $594,363,000 in capital costs and $500,000 per year in O&M costs. The breakdown of capital costs include:

- $23,529,000 for the Reach 1 pipeline and structures;
- $43,170,600 for the Reach 2 pipeline and structures;
- $61,891,500 for the Reach 3 tunnel;
- $10,536,900 for the COH Connection (Las Vegas Wash crossing);
- $26,802,600 for the COH pump station;
- $158,050,800 for the North River Mountains Tunnel No. 3 (NRMT3) including the working shafts;
- $72,852,000 for the hydroelectric/pressure regulating station (HPRS); and
- $197,529,600 for the BINDP.

2.2.1 Effluent Interceptor – Alignment A

The highly treated effluent discharged from the CLV and CCWRD treatment facilities would bypass the Las Vegas Wash via the EI. The COH Forcemain would convey the treated effluent from the COH WRF (Figure 2.2-2). The CLV and CCWRD flows would be combined with the COH flows at the Pabco Connection, and be transported to Lake Mead via the LCS. The

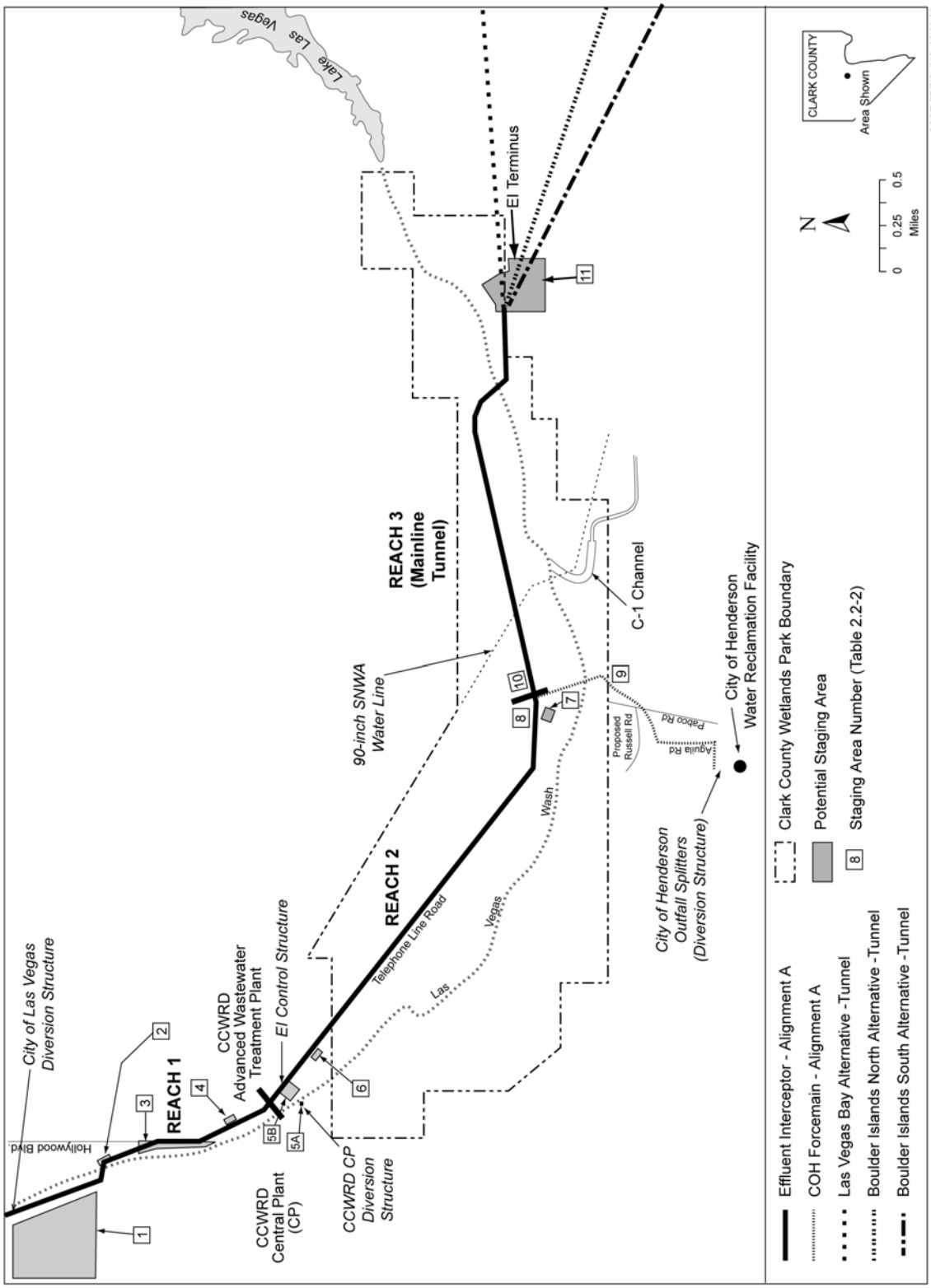


Figure 2.2-2 Effluent Interceptor – Alignment A and Ancillary Facilities.

pipeline, including EI-Alignment A, COH Forcemain, and LCS, would be designed and maintained in a manner that would protect the integrity of the effluent.

The EI-Alignment A portion of this alternative is described in terms of the alignment, ancillary facilities and structures, design flow, construction, and operation. Effluent Interceptor-Alignment A has been divided into three reaches and the COH Forcemain for ease of discussion.

2.2.1.1 Alignment

Information regarding the length, diameter, and construction method to be used for each segment of EI-Alignment A is summarized in Table 2.2-1. Biological and cultural resource surveys were conducted for a 400-ft corridor, 200 ft on either side of the center line, for the linear segments of the EI. The temporary and permanent disturbance would be contained within the surveyed area.

2.2.1.1.1 Reach 1

The CLV effluent would be collected into a 96 inch (244 centimeter [cm]) diameter pipeline that extends in a southeasterly direction to the vicinity of the CCWRD CP and AWT outfall connections (Figure 2.2-2). A combination of cut-and-cover (7,100 ft [2,164 m]) construction and tunneling (420 ft [128 m]) would be used in Reach 1 (Table 2.2-1). Reach 1 of the EI alignment would begin with a connection to the CLV diversion structure. The EI would cross Desert Inn Road then follow the southern boundary of the Desert Inn Road ROW within CLV property continuing to the west bank of the Las Vegas Wash. The EI, using cut-and-cover construction, would follow the west bank of the Las Vegas Wash adjacent to the flood control easement, in a southeasterly direction for approximately 1,500 ft (457 m). A tunnel shaft would be constructed at this location. A 19 to 29 ft (6 to 9 m) deep, 420 ft (128 m) long tunnel would be constructed beginning at this point and would run in an easterly direction under the Las Vegas Wash to the east bank of the Las Vegas Wash. There would be a second tunnel shaft at this location. From this point to Hollywood Boulevard, the pipeline would be installed using cut-and-cover construction, following the east bank of the Las Vegas Wash in a southeasterly direction, adjacent to the flood control easement. The EI would continue in a southerly direction along the western edge of Hollywood Boulevard to the southern edge of Telephone Line Road (Figure 2.2-2). The EI would continue in a southeasterly direction along Telephone Line Road, within CCWRD property, to the EI Control Structure.

The West Working Pit, approximately 40 x 25 ft (12 x 8 m), would be located at staging area 8A on CLV property, which would be used as a temporary construction staging area. The staging area for the 25 x 25 ft (8 x 8 m) East Retrieval Pit would be contained within a 70 ft (21 m) wide pipeline easement and staging area 5B adjacent to the Woodside Homes development. Spoils excavated from the working pit would be hauled by truck to a designated disposal area. The trucks would travel north along the temporary construction easement to Desert Inn Road.

2.2.1.1.2 Reach 2

Reach 2 of EI-Alignment A conveys the combined CLV and CCWRD effluent in a 114 inch (290 cm) diameter pipeline, approximately 13,650 ft (4,161 m) long, beginning 100 ft (30 m)

Table 2.2-2 Staging Areas (EI – Alignment A).

Staging Area	Property	Area
EI-Alignment A Reach 1		
1	CLV property – Directly south of WPCF	37 ac [1]
2	Las Vegas Wash Crossing – East Shaft	0.6 ac
3	CLV Property – Adjacent to Hollywood Boulevard	6.4 ac
4	CCWRD Property	0.7 ac
CCWRD CP & AWT Connection		
5A	CCWRD Property – Near CP Outfall	50 ft x 50 ft
5B	CCWRD Property – Near EI Control Structure and AWT	6.3 ac
EI-Alignment A Reach 2		
6	CCWRD Property – Just North of Wetlands Park Boundary	1.4 ac
7	Clark County Parks and Community Services property – Northwest of Pabco Road ECS [2]	1.1 ac
8	North Side of Pabco Road ECS	3.7 ac
COH Forcemain		
9	Tunnel Shaft South Side of Pabco Road ECS	3.7 ac
10	Located at North Side of Pabco Road ECS	3.7 ac
EI-Alignment A Reach 3 [3]		
11	Reclamation Property – (EI Terminus) East Shaft Staging Area and Terminus	40 ac

Notes:
[1] ac = acre.
[2] Erosion Control Structure.
[3] Reach 3 Tunnel starts at north side of Pabco Road ECS.

northwest of the EI Control Structure located near the entrance to the CCWRD AWT plant (Figure 2.2-2). Effluent Interceptor-Alignment A then follows the south edge of Telephone Line Road in a southeasterly direction to a point north of the Pabco Road ECS. Effluent Interceptor-Alignment A would connect with the Mainline Tunnel shaft for Reach 3 at this point (Figure 2.2-2). The staging areas for Reach 2 are shown on Figure 2.2-2. The staging areas shown correspond to the areas listed in Table 2.2-2. A 175 ft (53 m) wide construction easement

would be required for Reach 2. The majority of EI-Alignment A within Reach 2 would be installed using cut-and-cover construction.

The tunneling methods and spoils removal would be the same as described for the tunneling activities in Reach 1.

2.2.1.1.3 Reach 3

Reach 3 of EI-Alignment A begins on the north side of the Las Vegas Wash at the Pabco Road ECS with a tunnel shaft approximately 175 ft (53 m) deep and continues southeasterly for approximately 11,450 ft (3,490 m) terminating on the south side of the Las Vegas Wash at the EI Terminus site (Figure 2.2-2). The working shaft, located at the EI Terminus site, would be 30 ft (9 m) in diameter and approximately 170 ft (52 m) deep. The retrieval shaft would be located at staging area 10 adjacent to the end of Reach 2 and would have a 20 ft (6 m) diameter and 175 ft (53 m) depth.

The staging area at the working shaft/EI Terminus site is approximately 40 acres (17 hectares). The staging area at the retrieval shaft on the north side of the Las Vegas Wash would be approximately 3.7 acres (1.5 hectares) (Table 2.2-2). Spoils would be excavated from the working shaft and hauled by truck to a disposal site using the existing roadway system.

2.2.1.1.4 COH Forcemain

The COH WRF effluent would be conveyed to the EI via the COH Forcemain, which would consist of a 4,800 ft (1,463 m) long, 54 inch (137 cm) diameter pipe that begins at the WRF new effluent pump station and ends at the EI connection (Figure 2.2-2). The majority of the COH Forcemain would be installed using cut-and-cover construction. The COH Forcemain alignment crosses the WRF plant site to Aguila Road, heads north along Aguila Road, and crosses the Las Vegas Wash via a 175 ft (53 m) deep tunnel.

2.2.1.2 Ancillary Facilities and Structures

Ancillary facilities and structures for EI-Alignment A would be required for the operation and maintenance (O&M) of the SCOP pipeline. The descriptions of the EI-Alignment A ancillary facilities and structures follow.

2.2.1.2.1 Connection Facilities

Connection facilities are required to link the effluent flows from the treatment facilities to the EI.

City of Las Vegas Connection

The CLV connection structure would have the capability to send from 0 to 100 percent of the CLV flow to the Las Vegas Wash or the EI. The CLV connection structure would consist of a diversion structure, located within the CLV outfall channel immediately downstream from the existing long-throated Parshall flume, would divert the CLV WPCF discharges into Reach 1 of

the EI, or return the flow to the Las Vegas Wash. The diversion structure would be protected by a floodwall.

Clark County Water Reclamation District Connection

The CCWRD connection would consist of a CP diversion structure, AWT connection, EI control structure, and wash return structure (Figure 2.2-2). The existing CP outfall would be modified to include the CP diversion structure, which would be located on CCWRD property on the west side of the Las Vegas Wash. The diversion structure would have the capability to send from 0 to 100 percent of the CP flow to the Las Vegas Wash or the EI.

The pipeline connecting the CP diversion structure to the EI control structure would consist of a 450 ft (137 m) long tunnel (with an inside diameter of 96 inches [244 cm]) under the Las Vegas Wash, and a 220 ft (67 m) long pipeline constructed by the cut-and-cover method. Effluent flows from the AWT would be conveyed to the EI control structure via a 66 inch (167 cm) diameter pipe connection into the existing AWT outfall pipe.

The EI control structure, which serves as the junction structure for the flows from the CLV WPCF and the CCWRD CP and AWT, consists of the inlets from the three treatment plants and two outlets leading to the EI Reach 2 pipeline and the wash return structure. The wash return structure would be used to convey the overflow from the EI control structure to the Las Vegas Wash and prevent the water in the Las Vegas Wash from entering the EI during a flood event.

City of Henderson Connection

The COH Forcemain would begin at a new COH effluent pump station located north of the new final clarifiers (under construction) on the COH WRF site. The effluent pump station would have an overflow diversion weir to allow flow to bypass the pump station to the outfall splitter structure. The outfall splitter structure would allow from 0 to 100 percent of the COH WRF flow to be diverted to the Las Vegas Wash, via the COH's existing Las Vegas Wash outfall (Figure 2.2-2).

One of the COH's existing outfall structures and outfall channel would have to be modified to accommodate COH 2050 peak hour flows. The COH outfall channel would be widened to minimize velocities and reduce scour before entering the Las Vegas Wash. Riprap armoring would be installed along the bottom and sides of the channel for its entire length.

2.2.1.2.2 Effluent Interceptor Terminus

The EI Terminus is the transition point between the EI and the LCS (to Boulder Islands or Las Vegas Bay). The EI Terminus site is located about 1 mile (2 km) southwest of Lake Las Vegas on the south bank of the Las Vegas Wash at Township 21 South, Range 63 East, Section 28 M.D.M. (Figure 1.1-1). All temporary and permanent disturbance associated with the EI Reach 3 tunnel shaft and portal area; the NRMT3 shaft and portal area; and any structures associated with the EI Terminus, including a staging area, would be located within the 40-acre (16 hectares) EI Terminus site, located on land owned by Reclamation. An access portal (manhole) would be the only permanent structure located at the EI Terminus site (Figure 2.2-3).

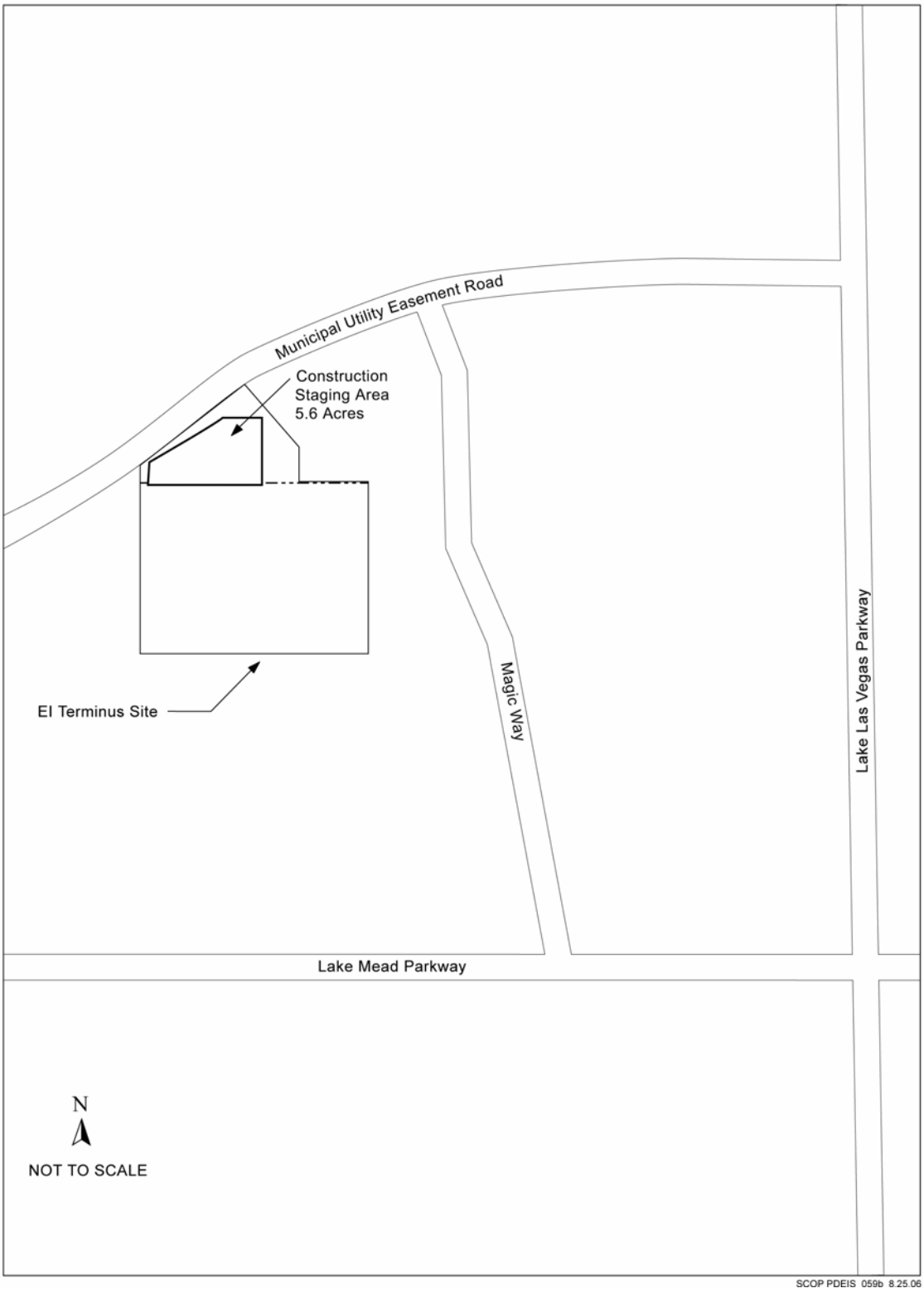


Figure 2.2-3 Effluent Interceptor-Alignment A Terminus Facility.

Access to the EI Terminus site would be provided by an existing municipal road accessible from Magic Way.

2.2.1.2.3 Manholes

Access manholes would be necessary to enter the pipeline for inspection or maintenance. An access manhole includes pipeline access, and a manhole or vault with ground-level access and cover. Along the EI pipeline, access manholes would be located at approximately every 2,000 ft (610 m). The manhole would be 30 inches (76 cm) in diameter and would be located at bends, transitions, and bifurcations along the alignment.

2.2.1.2.4 Maintenance and Access Roads

Access to the EI and ancillary facilities must be available at all times for inspection, maintenance, and emergencies. General construction, operation, and maintenance access to the project area would be via the major highways in the area, which include U.S. highways 95 (US 95), 93 (US 93), and 515 (US 515), Boulder Highway, and Lake Mead Parkway. The EI and COH Forcemain would be accessible by lesser roads such as Desert Inn Road, Hollywood Boulevard, Telephone Line Road, Pabco Road, Olson Street/Sunset Road, Magic Way, and Russell Road (Figure 2.2-4).

2.2.1.3 Land Requirements

A width of 175 ft (53 m) was used to calculate the total land area required for the EI temporary construction easement. A width of 125 ft (38 m) was used to calculate the total land area required for the COH Forcemain temporary construction easement. The permanent easement widths required for the EI reaches and COH Forcemain are:

- 80 ft (24 m) for Reach 1,
- 110 ft (34 m) for Reach 2,
- 40 ft (12 m) for Reach 3 (subsurface easement), and
- 50 ft (15 m) for the COH Forcemain.

Although it is anticipated that the majority of the excavated material and pipe material would be stored within the 175 ft (53 m) temporary construction easement, additional area would be required for material and equipment storage (Table 2.2-2). The sites being considered as construction staging areas would be located adjacent to the EI and COH Forcemain (Figure 2.2-2). The siting of the staging areas on these lands minimizes the amount of new disturbance to federal lands.

Table 2.2-2 lists properties that appear to be suitable for use as staging areas, based on their location and current land use. The staging-area numbers correlate with the identifier numbers presented on Figure 2.2-2.

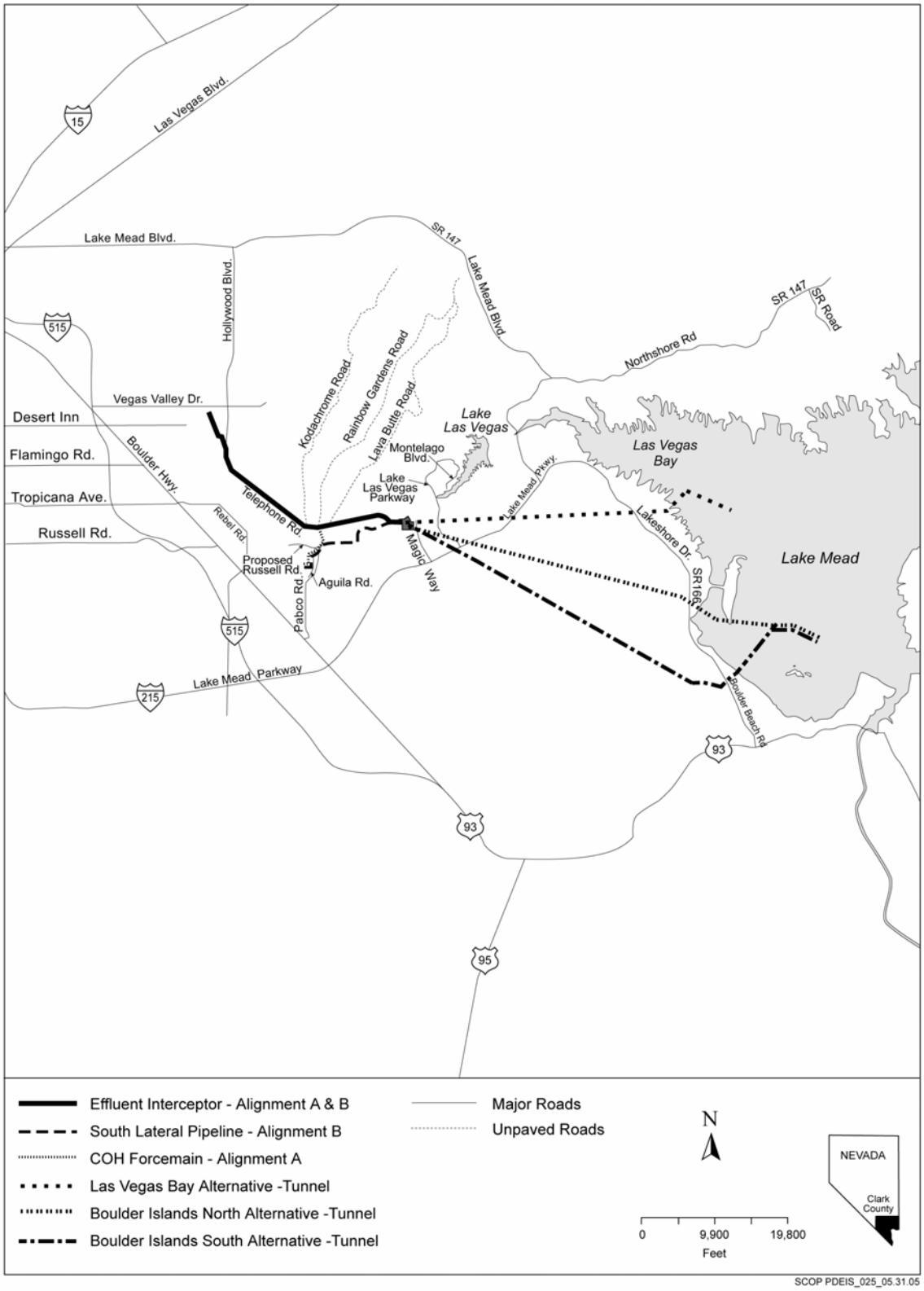


Figure 2.2-4 Maintenance and Access Roads.

2.2.1.4 Construction

Construction of the EI-Alignment A would take approximately 28 months. The only location that would require work in the Las Vegas Wash would be at the CCWRD wash return structure. All other proposed Las Vegas Wash crossings would be via tunnels. The two major construction techniques for the pipeline installation would include cut-and-cover and tunneling. Cut-and-cover construction is comprised of heavy excavation equipment trenching along the alignment and laying pipe to a specified slope.

Project construction activities would include:

- Earthwork including clearing, grading, grubbing, embankment construction, trench excavation, tunneling, fill, and erosion control activities;
- Removal or relocation of existing facilities;
- Structure construction (baffle structures, reservoirs, and control structures);
- Existing traffic maintenance during construction;
- Dust abatement;
- Wildlife fencing, security fencing, and gates;
- Cross-drainage culverts;
- Signing and lighting; and
- Landscaping and seeding.

Equipment to be used during the construction activities includes:

- Scrapers,
- Trenchers,
- Dozers,
- Haul Trucks,
- Dump Trucks,
- Water Trucks,
- Tunnel Boring Machines,
- Graders,
- Front-end Loaders,
- Backhoes,
- Cranes, and
- Flat-bed Trucks.

Techniques: Trench excavation (cut and cover) would be the method of pipe installation for parts of the pipeline alignment. Tunneling would be required on reaches that cross the Las Vegas Wash, typically in the manner of a standard jacking operation for the shorter reaches and shallower depths.

Cut and Cover: Cut-and-Cover construction is comprised of heavy excavators trenching along the alignment and laying pipe to a specified slope. The depth of the trench would vary from 11 to 32 ft (3 to 10 m), depending on the natural topography of the alignment and the reach of pipe. Reach 1 between the CLV facility and the CCWRD facility may require dewatering operations, due to the presence of groundwater, during the construction of the pipeline. Portions along Reach 3 may also require dewatering in areas near the Las Vegas Wash and at the EI Terminus location due to the depth of the structure. Table 2.2-1 summarizes the construction method to be used for each segment of the EI and COH Forcemain.

Tunneling: Tunneling would be required at all Las Vegas Wash crossings and at major utility crossings to limit direct impacts to the Las Vegas Wash and major utilities. The CWC would coordinate with the SNWA and other utility organizations to ensure that the EI does not impact any SNWA waterlines or other utilities. Tunneling would be required at the locations listed in Table 2.2-1.

2.2.1.5 Spoils and Materials

The top 6 inches (15 cm) of surface material would be stockpiled separately from other excavated material at the staging areas, and would be used as seedbed after final grading. It is assumed that the majority of the excavated material would be used as trench backfill or during final grading. The amount of excess material excavated from EI-Alignment A is shown on Table 2.2-3. It would be necessary to import backfill material, which would be stored along the trench. The backfill material would be obtained from a commercially available source. The procurement of this material would be part of the construction activities performed by the construction contractor**.** The pipe would be strung along the trench on top of the imported trench backfill material. The average volume of imported backfill that would be required for the cut-and-cover portions of EI-Alignment A are shown on Table 2.2-3.

This excess material would be used for other projects or hauled off to the nearest landfill. The number of truckloads required to haul the excess materials and deliver the backfill material is shown on Table 2.2-3.

Table 2.2-3 Spoils Generated and Backfill Material Required for the EI – Alignment A.

Segment	Spoils/Muck (cubic yards)	Backfill (cubic yards)	Truckloads [1]
Cut-and-Cover	355,000	31 – 60	17,750
Tunneling	72,000	--	3,600
Total	427,000	31 – 60	21,350

Note:
[1] Assumes 20 cubic yards per truckload.

2.2.1.6 Operation of the Effluent Interceptor – Alignment A

Effluent Interceptor-Alignment A would be designed to allow maximum flexibility for management of effluent flows. The EI and the associated treatment plant connections would be designed to allow from 0 to 100 percent of the plants' flows to the Las Vegas Wash or the EI. Control points for the system would be located at the three treatment plants. One-hundred percent of the effluent flows may be discharged to the Las Vegas Wash during emergencies or maintenance of the pipeline. Regular maintenance at the treatment facilities would be scheduled and coordinated to ensure that all three plants are not discharging 100 percent of their flows to the Las Vegas Wash at the same time. The CLV and CCWRD flows would be combined with the COH flows by the COH Forcemain and be transported to Lake Mead via the LCS.

The O&M of the EI would be managed by the CWC in coordination with the member agencies and the Management Advisory Committee. A minimum of 30 mgd (46 cfs) of treated effluent would be discharged to the Las Vegas Wash year round. Together with the 20 mgd (31 cfs) of base flow, the total flow in the Las Vegas Wash is expected to be at least 50 mgd (77 cfs).

As part of the pipeline alternatives, a Boulder Basin AMP would be designed and implemented. The Boulder Basin AMP, which is described in Section 2.2.2.6, would include operation of the EI relating to the quantity of effluent delivery to the Las Vegas Wash, EI, and LCS.

2.2.2 Lake Conveyance System, Boulder Islands North

The Boulder Islands North LCS would convey the combined effluent flows from the three treatment facilities to a discharge location near the Boulder Islands in Lake Mead (Figure 2.2-1). The Boulder Islands North LCS is described in terms of the alignment, ancillary facilities and structures, land requirements, construction, and spoils and backfill materials.

2.2.2.1 Alignment

The Boulder Islands North LCS alignment would begin at the EI Terminus, which is the transition point between the EI and LCS, and end northeast of the Boulder Islands as shown on Figure 2.2-5. All temporary and permanent disturbance would be located within the 40-acre (16 hectares) EI Terminus site, located on land owned by Reclamation. The pipeline would be designed to allow extension of the pipe if needed, based on changing lake conditions. The Boulder Islands North LCS alignment is divided into two segments consisting of the NRMT3 and the BINDP.

2.2.2.1.1 North River Mountains Tunnel No. 3

The NRMT3 would begin at the NRMT3-West working shaft located at the EI Terminus and would proceed in a southeasterly direction for approximately 39,000 ft (11,887 m) to the NRMT3-East working shaft located on NPS land (Figure 2.2-5). The NRMT3 would be drilled through competent bedrock and would pass beneath property owned by Reclamation, BLM, Lake Las Vegas Golf Course, Three Kids Mine, and NPS. The NRMT3-West working shaft would be approximately 70 ft (21 m) deep. The activities for the western segment of the NRMT3 would be

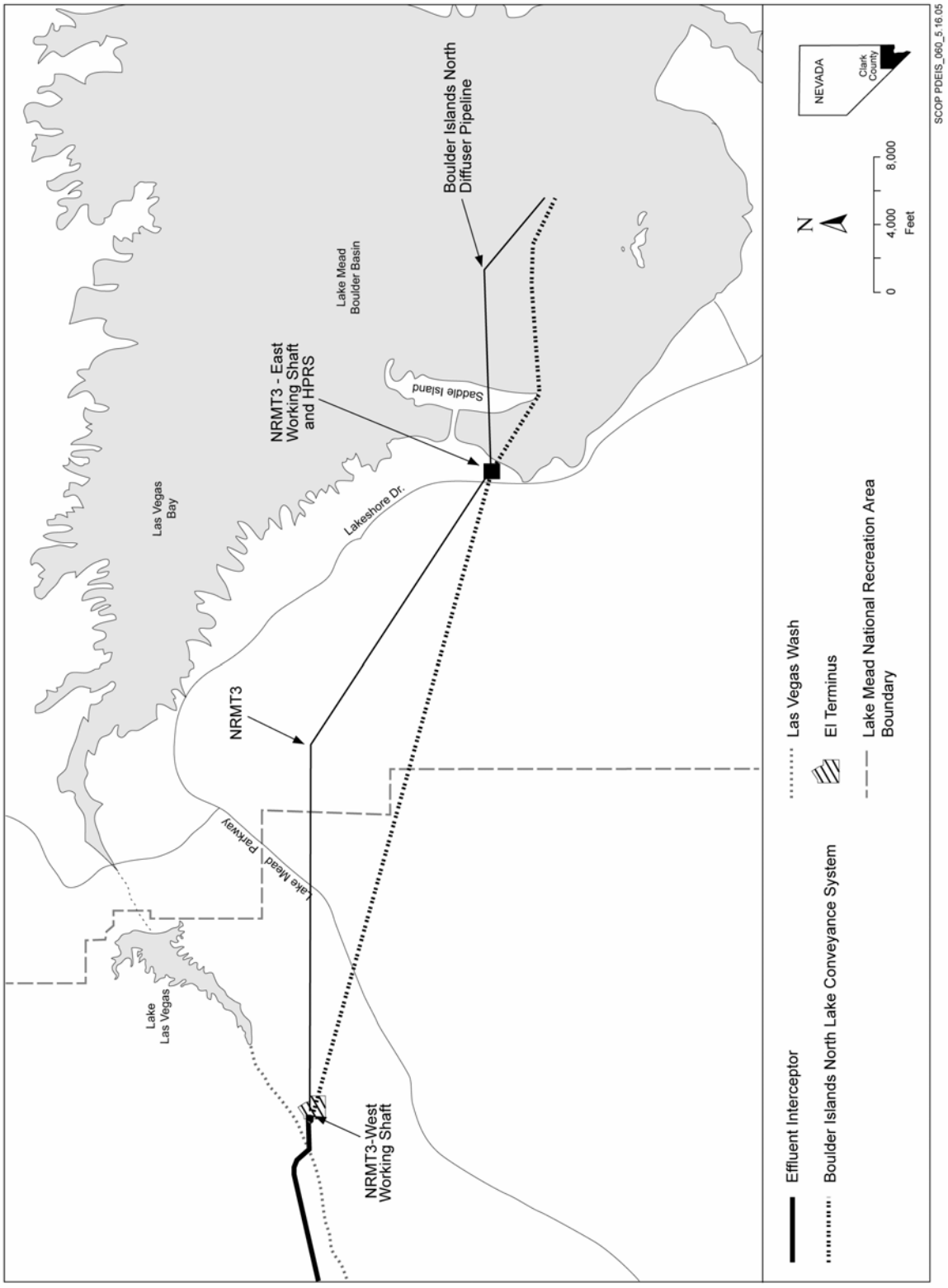


Figure 2.2-5 Boulder Islands North Lake Conveyance System.

staged at the EI Terminus site. The NRMT3-East working shaft would be approximately 60 ft (18 m) deep. The activities for the eastern segment of the NRMT3 would be staged at the NRMT3-East working shaft location. All temporary and permanent disturbance associated with the tunnel shaft, portal area, and HPRS would be located within the 5-acre (2-hectares) site, located on land owned by the NPS. Electrical power and water would be provided to the shafts by using existing roads and utility corridors (Figures 2.2-6 and 2.2-7).

2.2.2.1.2 Boulder Islands North Diffuser Pipeline

The BINDP would be installed using cut-and-cover, dredged, and subaqueous construction techniques. The BINDP would be approximately 28,400 ft (8,656 m) long. The BINDP would start at the HPRS located at the NRMT3-East shaft area and would consist of a series of pipelines installed using a cut-and-cover method to the water line of Lake Mead. At the water line, a dredging construction technique would begin and continue to the lake bottom elevation of 1,000 ft (305 m), at which point subaqueous construction would be used to the diffuser location. The diffuser would be located northeast of the Boulder Islands at an elevation of 880 ft (268 m). The cut-and-cover section is approximately 6,600 ft (2,012 m), the dredged section is approximately 5,300 ft (1,615 m), and the subaqueous section is approximately 16,500 ft (5,029 m) in length.

The cut-and-cover pipeline would be installed in a trench approximately 20 ft (6 m) deep with a minimum cover of 8 ft (3 m). Biological and cultural resource surveys were conducted for a 400-ft corridor, 200 ft on either side of the center line, for the cut-and-cover segment of the BINDP. The temporary and permanent disturbance would be contained within the surveyed area. The dredged pipeline would be installed in an underwater trench 55 ft (17 m) wide with a minimum cover of 6 ft (3 m). The subaqueous pipeline would be installed on pylons anchored to the bottom of Lake Mead. The pipeline would be designed to allow extension of the pipe if needed, based on changing lake conditions.

2.2.2.2 Ancillary Facilities and Structures

Ancillary facilities and structures for the Boulder Islands North LCS would be required for the O&M of the pipeline. The Boulder Islands North LCS ancillary facilities and structures are described in this section.

2.2.2.2.1 Hydroelectric / Pressure Regulating Station

An HPRS would be constructed at the NRMT3-East working shaft location to reduce the internal pressure in the pipeline before discharging to Lake Mead. In addition to reducing the pressure in the pipeline, power would be generated and delivered to the AMSWTF via an underground transmission line. The transmission line alignment is shown on Figure 2.2-7. The HPRS would begin generating power immediately following infrastructure construction. The projected 2050 flows would generate approximately 10 to 15 megawatts (mW) of hydroelectric power. The HPRS would be constructed at an elevation of approximately 1,275 ft (388 m), which is above the historical high water level of Lake Mead. Operation of the HPRS would not be dependent on the Lake level. The location of the HPRS is shown on Figure 2.2-6. The HPRS would be

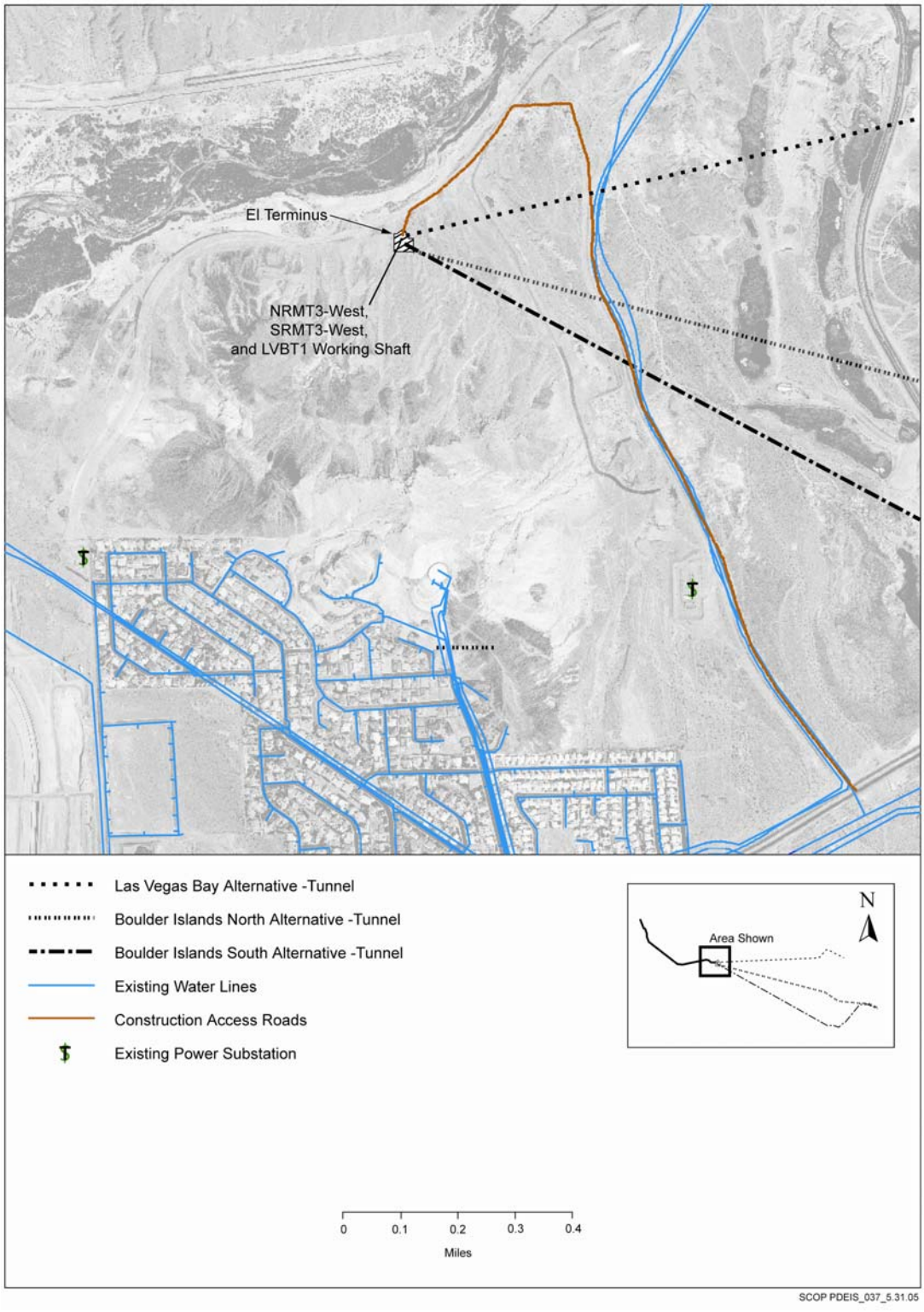


Figure 2.2-6 NRMT3-West, SRMT3-West, and LVBT1 Working Shaft.

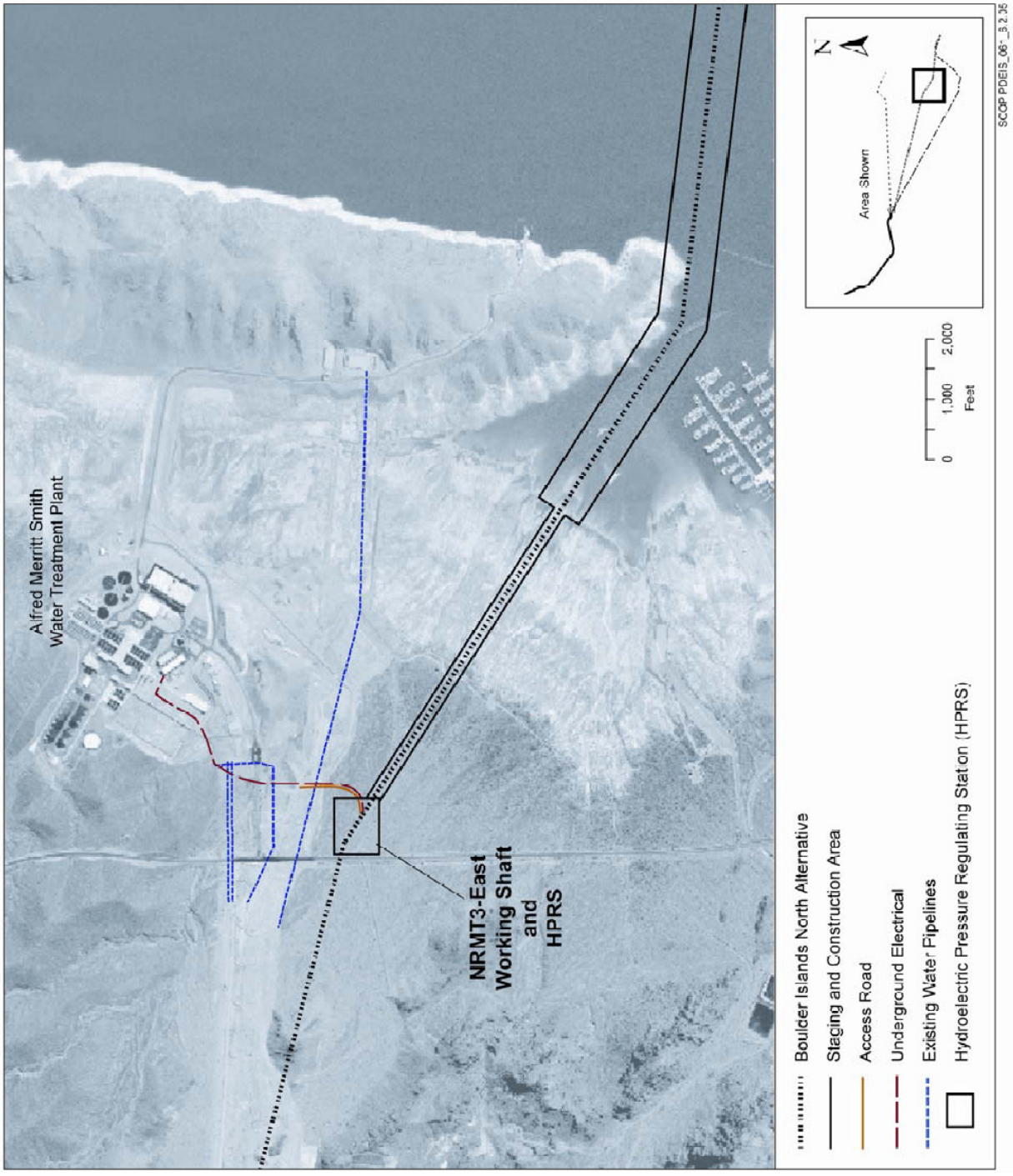


Figure 2.2-7 NRMT3-East Working Shaft and Hydroelectric/Pressure Regulating Station.

constructed in a partially below-grade structure with an earthened cover and surrounding berm to shield the structure from LMNRA visitors. All temporary and permanent disturbance associated with the HPRS would be located within the 5-acre (2-hectares) site, located on land owned by the NPS. The permanent footprint of the below-grade structure would be less than 1 acre (0.4 hectare). Electric power and potable water would be provided via existing power and water lines (Figure 2.2-7).

2.2.2.2.2 Maintenance and Access Roads

General construction, operation, and maintenance access to the Boulder Islands North alignment and shaft locations would be via the major highways in the area, which include US 95, US 93, US 515, Lake Mead Parkway, and Lakeshore Drive (Figure 2.2-5). The working shafts and HPRS would be accessible by existing unpaved roads that provide adequate vehicle access to the shaft locations (Figures 2.2-4, 2.2-6, and 2.2-7). Many of the roads that would be used for access to the various project sites are unnamed, unpaved roads. The unpaved road that would primarily be used for access to the NRMT3-East working shaft is an access road near the entrance to the AMSWTF site.

2.2.2.2.3 Diffuser

The outlet of the LCS would consist of a single port diffuser from each of the pipelines. The subaqueous pipeline would consist of a series of High Density Polyethylene (HDPE) pipes with the diffuser at the end of these pipes. The diffuser ports would be located within Lake Mead and anchored to the Lake bottom at an elevation of approximately 880 ft (268 m). The diffuser would be located approximately 4,200 ft (1,280 m) and 1,500 ft (457 m) from the nearest Boulder Islands shoreline when Lake levels are at 1,178 ft (359 m) and 1,000 ft (305 m), respectively. The velocity and rate of flow through the ports would be controlled from the HPRS. The ports would be oriented to allow a horizontal or slightly downward discharge.

The final configuration of the diffuser would be determined as part of final design. Current modeling indicates that the effluent discharged from the diffuser would have significant thermal buoyancy. This buoyancy would cause the effluent to rise above the elevation of the drinking water intakes. Preliminary and final design would include modeling of the diffuser operations. The modeling would consider changing Lake conditions.

2.2.2.3 Land Requirements

A permanent subsurface utility easement approximately 40 ft (12 m) wide would be needed along the entire tunnel section of the Boulder Islands North LCS. In addition, the NRMT3-East working shaft would require approximately 5 acres (2 hectares) for temporary construction activities. After completion of construction activities, a permanent easement of 300 x 300 ft (91 x 91 m) at the working shafts would be needed.

The BINDP segment of the alignment would require a 1,000 ft (305 m) wide temporary construction easement to provide adequate working area for equipment, pipe, and trench spoils.

A 150 ft (48 m) wide permanent easement would be needed once construction activities are complete.

2.2.2.4 Construction

Construction activities, durations, and types of equipment needed for each segment of the Boulder Islands North LCS are presented in Table 2.2-4. The various segments of the Boulder Islands North LCS would be constructed concurrently.

Employment under the Boulder Islands North Alternative would consist of approximately 8,906 workers each year from 2007 until 2009. Once the EI is constructed, the number of workers needed would be lowered to approximately 7,662 workers. However, in 2012, the total number of workers would increase to approximately 7,813 workers when construction of the hydroelectric power generation facility would be constructed. The number of workers required each year does not reflect an additional 8,906, 7,662, and 7,813 people per year, rather it is expected that this is the total level of employment required per year to sustain the construction, construction support, and other commercial growth rate. Many employees would retain their employment year after year.

Construction equipment and materials for each segment of the alignment would be hauled to the appropriate working shaft site or staging area. The types of materials and equipment that would be delivered are shown on Table 2.2-5. The number of trucks that would deliver the materials and equipment is also shown on Table 2.2-5.

Construction activities and equipment for the BINDP would be similar to those described for the EI. Construction of the BINDP would be limited to the 6-month time frames between October and March of each year. Thus, this segment of the alignment would require 2 or 3 years to complete with construction occurring only during the specified 6-month time frames.

Construction activities and equipment for the BINDP are different than for the other segments of the alignment as shown on Table 2.2-4. The launching of equipment and materials for the diffuser pipeline section of the alignment would occur from two barges. A floating dock would be mobilized to allow trucks to back onto the dock and be loaded with spoils dredged from the floor of Lake Mead. Dredging would be conducted using a clamshell dredge, which consists of a large barge-mounted crane equipped with a clamshell bucket and stabilizing spuds. The project would also require two transfer barges, a small tug or work boat, a second shore-based crane with a smooth-jawed (i.e., no teeth) bucket or large backhoe with a smooth bucket to unload the transfer barges to trucks for transport to the spoil area. The transfer barges would be smaller than the crane barge and consist of a sealed water-tight hull with raised perforated sides to contain dredged spoils as they are deposited onto the barge by the clamshell. Sufficient spoil material would be stockpiled in the designated temporary spoil area for backfilling the trench after the pipeline is laid. Small quantities of fuel would be transported by boat to equipment residing on the barges. Fuel would not be stored on site.

A turbidity curtain would be installed in the areas that require dredging and around the diffuser location. The type of turbidity curtain to be used during dredging activities would be selected in coordination with the CWC, SNWA, NPS, and other agencies to ensure that the curtain performs

as needed. It is premature to provide details regarding the turbidity curtain at this time. However, the curtains would be a permeable geotextile fabric that is suspended from buoys floating on the surface of the Lake. Divers would anchor the curtain with weights to secure it to the Lake bottom. The curtain would isolate silt within the curtain perimeter and minimize silt spread outside the dredging areas. An approximate 1,000 ft (305 m) wide section in the Lake would be encompassed by the turbidity curtain at each location to allow room for the dredging support equipment and barges to maneuver. The 1,000 ft (305 m) sections would include paralleling the pipeline (500 ft [152 m] on each side of the centerline) during dredging activities,

Table 2.2-4 Construction Activities, Duration, and Equipment for the Boulder Islands North Lake Conveyance System.

Segment	Construction Activities	Construction Duration (months)	Equipment
North River Mountains Tunnel No. 3 – West (NRMT3-West)	• Mobilization (material and equipment delivery) • Shaft excavation and blasting • Tunnel excavation • Tunnel lining and grouting • Final shaft lining • Connection to EI	35	• Cranes • Muck-loading equipment • Drills • Compressors • Trucks • Dozers • Graders • Backhoes • Construction trailers • Tunnel-boring machine
North River Mountains Tunnel No. 3 – East (NRMT3-East)	• Mobilization (material and equipment delivery) • Shaft excavation and blasting • Tunnel excavation • Tunnel lining and grouting • Final shaft lining	67	Same as NRMT3 – West
Boulder Islands North Diffuser Pipeline (BINDP)	• Mobilization • Dredging • Subaqueous pipeline construction	31[1]	• Barges • Barge-based cranes • Clamshell dredge • Tug or workboat • Turbidity curtain • Shore-based crane • Backhoe • Dozer • Trucks

Note:
[1] Six month time frame from October to March.

Table 2.2-5 Material and Equipment Deliveries for the Boulder Islands North Lake Conveyance System.

Segment	Material & Equipment	Duration	Truckloads
NRMT3-West	• Equipment - Miscellaneous - Construction trailers	• 3 months • Once during mobilization and once during demobilization	• 20 per day • 10 (delivered then retrieved)
	• Materials - Pipe - Shaft lining and backfill - Grout - Pipe and Pipe embedment materials for connection to EI (at EI Terminus)	• 35 months • 3 months • 12 months • 31 months	• 20 per day • 50 per day • 50 per day • 50 per day
NRMT3-East	• Equipment - Miscellaneous - Construction trailers	• 3 months • Once during mobilization and once during demobilization	• 20 per day • 10 (delivered then retrieved)
	• Materials - Pipe - Shaft lining and backfill - Grout - Pipe and Pipe embedment materials for connection to Boulder Islands Outfall Pipeline	• 35 months • 3 months • 12 months • 31 months	• 20 per day • 50 per day • 50 per day • 50 per day
BINDP	• Equipment - Miscellaneous • Materials - Pipe	• 3 months • 31 months	• 20 per day • 50 per day

and approximately 200 ft (61 m) downstream of where dredging along the pipeline alignment would cease. The curtain would be removed following each construction season.

The subaqueous and dredged pipelines would be constructed of multiple HDPE that are fused onshore, floated into position by barges and slowly filled and allowed to sink to the bottom of Lake Mead. The dredging equipment would be staged off barges and the pipeline lowered into the dredged trench.

2.2.2.5 Spoils and Backfill Materials

The majority of the material that would be excavated from the Boulder Islands North LCS is considered "public minerals" with respect to subsurface rights on federal lands. The excess spoils may be used for public projects such as dust control on federal lands or construction materials for roadways, flood control facilities, or other public projects. The amount of spoils generated from each segment of the Boulder Islands North LCS is shown on Table 2.2-6.

The tunnel spoils would be 2 to 6 inches (5 to 15 cm) or less in size. The spoils would be used for public purposes and spoils would be hauled by truck from the working shafts via the haul routes shown on Figure 2.2-7.

Table 2.2-6. Spoils Removed for the Boulder Islands North Lake Conveyance System.

Segment	Spoils Removed (cubic yards)	Backfill / Grout (cubic yards) [1]	Truckloads [2]
NRMT3-West and Tunnel	154,000	20,400	8,720
NRMT3-East and Tunnel	154,000	20,400	8,720
BINDP	9,500	n/a	475
Total	317,500	40,800	17,915

Notes:

[1] The BINDP requires no hauling from off-site location, backfill processed within construction easements.

[2] Approximate truckloads, depending upon the contractor's choice of rock hauling trailers, this table assumes 20 cubic yards per truckload. Backfill/Grout was estimated at 20 cubic yards per truck load.

2.2.2.6 Operation of the Boulder Islands North Lake Conveyance System

The Boulder Islands North LCS would be designed to allow maximum flexibility for management of effluent flows. Flows to the LCS would be directed and controlled at the HPRS, which would be located as shown on Figure 2.2-7.

The hydroelectric generation station would likely have two turbines, designed to recover electric power while decreasing the pressure in the LCS. The construction for the hydroelectric units would be staged to match the increased flows over the years of the project. The overall building size and locations of pipe connections for the hydroelectric units would be determined in the initial phase of construction. In the event of a power loss, the gates on the turbines would close and the PRS sleeve valves would open to keep the LCS in operation.

Downstream of the HPRS, the flows would be directed to multiple pipelines that discharge into Lake Mead. Each pipeline would end in a single diffuser port. The diffuser ports would be located within Lake Mead and anchored to the Lake bottom at an elevation of approximately 880 ft (268 m). The velocity and rate of flow through the ports would be controlled from the PRS. The ports would discharge the flow in a horizontal or slightly downward direction. The Lake conditions and flows would determine the operation and orientation of these ports.

Discharges in the vicinity of the Boulder Islands would be subject to NPDES permitting requirements established by NDEP. The NDEP has taken an active role in protecting water quality and regulating wastewater discharges into Lake Mead, and will continue to do so. The NDEP has been particularly interested in phosphorus loading and chlorophyll concentrations in Lake Mead. The NDEP implemented a TMDL program including WLAs for phosphorus (334 lbs/day) and ammonia (970 lbs/day) discharged into the Las Vegas Wash in the 1980s. Although these WLAs would not apply to discharges through the LCS, the TP loading from effluent discharged through the LCS and the Las Vegas Wash into the Boulder Basin would not exceed the current WLA on an average annual basis during ordinary conditions. Although it is difficult to predict if and when extraordinary circumstances may occur, they may arise if regulatory agencies impose requirements that result in increased phosphorus discharges that result in an appropriate environmental benefit. In all circumstances, however, the discharge would be regulated by NDEP, who would ensure compliance with all NPDES permit provisions and federal and Nevada water quality requirements.

In addition, as part of the Boulder Islands North Alternative, a Boulder Basin AMP would be designed and implemented. A summary of the Boulder Basin AMP is provided in the following paragraphs. Preparation of the Boulder Basin AMP is ongoing, but the most up-to-date version is available upon request. However, as indicated by its title, the plan is meant to be “adaptive”. A Core Management Team (CMT) consisting of representatives of the NPS, Reclamation, SNWA, and the CWC would manage and revise the AMP as necessary to protect the water quality and recreational and resource values of Lake Mead. The Boulder Basin AMP would be evaluated twice per year (spring and fall) to assess whether the objectives are being met. The Boulder Basin AMP would be modified, if necessary, to address inefficiencies, new contaminants of concern, or changes in Lake conditions. Monitoring data collected as part of the Boulder Basin AMP would be analyzed and reviewed continually to ensure early detection of potential issues.

The initial Boulder Basin AMP is based on the extensive water quality modeling of the Boulder Basin, the current knowledge of Lake Mead and the Las Vegas Wash, and focuses on establishment of baseline conditions and management of the operations of the wastewater treatment and SCOP facilities. It specifically addresses the management of the treatment and release of effluent. It also recognizes the need for identification and management of non-effluent related stressors in the Lake Mead ecosystem.

The initial Boulder Basin AMP would develop processes for the following.

- Establishment of the Boulder Basin AMP Program Structure.
- Establishment of strategic and tactical management objectives and goals for water quality in Boulder Basin. This involves setting goals regarding meeting the various water quality standards as well as determining objectives regarding nutrient management, natural resource

use and disturbance, drinking water quality, downstream water quality, and recreational use including sport fisheries.

- The Boulder Basin AMP is based on two fundamental criteria: (1) operate the SCOP facilities so the effluent is distributed in a manner that would protect drinking water and downstream users, and protect NPS recreational and resource values; and (2) monitor and manage non-effluent related stressors to minimize variances in nutrient loads within Boulder Basin.
- Monitoring water quality. Water quality status and trends would be determined by monitoring at strategic and sensitive areas in Lake Mead. Baseline monitoring would start in 2006 or 2007. Long-term monitoring would also be implemented to provide vital information about the water quality in the Boulder Basin.
- Data analysis and modeling for water quality in the Boulder Basin. This would be an ongoing effort that would involve performing laboratory tests, simple calculations, developing a Boulder Basin Management Indices system (BBMI), and continually updating and utilizing the three-dimensional modeling using the Estuary and Lake Computer Model (ELCOM)-Computational Aquatic Ecosystem Dynamic Model (CAEDYM)-PLUMES suite of models. The BBMI would be reviewed at least annually by a technical committee consisting of appointed experts in the fields of limnology, modeling, permitting, fisheries, and other water quality areas as necessary in an attempt to develop a management indices system that would assist in predicting water quality in Lake Mead and identifying potential water quality areas of concern.
- Develop a Decision Making Process. This process would be used to identify areas of concern and the actions required to resolve the concern. Decision protocols would be developed for protecting water quality at the SNWA intakes and Hoover Dam outlets, and NPS recreational and resource values.
- Development of a SCOP Operational Plan. The components of the SCOP system that are subject to adaptive management changes include: operating the diffuser ports to control the effluent insertion level and horizontal location within the reservoir, adjusting the total nutrient levels released through the wastewater reclamation facilities, and adjusting the flow of effluent released to the Las Vegas Wash. At the outset, an initial SCOP Operational Plan would be developed. This plan would include details for the operation of the system for different seasons, Lake levels, and nutrient loadings. The Operations Plan would be adaptive, especially in the first few operational years of the SCOP. Meetings would be held as needed to change and update the criteria documented in the Plan based on real-world conditions in Lake Mead and the Las Vegas Wash.
- Development of a Management Action Plan (MAP). This process would be designed to respond to water quality changes in areas of concern. When an area of concern is identified through data analysis, modeling, and the decision-making process, a MAP would be designed and implemented as necessary to ensure that existing water quality and recreational and resource values in the areas of concern would be protected. Management action may consist of changing the flow distribution between the Las Vegas Wash and the diffusers, increasing nutrient removal through wastewater treatment processes, best management practices (BMPs) and best available technologies for non-effluent related stressors, and varying the hydraulic operation of the diffusers.

The Boulder Basin AMP process would develop an appropriate mix of indices, goals, milestones, and performance measures to evaluate environmental conditions. The Boulder Basin AMP would also help to identify existing and emerging environmental problems, set environmental priorities, and make program-specific decisions to address the highest priorities.

The Boulder Basin AMP would be administered through the CMT in conjunction with a number of committees and workgroups. It is envisioned that successful progress would be facilitated by a program structure that provides networking opportunities for basin-wide dialogue by providing discussion through evolving interest from active agencies and community involvement. There are many programs and projects that either have been or are in various stages of implementation on Lake Mead. The CMT would work with the other agencies and programs to coordinate the release of effluent through the Las Vegas Wash and the diffuser.

The initial Boulder Basin AMP organization is comprised of the CMT, a Technical Committee, and an Advisory Committee. Figure 2.2-8 presents the Organizational Structure for the initial Boulder Basin AMP. The organizational structure would be reviewed periodically and adjusted if needed and agreed to by all parties in the CMT.

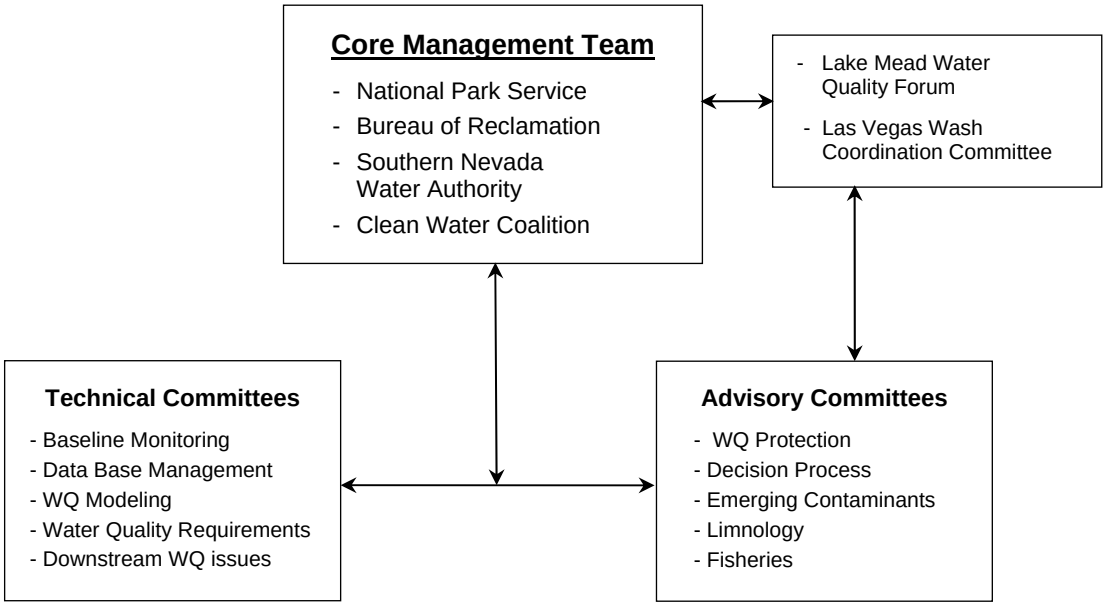


Figure 2.2-8 Organizational Structure for the Initial Boulder Basin AMP.

The Lake Mead Water Quality Forum (LMWQF) and the LVWCC would be used as a communication tool with the public and other local, state, and federal agencies. Once SCOP is operational, a summary of the previous year's water quality data and the next year's Operating

Plan would be presented annually to members of the LMWQF and the LVWCC. Attainment of water quality goals would be discussed.

The CMT would oversee the completion of the initial Boulder Basin AMP and the development of a long-term AMP for all SCOP-related operations within Boulder Basin. The CMT would provide oversight on the monitoring of the SCOP facilities and provide interagency coordination on the overall use of Boulder Basin.

The initial Boulder Basin AMP would identify the water quality goals as well as management strategies that would allow a timely identification and reaction if certain action levels for the areas of concern are observed. An example of a management strategy that may be implemented includes development of predictive BBMI between Secchi depth, TP concentrations, and chlorophyll *a* concentrations that can be used to determine when water quality standards may be exceeded.

Currently there is not sufficient data to establish an "action level" of TP through Hoover Dam. Once a minimum of 3 years of baseline data is accumulated, an appropriate "action level" would be selected. The baseline data would be used to develop a methodology for determining management decisions that would maintain TP through Hoover Dam below the State of Nevada RMHQ level. This action would be evaluated and adjusted as necessary.

A water quality monitoring plan would be developed as part of the Boulder Basin AMP. Water quality monitoring in Lake Mead has historically focused on regulatory monitoring for the effluent discharged through the Las Vegas Wash and the water quality for the drinking water supply. The water quality monitoring undertaken to support the Boulder Basin AMP would not be considered a part of the existing NDEP regulatory monitoring. The regulatory monitoring data and information, as well as other water quality data collected by other agencies, would be used to supplement the Boulder Basin AMP data base.

An initial baseline monitoring program including a determination of water quality parameters and the establishment of sampling locations and sampling frequency has been established to assess water quality parameters within Lake Mead and just below Hoover Dam. The parameters that would be monitored as part of the initial baseline monitoring program are shown in Table 2.2-7.

The regulatory and initial operational monitoring locations that have been identified for baseline monitoring are shown in Figure 2.2-9. Samples would be collected from various levels throughout the water column including the hypolimnion. As data is collected, the operational monitoring parameters and locations would be reviewed and, if necessary, adjusted to provide the most valuable information for management of the water quality in Boulder Basin.

In addition to the monitoring parameters presented in Table 2.2-7, a monitoring effort would be undertaken to provide background data for EDCs and PPCP. Monitoring for these compounds would provide useful background data necessary to further define their fate and transport within the lower Colorado River system. Table 2.2-8 presents the compounds that would be monitored through the initial Boulder Basin AMP. This list of analytes may change based on data results, future research, and other conditions such as changing Lake levels.

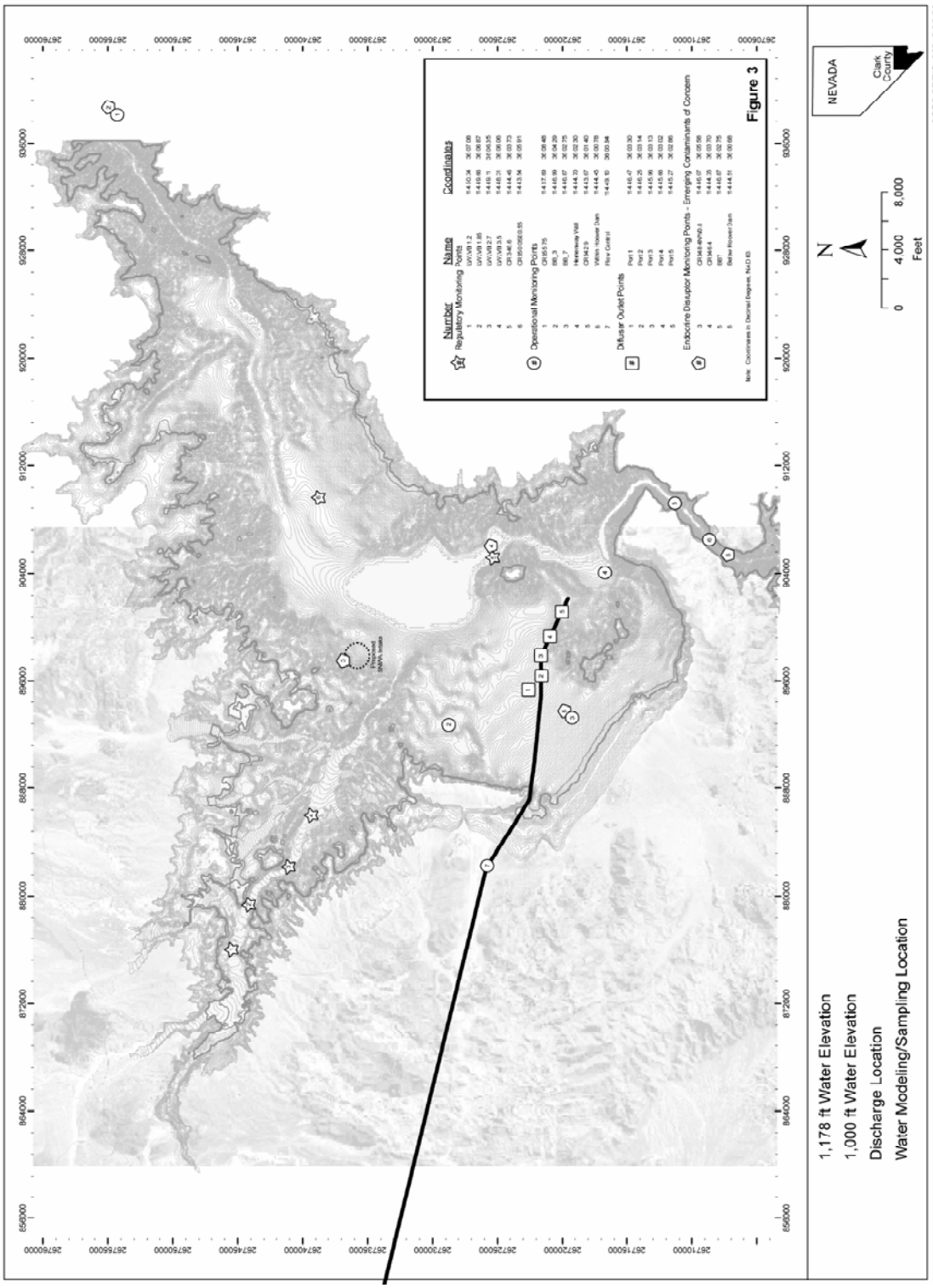


Figure 2.2-9 Water Quality Modeling/Sampling and Discharge Locations.

Table 2.2-7 Initial Baseline Monitoring Parameters.

Parameter	Parameter
Temperature	Fecal Coliform
Dissolved Oxygen	NH_4 (ammonium ion)
Conductivity	NO_2 (nitrite ion)
pH	NO_3 (nitrate ion)
Br (bromide ion)	Total Coliform
Chlorophyll *a*	Total Nitrogen
Chloride	Total Phosphorus
E coli	Total Suspended Solids
Dissolved Ortho Phosphorus	Total Organic Carbon
Total Dissolved Solids	Sulfate
Color	Turbidity

The initial monitoring locations for emerging contaminants of concern within Lake Mead are shown on Figure 2.2-9.

Once the baseline information and data sets are established, a program would be developed for long-term water quality monitoring in the Boulder Basin. The parameters recommended for long-term monitoring would be similar to those chosen for baseline monitoring.

The data collected during monitoring would be routinely analyzed by a technical committee to determine the water quality and hydrodynamics of Lake Mead. The results of this data analysis would be periodically reviewed by the CMT and appropriate actions would be implemented.

2.3 Boulder Islands South Alternative

The Boulder Islands South Alternative includes plant optimization, increased treatment (as needed), and a pipeline that would collect the highly treated effluent discharged from each of the treatment facilities and transport the effluent to an alternate receiving area in the vicinity of the Boulder Islands (Figure 2.2-1). Effluent discharge limits for releases near the Boulder Islands would not be subject to the TMDLs, which apply to the flow of the Las Vegas Wash, and in turn protects water quality in the Las Vegas Bay. The TMDL limits would still apply to Las Vegas Wash discharges. Discharge limits in the Boulder Islands area would be subject to concentration-based Water Quality Based Effluent Limitations. The three treatment agencies would expand their facilities to handle the increasing quantities of wastewater through 2050.

Table 2.2-8 Emerging Compounds of Concern to be Monitored.

Compound	Class	Common Names
a-BHC	Pesticide	Organochlorine
Atorvastatin	Anti-cholesterol	Lipitor
Atrazine	Herbicide	Triazine
b-BHC	Pesticide	Organochlorine
Benzophenone	UV Blocker	Sun Screen
BHT	Antioxidant	Personal care product
Bisphenol A	Plasticizer	
Carbamazepine	Anti-convulsant	
d-BHC	Pesticide	Organochlorine
DEET	Insect Repellant	Personal care product
Diazinon	Pesticide	Organophosphate
Diclofenac	Analgesic	Voltaren
Estradiol	Human Hormone	Estrogen
Estrone	Human Hormone	Estrogen
Ethynylestradiol	Synthetic Hormone	Birth Control
Fluoxetine	Anti-depressant	Prozac
Galaxolide	Fragrance	Synthetic Musk
g-BHC	Pesticide	Organochlorine-Lindane
Gemfibrozil	Anti-lipid	Lopid
Meprobamate	Anti-anxiety	Miltown
Methoxychlor	Pesticide	Organochlorine
Musk Ketone	Fragrance	Synthetic Musk
Naproxen	Analgesic	Aleve
Octylphenol	Alkylphenol	Soap/Detergent-Degradation Product
Phenytoin	Anti-convulsant	Dilantin
Progesterone	Human Hormone	Estrogen
Simvastatin	Anti-lipid	Zocor
Sulfamethoxazole	Antibiotic	
TCEP	Fire Retardant	Phosphate-based
Testosterone	Human Hormone	Androgen
Triclosan	Anti-microbial	
Trimethoprim	Antibiotic	

Current, conventional treatment processes and plant optimization, which are described in Section 2.1, would be used to meet the requirements set by the NDEP through the NPDES permitting program. The Boulder Islands South Alternative is broken up into two main pipeline segments, EI-Alignment B and the Boulder Islands South LCS. In addition, there are ancillary facilities associated with this alternative including connection structures to the treatment plants, wash return structure, the EI Terminus facility, a PRS at the end of the EI and near the end of the Boulder Islands South LCS, and a diffuser.

The design for the EI-Alignment B, South Lateral Pipeline, and related facilities in terms of flows, would be the same as described for EI-Alignment A in Section 2.2.

The Boulder Islands South Alternative would cost approximately $590,000,000 in capital costs and $500,000 per year in O&M costs. The breakdown of capital costs include:

- $30,526,460 for the Reach 1 pipeline and structures, and CLV and CCWRD connections;
- $43,243,366 for the Reach 2 pipeline and structures;
- $48,058,150 for Reach 3 and the EI Terminus;
- $137,263,700 for the South River Mountains Tunnel No. 3 (SRMT3);
- $294,119,024 for the subaqueous pipeline and PRS;
- $15,208,950 for the water tank shaft and Boulder Islands South Outfall Pipeline (BISOP); and
- $21,580,350 for the South Lateral Pipeline and COH Wash Return Structure.

2.3.1 Effluent Interceptor – Alignment B

A large portion of the highly treated effluent discharged from the CLV and CCWRD treatment facilities would bypass the Las Vegas Wash via EI-Alignment B. The South Lateral Pipeline would convey the treated effluent from the COH WRF (Figure 2.3-1). The CLV and CCWRD flows would be combined with the COH flows at the EI Terminus and be either returned to the Las Vegas Wash at a point upstream of Lake Las Vegas, or be transported to Lake Mead via the LCS. The EI-Alignment B, which includes the South Lateral Pipeline, would be designed and maintained in a manner that would protect the integrity of the effluent.

The EI-Alignment B portion of this alternative is described in terms of the alignment, ancillary facilities and structures, design flow, construction, and operation. The EI-Alignment B has been divided into three reaches and the South Lateral Pipeline for ease of discussion.

2.3.1.1 Alignment

Information regarding the length, diameter, and construction method to be used for each segment of EI-Alignment B is summarized in Table 2.3-1.

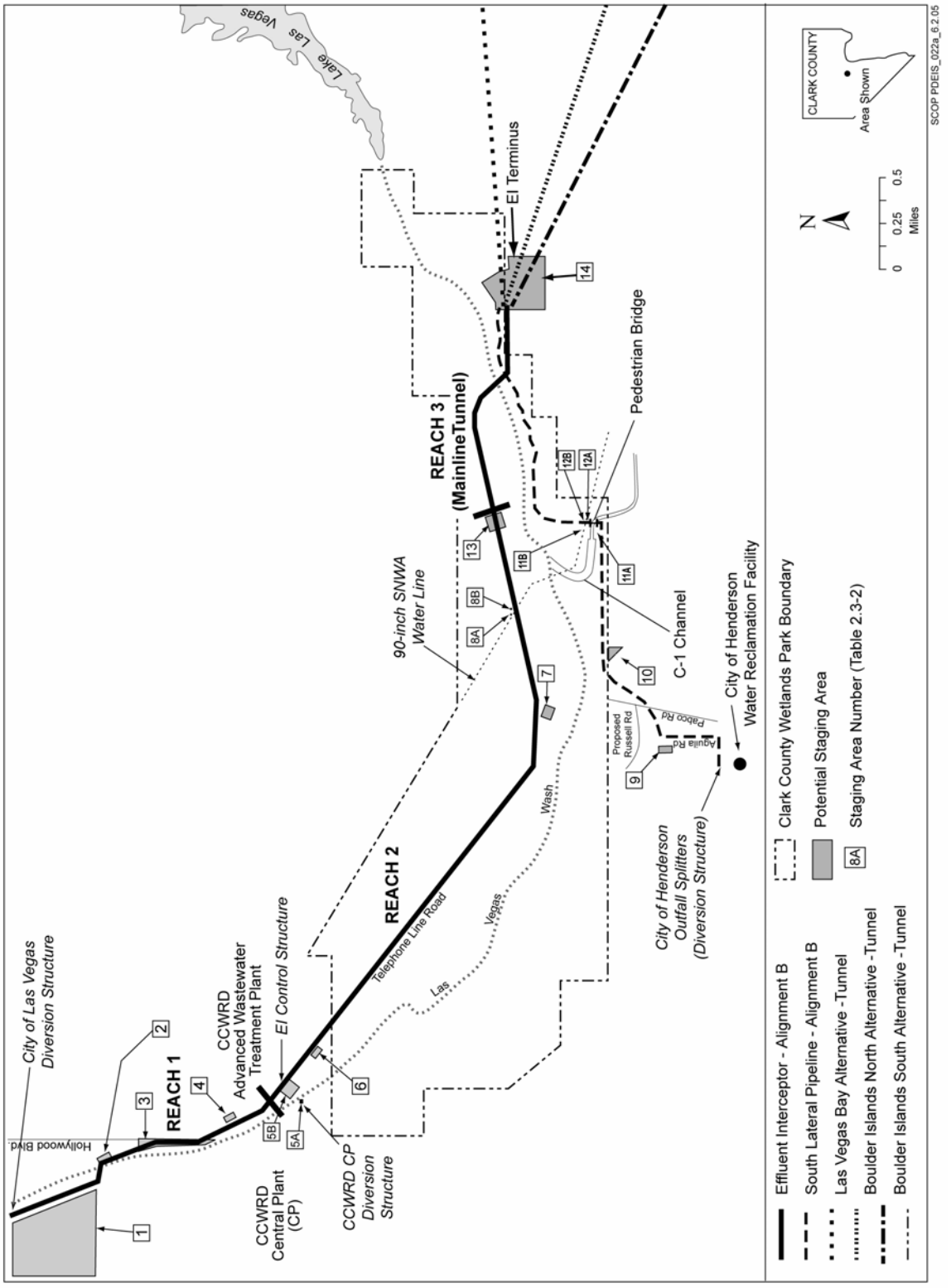


Figure 2.3-1 Effluent Interceptor – Alignment B and Ancillary Facilities.

Table 2.3-1 Effluent Interceptor – Alignment B, Total Dimensions of Construction Techniques.

Reach	Length (ft)	Inner Diameter (inches)	Construction Technique	Depth to Invert (ft)
1	7,100	96	Cut-and-Cover	19 – 29
1	420	96	Tunnel	25 – 42
2	18,600	114	Cut-and-Cover	18 – 32
3	6,500	114	Tunnel	128 – 178
South Lateral Pipeline	17,400	54	Cut-and-Cover	11 – 25

2.3.1.1.1 Reach 1

Reach 1 of EI-Alignment B under the Boulder Islands South Alternative is the same as described for the Boulder Islands North Alternative in Section 2.2.1.1.1.

2.3.1.1.2 Reach 2

Reach 2 of EI-Alignment B conveys the combined CLV and CCWRD effluent in a 114 inch (289 cm) diameter pipeline, approximately 18,600 ft (5,669 m) long, beginning 100 ft (30 m) northwest of the EI control structure located near the entrance to the CCWRD AWT plant (Figure 2.3-1). A 175 ft (53 m) wide construction easement would be required for Reach 2. The majority of EI-Alignment B within Reach 2 would be installed using cut-and-cover construction. Effluent Interceptor–Alignment B then follows the south edge of Telephone Line Road in a southeasterly direction to a point north of the Pabco Road ECS. At this point, EI-Alignment B would continue in a northeasterly direction across open terrain north of the Las Vegas Wash to the Mainline Tunnel shaft for Reach 3 (Figure 2.3-1). The staging areas for EI-Alignment B Reach 2 are shown on Figure 2.3-1. The staging areas shown correspond to the areas listed in Table 2.3-2.

Effluent Interceptor–Alignment B would cross under an existing 90 inch (228 cm) SNWA pipeline. The tunnel would be approximately 55 ft (17 m) long and would be located 1,500 ft (457 m) east of the Pabco Road ECS. The tunneling methods and spoils removal would be the same as described for the tunneling activities in Reach 1.

A meandering 16 ft (5 m) wide chat trail, a trail made of small stones, approximately 6,840 ft (2,085 m) in length, would be constructed within the permanent easement along the portion of the alignment that goes across open terrain to the Mainline Tunnel shaft in Reach 3. The existing grade would be matched to the extent possible with minor grade limitations for maintenance access.

Table 2.3-2 Staging Areas (EI – Alignment B).

Staging Area	Property	Area
EI-Alignment B Reach 1		
1	CLV property – directly south of WPCF	37 ac[1]
2	Las Vegas Wash Crossing – east shaft	0.6 ac
3	CLV property – adjacent to Hollywood Boulevard	6.4 ac
4	CCWRD property	0.7 ac
CCWRD CP & AWT Connection		
5A	CCWRD property – near CP outfall	50 ft x 50 ft
5B	CCWRD property – near EI control structure and AWT	6.3 ac
EI-Alignment B Reach 2		
6	CCWRD property – north of Wetlands Park boundary	1.4 ac
7	Clark County Parks and Community Services property – northwest of Pabco ECS	1.1 ac
8A	Clark County Parks and Community Services property - west working pit for 90-inch SNWA pipeline crossing	40 ft x 25 ft
8B	Clark County Parks and Community Services property - east retrieval pit for 90-inch SNWA pipeline crossing	25 ft x 25 ft
COH South Lateral Pipeline		
9	Private property – east of Aquila Road	1.2 ac
10	COH property – proposed west of Weston Hills and Tuscany Hills developments	1.5 ac
11A	Reclamation property – south bore and jack pit for C-1 Channel crossing	50 ft x 50 ft
11B	Reclamation property – north bore and jack pit for C-1 Channel crossing	50 ft x 50 ft
12A	Reclamation property – south working pit for 90-inch SNWA pipeline crossing	40 ft x 25 ft
12B	Reclamation property – north retrieval pit for 90-inch SNWA pipeline crossing	25 ft x 25 ft
EI-Alignment B Reach 3		
13	Reclamation property – west shaft staging area	3.7 ac
14	Reclamation property – (EI Terminus) east shaft staging area and Terminus	40 ac

Note:
[1] ac = acre

2.3.1.1.3 Reach 3

Reach 3 of EI-Alignment B begins on the north side of the Las Vegas Wash with a tunnel shaft approximately 175 ft (53 m) deep and continues southeasterly for approximately 6,500 ft (1,981 m) terminating on the south side of the Las Vegas Wash at the EI Terminus site (Figure 2.3-1). The working shaft, located at the EI Terminus site, would be 30 ft (9 m) in diameter and approximately 170 ft (52 m) deep. The retrieval shaft would be located at staging area 13 adjacent to the end of Reach 2 and would have a 20 ft (6 m) diameter and 175 ft (53 m) depth.

The staging area at the working shaft/EI Terminus site is approximately 40 acres (16 hectares). The staging area at the retrieval shaft on the north side of the Las Vegas Wash would be approximately 3.7 acres (1.5 hectares) (Table 2.3-2). Spoils would be excavated from the working shaft and hauled by truck to a disposal site using the existing roadway system.

2.3.1.1.4 South Lateral Pipeline

The COH WRF effluent would be conveyed to the EI Terminus via the South Lateral Pipeline, which would consist of a 17,400 ft (5,303 m) long, 54 inch (137 cm) diameter pipe that begins at the WRF outfall splitter structure and ends at the EI Terminus (Figure 2.3-1). The majority of the South Lateral Pipeline would be installed using cut-and-cover construction. The South Lateral Pipeline alignment crosses the WRF plant site to Aguila Road, heads north along Aguila Road, and continues east along Russell Road to the northwest corner of the COH property. It then continues northeasterly toward the Weston Hills development and then easterly in the proposed Russell Road alignment approximately 720 ft (219 m) in the dedicated section of Russell Road, along the northwestern corner of the Tuscany Hills development. The pipeline then turns to the northeast and continues north of the planned 24 ft (7 m) fire/utility access easement for the Tuscany Hills lift station, makes a trenchless crossing under the C-1 Channel, and continues northeasterly along the planned Wetlands Park Scenic Drive (Clark County 1995) to the EI Terminus (Figure 2.3-1). The C-1 Channel crossing would be a trenchless crossing at a depth of between 10 and 22 ft (3 and 7 m).

The South Lateral Pipeline would include the construction of a chat trail, approximately 1,220 ft (371 m) in length, similar to what would be constructed in Reach 2 of EI-Alignment B in Section 2.3.1.1.2. The chat trail would be constructed within the South Lateral Pipeline's permanent easement, within the Wetlands Park to match existing grade to the extent possible with minor grade limitations for maintenance access. The trail would be graded and then surfaced with decomposed granite or some other non-bituminous material. A pedestrian bridge would be built, as part of the trail, across the C-1 Channel to provide connectivity to the Wetlands Park areas north and south of the C-1 Channel (Figure 2.3-1).

2.3.1.2 Ancillary Facilities and Structures

Ancillary facilities and structures for EI-Alignment B would be required for the O&M of the SCOP pipeline. The descriptions of the EI-Alignment B ancillary facilities and structures follow.

2.3.1.2.1 Connection Facilities

Connection facilities are required to link the effluent flows from the treatment facilities to the EI-Alignment B or South Lateral Pipeline. The CLV Connection and CCWRD Connection are the same as described for EI-Alignment A in Section 2.2.1.2.1.

The COH Connection to EI-Alignment B would be via the South Lateral Pipeline, which would tie into an existing outfall splitter structure on the COH WRF site. The outfall splitter structure would allow 0 to 100 percent of the COH WRF flow to be diverted to either the South Lateral Pipeline or the Las Vegas Wash, via the COH's existing Las Vegas Wash outfall (Figure 2.3-1).

One of the COH's existing outfall structures and outfall channel would have to be modified to accommodate COH 2050 peak hour flows. The COH outfall channel would be widened to minimize velocities and reduce scour before entering the Las Vegas Wash. Riprap armoring would be installed along the bottom and sides of the channel for its entire length.

2.3.1.2.2 Effluent Interceptor Terminus

The EI Terminus is the transition point between EI-Alignment B and South Lateral Pipeline, and the LCS (to Boulder Islands or Las Vegas Bay). Combined effluent would either be discharged to the Las Vegas Wash or to the LCS to convey flow to an alternate receiving area in Lake Mead. The EI Terminus site is located about 1 mile southwest of Lake Las Vegas on the south bank of the Las Vegas Wash at Township 21 South, Range 63 East, Section 28 M.D.M. (Figure 1.1-1). The 40-acre EI Terminus site, located on land owned by Reclamation, would include a PRS, distribution box, and wash return structure (Figure 2.3-2). The PRS site would be surrounded by a 6 ft (2 m) high perimeter wall constructed of block, similar to the type of block used in the surrounding areas. The perimeter wall would be set back from the site access road leading to a fabricated wrought iron gate with a keypad entry security system.

The EI Terminus site was selected based on the proximity to the Las Vegas Wash and the ability to hydraulically convey the combined effluents to any one of the alternate receiving areas within Lake Mead. Access to the EI Terminus would be provided by an existing municipal road accessible from Magic Way.

The EI Terminus site would require grading modifications to allow natural drainage channels to flow around the site. The site itself would drain from south to north and exit the site near the entrance gate (Figure 2.3-2). The drainage modifications would incorporate natural drainage channels in the vicinity of the site. All areas disturbed by the drainage improvements would be restored to match existing conditions as closely as possible. The parking area and the access road to the site would be paved with asphalt concrete as shown on Figure 2.3-2.

Electrical power to the EI Terminus would be provided by Nevada Power Company's Lindquist Substation. The transmission lines from the Lindquist Substation would be located along existing roads or within an existing utility corridor.

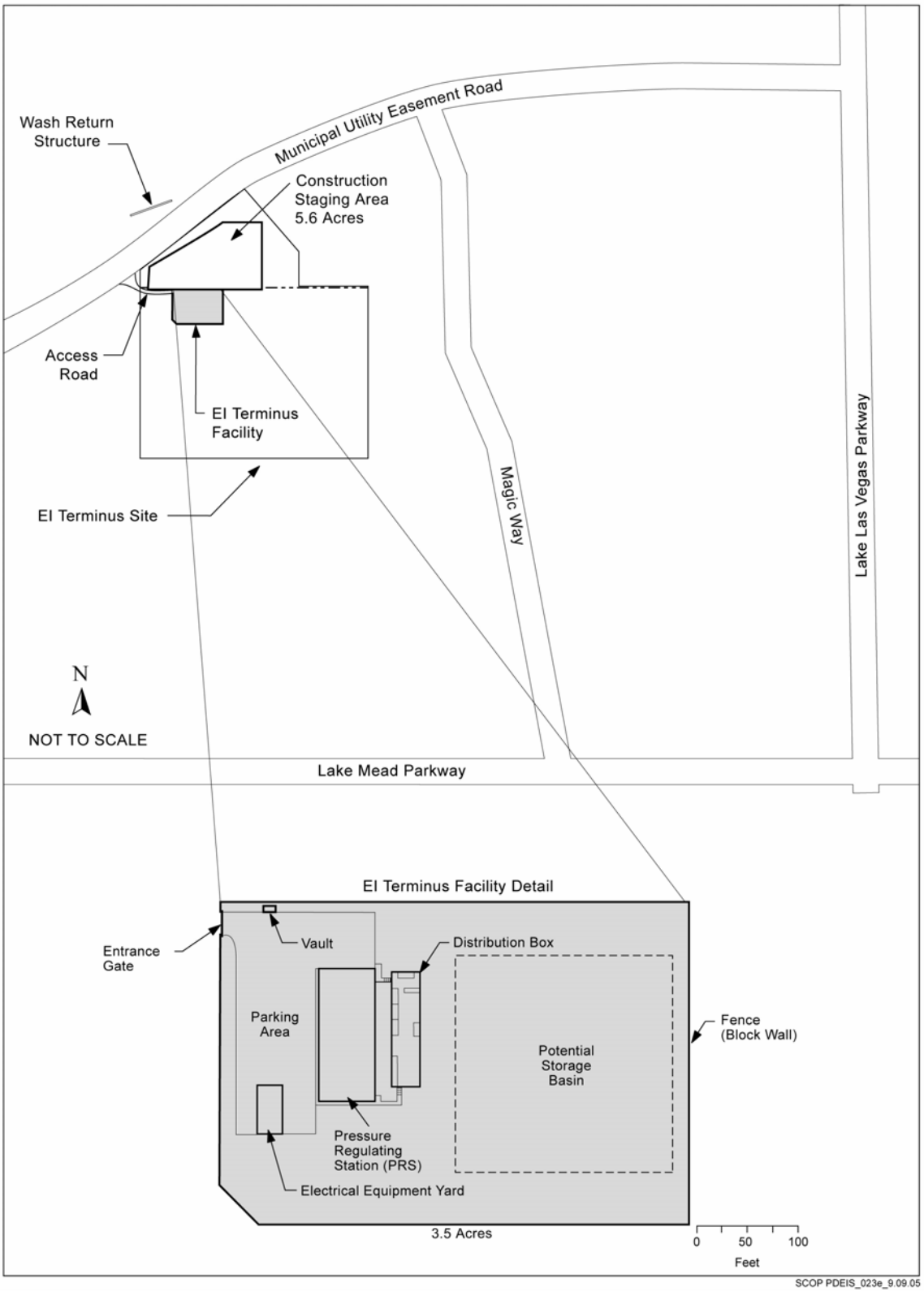


Figure 2.3-2 Effluent Interceptor – Alignment B Terminus Facility.

Pressure Regulating Station

The PRS would be designed to maintain full-flow conditions in Reaches 2 and 3 of EI-Alignment B. In addition, the PRS would allow a free-water surface to be established at this location in the hydraulic profile enabling COH WRF effluent to enter the EI pipeline system.

The PRS building would be designed to house and maintain large water pipe, valves, and electrical equipment. The design of the building exterior and its landscape would be residential in character, and blend in with the desert landscape. The visual appearance of the PRS would follow a "Spanish" style of architecture similar to the Lake Las Vegas Fire Station and nearby golf course buildings. The color of the exterior walls and clay tile roofing would be selected to blend with the desert colors in the area.

Distribution Box

The distribution box would be a concrete structure that combines the flows from EI-Alignment B and the South Lateral pipelines and diverts them to the Las Vegas Wash or the LCS. The distribution box would be equipped with an overflow weir allowing flow to be discharged to the Las Vegas Wash through a 120-inch (305-cm) pipeline to the wash return structure.

Wash Return Structure

The wash return structure used to discharge effluent to the Las Vegas Wash would be located north of the EI Terminus at the top of the Las Vegas Wash bank (Figure 2.3-2). The structure would be a long narrow box with a weir outlet discharging over a riprap embankment, allowing the water to cascade down to the Las Vegas Wash water-surface elevation (Figure 2.3-3). The velocity of the effluent discharged to the Las Vegas Wash would not exceed 4 ft per second (fps) (1 m per second [mps]).

2.3.1.2.3 Manholes

Access manholes would be necessary to enter the pipeline for inspection or maintenance. An access manhole includes pipeline access, and a manhole or vault with ground level access and cover. Along the EI pipeline, access manholes would be located at approximately every 2,000 ft (610 m). The manhole would be 30 inches (76 cm) in diameter and would be located at bends, transitions, and bifurcations along the alignment.

2.3.1.2.4 Maintenance and Access Roads

Access to EI-Alignment B and ancillary facilities must be available at all times for inspection, maintenance, and emergencies. General construction, operation, and maintenance access to the project area would be via the major highways in the area, which include US 95, US 93, and I-515, Boulder Highway, and Lake Mead Parkway. The EI and South Lateral Pipeline would be accessible by lesser roads such as Desert Inn Road, Hollywood Boulevard, Telephone Line Road, Pabco Road, Olson Street/Sunset Road, Magic Way, and Russell Road (Figure 2.2-4).

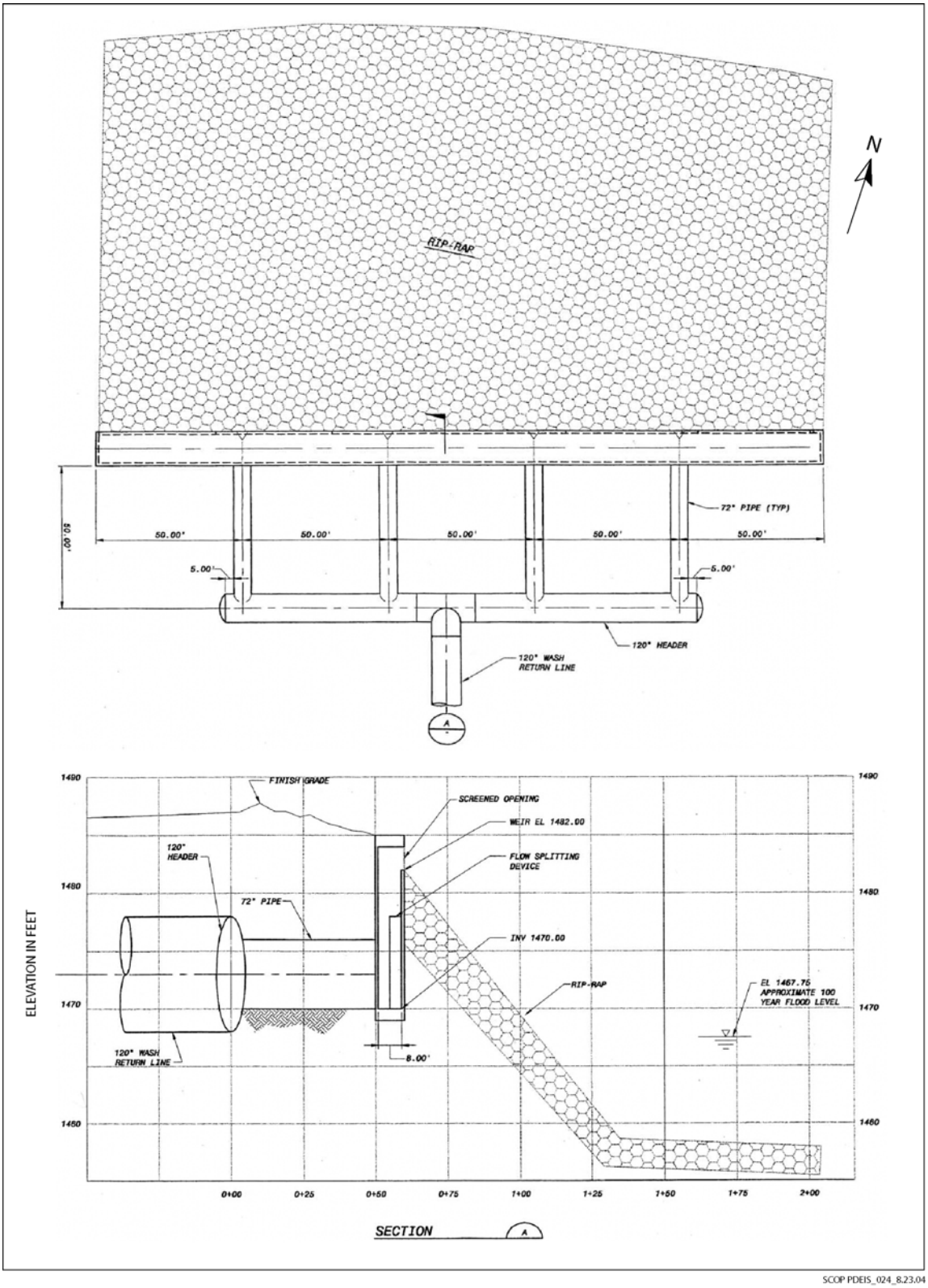


Figure 2.3-3 Wash Return Structure.

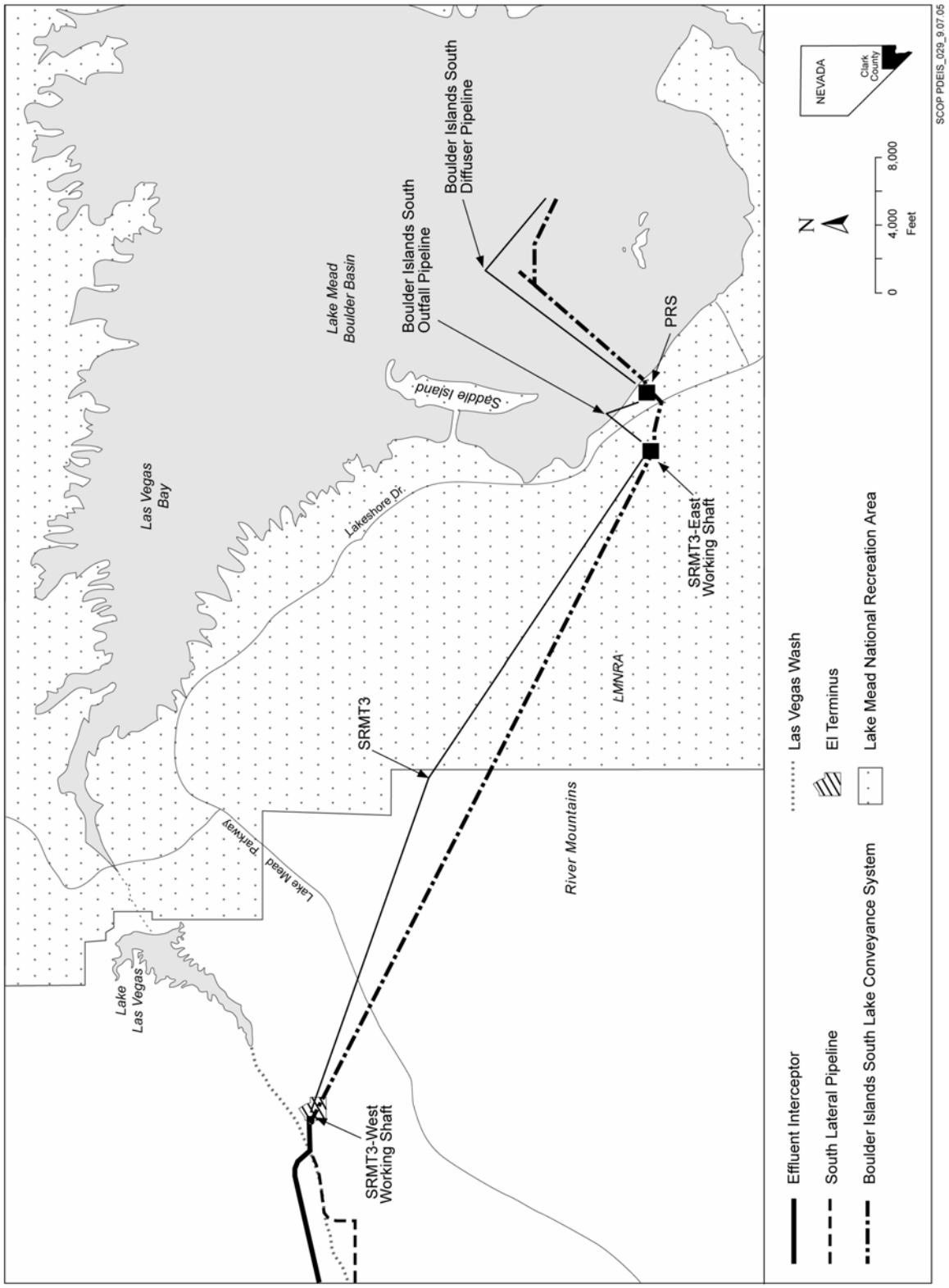


Figure 2.3-4 Boulder Islands South Lake Conveyance System.

2.3.1.3 Land Requirements

A width of 175 ft (53 m) was used to calculate the total land area required for the EI temporary construction easement. A width of 125 ft (38 m) was used to calculate the total land area required for the South Lateral Pipeline temporary construction easement. The permanent easement widths required for EI-Alignment B reaches and South Lateral Pipeline are:

- 80 ft (24 m) for Reach 1,
- 110 ft (33 m) for Reach 2,
- 40 ft (12 m) for Reach 3 (subsurface easement), and
- 50 ft (15 m) for the South Lateral Pipeline.

Although it is anticipated that the majority of the excavated material and pipe material would be stored within the 175 ft (53 m) temporary construction easement, additional area would be required for material and equipment storage (Table 2.3-2). The sites being considered as construction staging areas would be located adjacent to EI-Alignment B and the South Lateral

Pipeline (Figure 2.3-1). The siting of the staging areas on these lands minimizes the amount of new disturbance to federal lands. Table 2.3-2 lists properties that appear to be suitable for use as staging areas, based on their location and current land use. The staging area numbers correlate with the identifier numbers presented in Figure 2.3-1.

2.3.1.4 Construction

Construction of EI-Alignment B would take approximately 28 months. There would be no need to work in the Las Vegas Wash because crossings would be via tunnels. The two major construction techniques for the pipeline installation would include cut-and-cover and tunneling.

Project construction activities would be the same as those described in Section 2.2.1.4. Table 2.3-1 summarizes the construction method to be used for each segment of EI-Alignment B and the South Lateral Pipeline.

Tunneling would be required at all Las Vegas Wash crossings and at major utility crossings to limit direct impacts to the Las Vegas Wash and major utilities. The CWC would coordinate with the SNWA and other utility organizations to ensure that the EI does not impact any SNWA waterlines or other utilities. Tunneling would be required at the locations listed in Table 2.3-1.

2.3.1.5 Spoils and Backfill Materials

The top 6 in (15 cm) of surface material would be stockpiled separately from other excavated material at the staging areas, and would be used as seedbed after final grading. It is assumed that the majority of the excavated material would be used as trench backfill or during final grading. The amount of excess material excavated from EI-Alignment B is shown on Table 2.3-3. It would be necessary to import backfill material, which would be stored along the trench. The pipe would be strung along the trench on top of the imported trench backfill material. The average volume of imported backfill that would be required for the cut-and-cover portions of EI-Alignment B are shown on Table 2.3-3. The backfill material would be obtained from a

commercially available source. The procurement of this material would be part of the construction activities performed by the construction contractor**.**

This excess material would be used for other projects or hauled off to the nearest landfill. The number of truckloads required to haul the excess materials and deliver the backfill material is shown on Table 2.3-3.

Table 2.3-3 Spoils Generated and Backfill Material Required for EI-Alignment B.

Segment	Spoils/Muck (cubic yards)	Backfill (cubic yards)	Truckloads [1]
Cut-and-Cover	483,500	31-60	24,175
Tunneling	40,840	0	2,042
Total	524,340	31-60	26,217

Note:
[1] Assumes 20 cubic yards per truckload.

2.3.1.6 Operation of the Effluent Interceptor – Alignment B

Effluent Interceptor-Alignment B would be designed to allow maximum flexibility for management of effluent flows. The EI and the associated treatment plant connections would be designed to allow 0 to 100 percent of the plants' flows to the Las Vegas Wash or the EI. Control points for the system would be located at the three treatment plants. One-hundred percent of the effluent flows may be discharged to the Las Vegas Wash during emergencies or maintenance of the pipeline. Regular maintenance at the treatment facilities would be scheduled and coordinated to ensure that all three plants are not discharging 100 percent of their flows to the Las Vegas Wash at the same time. The CLV and CCWRD flows would be combined with the COH flows at the EI Terminus and be either returned to the Las Vegas Wash at a point upstream of Lake Las Vegas, or be transported to Lake Mead via the LCS.

The O&M of EI-Alignment B would be managed by the CWC in coordination with the member agencies and the Management Advisory Committee. A minimum of 30 mgd (46 cfs) of treated effluent would be discharged to the Las Vegas Wash year round. Together with the 20 mgd (31 cfs) of base flow, the total flow in the Las Vegas Wash is expected to be at least 50 mgd (77 cfs).

A Boulder Basin AMP would be designed and implemented. The Boulder Basin AMP, which is described in Section 2.2.2.6, would include operation of the EI relating to the quantity of effluent delivery to the Las Vegas Wash, EI, and LCS.

The EI Terminus is the transition point between EI-Alignment B and the South Lateral Pipeline, and the LCS (to Boulder Islands or Las Vegas Bay). Combined effluent would either be discharged to the Las Vegas Wash or to the LCS to convey flow to an alternate receiving area in Lake Mead.

The PRS, located at the EI Terminus site, would be designed to maintain full-flow conditions in Reaches 2 and 3 of EI-Alignment B. In addition, the PRS would allow a free-water surface to be established at this location in the hydraulic profile enabling COH WRF effluent to enter the EI pipeline system.

2.3.2 Lake Conveyance System, Boulder Islands South

The Boulder Islands South LCS would convey the combined effluent flows from the three treatment facilities to a discharge location near the Boulder Islands in Lake Mead (Figure 2.2-1). The Boulder Islands South LCS is described in terms of the alignment, ancillary facilities and structures, land requirements, construction, and spoils and backfill materials.

2.3.2.1 Alignment

The Boulder Islands South LCS alignment would begin at the EI Terminus and end northeast of the Boulder Islands as shown on Figure 2.3-4. The pipeline would be designed to allow extension of the pipe if needed, based on changing lake conditions. This alignment is divided into three segments consisting of the SRMT3, BISOP, and the Boulder Islands South Diffuser pipeline (BISDP).

2.3.2.1.1 South River Mountains Tunnel No. 3

The SRMT3 would begin at the SRMT3-West working shaft located at the EI Terminus and would proceed in a southeasterly direction for approximately 23,250 ft (7,087 m) to the SRMT3-East working shaft located on NPS land (Figure 2.3-4). The SRMT3 would be drilled through competent bedrock and would pass beneath property owned by Reclamation, BLM, Lake Las Vegas Golf Course, Three Kids Mine, and NPS. The SRMT3-West working shaft would be approximately 70 ft (21 m) deep. The activities for the western segment of the SRMT3 would be staged at the EI Terminus site. The SRMT3-East working shaft would be 60 ft (18 m) deep. The activities for the eastern segment of the SRMT3 would be staged at the SRMT3-East working shaft location. Electrical power and water would be provided to the shafts by using existing roads and utility corridors (Figures 2.2-6 and 2.3-4).

2.3.2.1.3 Boulder Islands South Diffuser Pipeline

The BISDP would be installed using cut-and-cover, dredged, and subaqueous construction techniques. The BISDP would be approximately 16,800 ft (5,121 m) long. The BISDP would start at the PRS, proceed in a northeasterly direction to the vicinity of the Boulder Islands (Figure 2.3-4), and would consist of a series of pipelines installed using a cut-and-cover construction technique to the water line of Lake Mead. Dredging would be used to install the pipeline to the Lake-bottom elevation of 1,000 ft. Subaqueous construction would be used from the Lake-bottom elevation of 1,000 ft (305 m) to the diffuser location northeast of Boulder Islands at an elevation of 880 ft (268 m). The cut-and-cover section is approximately 2,300 ft (701 m); the dredged section is approximately 3,000 ft (914 m); and the subaqueous section is approximately 11,500 ft (3,505 m) in length.

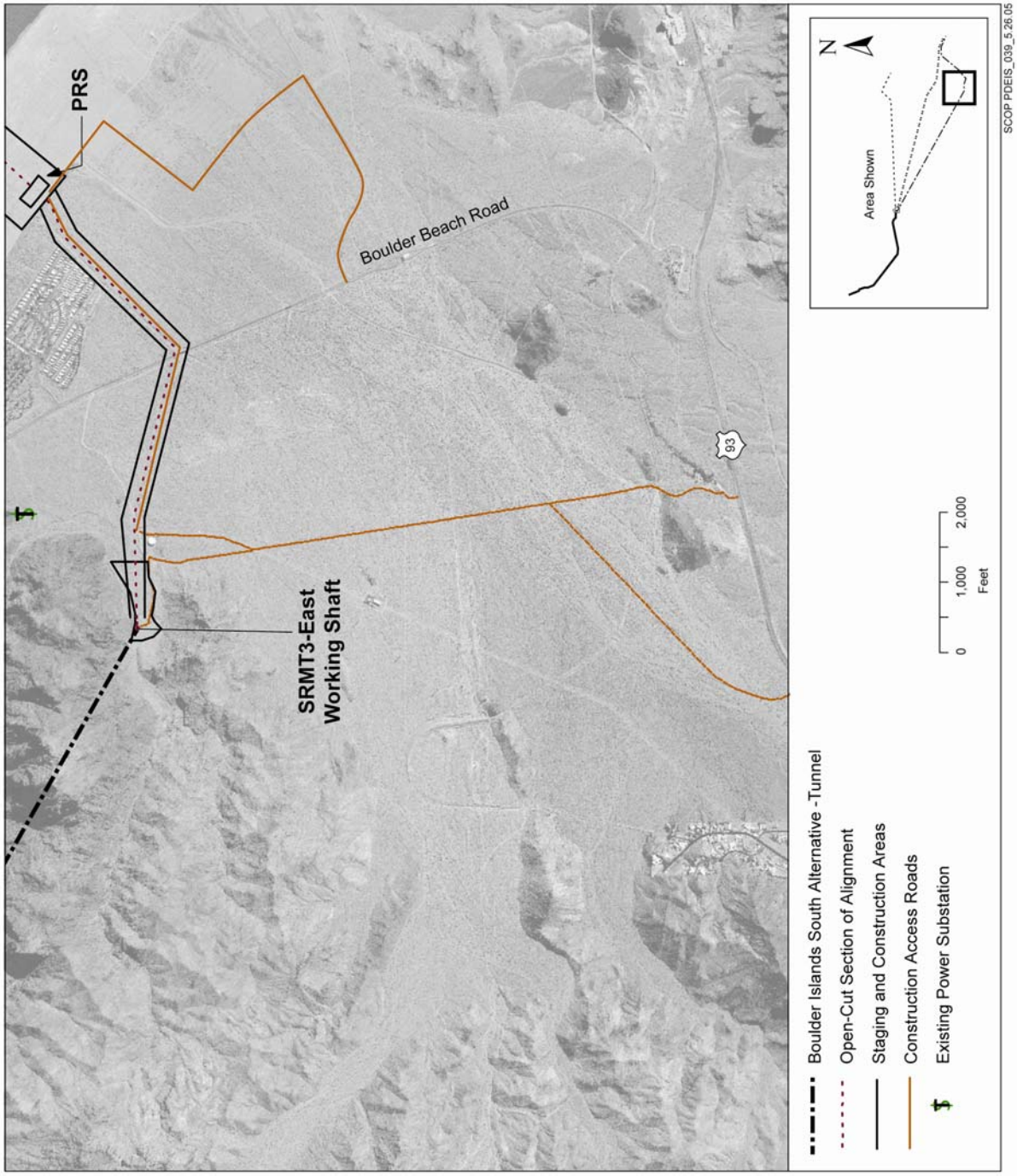


Figure 2.3-5 SRMT3-East Working Shaft.

The cut-and-cover pipeline would be installed in a trench approximately 20 ft (6 m) deep with a minimum cover of 8 ft (2 m). The dredged pipeline would be installed in an underwater trench 55 ft (17 m) wide with a minimum cover of 6 ft (2 m). The subaqueous pipeline would be installed on pylons anchored to the bottom of Lake Mead. The pipeline would be designed to allow extension of the pipe if needed, based on changing lake conditions.

2.3.2.2 Ancillary Facilities and Structures

Ancillary facilities and structures for the Boulder Islands South LCS would be required for the O&M of the pipeline. The Boulder Islands South LCS ancillary facilities and structures are described in this section.

2.3.2.2.1 Pressure Regulating Station

A PRS would be constructed to reduce the internal pressure in the pipeline before discharging to Lake Mead. The PRS would be constructed at a location that is above the historical high water level of Lake Mead. The location of the PRS is shown on Figures 2.3-4 and 2.3-5. The PRS would be constructed in a below-grade structure except for the top slab and a small at-grade structure for access and ventilation equipment. The permanent footprint of the below-grade structure would be approximately 180 x 60 ft (55 x 18 m). Electric power, and potable water would be provided via existing power and water lines (Figure 2.3-4).

2.3.2.2.2 Maintenance and Access Roads

General construction, operation, and maintenance access to the Boulder Islands South alignment and shaft locations would be via the major highways in the area, which include US 95, US 93, US 515, Lake Mead Parkway, and Lakeshore Drive (Figure 2.2-4). The working shafts and PRS would be accessible by existing unpaved roads that provide adequate vehicle access to the shaft locations (Figures 2.2-6 and 2.3-5). Many of the roads that would be used for access to the various project sites are unnamed, unpaved roads. The unpaved road that would primarily be used for access to the SRMT3-East working shaft is approved road 76 (AR 76). Limited closure of AR-76 may be required during construction activities.

2.3.2.2.3 Diffuser

The outlet of the LCS would consist of a subaqueous pipeline and multiport diffuser. The subaqueous pipeline would consist of a series of HDPE pipes with the diffuser at the end of these pipes. The diffuser ports would be located within Lake Mead and anchored to the Lake bottom at an elevation of approximately 880 ft (268 m). The diffuser would be located approximately 4,200 ft (1,280 m) and 1,500 ft (457 m) from the nearest Boulder Islands shoreline when Lake levels are at 1,178 ft (359 m) and 1,000 ft (305 m), respectively. The velocity and rate of flow through the ports would be controlled from the PRS. The ports would be oriented to allow a horizontal or slightly downward discharge. The Lake conditions would determine the operation of the ports.

The final configuration of the diffuser would be determined as part of final design. Current modeling indicates that the effluent discharged from the diffuser would have significant thermal buoyancy. This buoyancy would cause the effluent to rise above the elevation of the drinking water intakes. Preliminary and final design would include modeling of the diffuser operations. The modeling would consider changing Lake conditions.

2.3.2.3 Land Requirements

A permanent subsurface utility easement approximately 40 ft (12 m) wide would be needed along the entire tunnel section of the Boulder Islands South LCS. In addition, the SRMT3-East working shaft would require approximately 9 acres (4 hectares) for temporary construction activities. After completion of construction activities, a permanent easement of 300 x 300 ft (91 x 91 m) at the working shafts would be needed.

The BISOP segment of the alignment would require a 1,000 ft (305 m) wide temporary construction easement to provide adequate working area for equipment, pipe, and trench spoils. A 150 ft (46 m) wide permanent easement would be needed once construction activities are complete.

2.3.2.4 Construction

Construction activities, durations, and types of equipment needed for each segment of the Boulder Islands South LCS are presented in Table 2.3-4. The various segments of the Boulder Islands South LCS would be constructed concurrently.

Employment under the Boulder Islands South Alternative would consist of approximately 9,509 workers each year from 2005 until 2009. Once the EI is constructed, the number of workers needed would be lowered to approximately 8,265 workers. The number of workers required each year does not reflect an additional 9,509 and 8,265 people per year, rather it is expected that this is the total level of employment required per year to sustain the construction, construction support, and other commercial growth rate.

Construction equipment and materials for each segment of the alignment would be hauled to the appropriate working shaft site or staging area. The types of materials and equipment that would be delivered are shown on Table 2.3-5. The number of trucks that would deliver the materials and equipment is also shown on Table 2.3-5.

Construction activities and equipment for the BISOP would be similar to those described for the EI. Construction of the BISOP would be limited to the 6-month time frame between October and March. Thus, this segment of the alignment would require two or three construction seasons to complete.

Table 2.3-4 Construction Activities, Duration, and Equipment for the Boulder Islands South Lake Conveyance System.

Segment	Construction Activities	Construction Duration (months)	Equipment
South River Mountains Tunnel No. 3 – West (SRMT3-West)	• Mobilization (material and equipment delivery) • Shaft excavation and blasting • Tunnel excavation • Tunnel lining and grouting • Final shaft lining • Connection to EI	35	• Cranes • Muck-loading equipment • Drills • Compressors • Trucks • Dozers • Graders • Backhoe • Construction trailers • Tunnel-boring machine
South River Mountains Tunnel No. 3-East (SRMT3-East)	• Mobilization (material and equipment delivery) • Shaft excavation and blasting • Tunnel excavation • Tunnel lining and grouting • Final shaft lining	67	Same as SRMT3 – West
Boulder Islands South Outfall Pipeline (BISOP)	• Mobilization • Pipeline construction • Highway crossing & tunnel construction • PRS construction	16 [1]	Same as SRMT3 – West (without the tunnel-boring machine)
Boulder Islands South Diffuser Pipeline (BISDP)	• Mobilization • Dredging • Subaqueous pipeline construction	31 [1]	• Barges • Barge-based cranes • Clamshell dredge • Tug or workboat • Turbidity curtain • Shore-based crane • Backhoe • Dozer • Trucks

Note:
[1] Six month time frame from October to March.

Table 2.3-5 Material and Equipment Deliveries for the Boulder Islands South Lake Conveyance System.

Segment	Material & Equipment	Duration	Truckloads
SRMT3-West	• Equipment - Miscellaneous - Construction trailers	• 3 months • Once during mobilization and once during demobilization	• 20 per day • 10 (delivered then retrieved)
	• Materials - Pipe - Shaft lining and backfill - Grout - Pipe and Pipe embedment materials for connection to EI (at EI Terminus)	• 35 months • 3 months • 12 months • 31 months	• 20 per day • 50 per day • 50 per day • 50 per day
SRMT3-East	• Equipment - Miscellaneous - Construction trailers	• 3 months • Once during mobilization and once during demobilization	• 20 per day • 10 (delivered then retrieved)
	• Materials - Pipe - Shaft lining and backfill - Grout - Pipe and Pipe embedment materials for connection to BISOP	• 35 months • 3 months • 12 months • 31 months	• 20 per day • 50 per day • 50 per day • 50 per day
BISOP	• Equipment - Miscellaneous	• 3 months	• 20 per day
	• Materials - Pipe - Backfill	• 12 months (during two winter seasons) • 3 months	• 20 per day • 50 per day
BISDP	• Equipment - Miscellaneous	• 3 months	• 20 per day
	• Materials - Pipe	• 31 months	• 50 per day

Construction activities and equipment for the BISDP are different than for the other segments of the alignment as shown on Table 2.3-4, and are the same as those described for the BINDP under the Boulder Islands North Alternative in Section 2.2.2.4.

2.3.2.5 Spoils and Backfill Materials

The majority of the material that would be excavated from the Boulder Islands South LCS is considered "public minerals" with respect to subsurface rights on federal lands. The excess spoils may be used for public projects such as dust control on federal lands or construction materials for roadways, flood control facilities, or other public projects. The amount of spoils generated from each segment of the Boulder Islands South LCS is shown on Table 2.3-6.

The tunnel spoils would be 2 to 6 inches (5 to 15 cm) or less in size. The spoils would be used for public purposes and spoils would be hauled by truck from the working shafts via the haul routes shown on Figures 2.2-6 and 2.3-5. The excess trench materials from the BISOP would be hauled to the disposal area using existing unpaved and paved roads. Some of the materials from the diffuser pipeline dredging operation would be deposited over the pipe. Excess materials would be stockpiled in the staging area then hauled via existing unpaved and paved roads to an appropriate disposal location.

Table 2.3-6 Spoils Removed for the Boulder Islands South Lake Conveyance System.

Segment	Spoils Removed (cubic yards)	Backfill / Grout (cubic yards) [1]	Truckloads [2]
SRMT3-West and Tunnel	154,000	20,400	8,720
SRMT3-East and Tunnel	154,000	20,400	8,720
BISOP	100,000	n/a	5,000
BISDP	9,500	n/a	475
Total	417,500	40,800	22,915

Notes:

[1] The BISOP and BISDP require no hauling from off-site location, backfill processed within construction easements.

[2] Approximate truckloads, depending upon the contractor's choice of rock hauling trailers, this table assumes 20 cubic yards per truckload. Backfill / Grout was estimated at 20 cubic yards per truckload.

2.3.2.6 Operation of the Boulder Islands South Lake Conveyance System

The Boulder Islands South LCS would be designed to allow maximum flexibility for management of effluent flows. Flows to the LCS would be directed and controlled at the EI Terminus site. A PRS would be constructed to reduce the internal pressure in the pipeline before discharging to Lake Mead. The PRS would be located as shown on Figure 2.3-5.

At the PRS, the flows would be directed to multiple pipelines that connect to the diffuser. The diffuser ports would be located within Lake Mead and anchored to the Lake bottom at an elevation of approximately 880 ft (268 m). The velocity and rate of flow through the ports would be controlled from the PRS. The ports would discharge the flow in a horizontal, or slightly downward direction. The Lake conditions and flows would determine the operation and orientation of these ports. Operation of the diffuser would be included as part of the Boulder Basin AMP, which is described in Section 2.2.2.6.

2.4 Las Vegas Bay Alternative

The Las Vegas Bay Alternative includes a pipeline that would collect the highly treated effluent discharged from each of the CWC's treatment facilities and transport the effluent to an alternate receiving area in Las Vegas Bay (Figure 2.2-1). Effluent discharge limits would no longer be subject to the TMDLs, but instead would be subject to concentration-based Water Quality Based Effluent Limitations. The three treatment agencies would expand their facilities to handle the increasing quantities of wastewater. Current, conventional treatment processes and plant optimization, which are described in Section 2.1, would be used to attempt to meet the requirements set by the NDEP through the NPDES permitting program. The EI and Las Vegas Bay LCS are described in the following sections.

The design for the EI-Alignment B, South Lateral Pipeline, and related facilities, in terms of flows, would be the same as described for EI-Alignment A in Section 2.2.

The Las Vegas Bay Alternative would cost approximately $540,000,000 in capital costs and $300,000 per year in O&M costs. The breakdown of capital costs include:

- $31,577,000 for the Reach 1 pipeline and structures, and CLV and CCWRD connections;
- $44,775,000 for the Reach 2 pipeline and structures;
- $59,658,000 for Reach 3 and the EI Terminus;
- $50,685,000 for the Las Vegas Bay Tunnel Phase 1 and Phase 2 (LVBT1 and LVBT2);
- $333,313,000 for the subaqueous pipeline, diffuser, and PRS;
- $19,992,000 for the South Lateral Pipeline and COH Wash Return Structure.

2.4.1 Effluent Interceptor – Alignment B

The EI-Alignment B segment of the Las Vegas Bay Alternative is the same as described for the Boulder Islands South Alternative. The description of EI-Alignment B is presented in Section 2.3.1, EI – Alignment B.

2.4.2 Lake Conveyance System, Las Vegas Bay

The Las Vegas Bay LCS would convey the combined effluent from the EI Terminus to a discharge location in Las Vegas Bay (Figure 2.2-1). The Las Vegas Bay LCS is described in

terms of the alignment, ancillary facilities and structures, land requirements, construction, and spoils and backfill materials.

2.4.2.1 Alignment

The Las Vegas Bay Alternative begins at the EI Terminus and ends in the Las Vegas Bay as shown on Figure 2.4-1. This alignment has been divided into three segments consisting of the LVBT1, LVBT2, and the Las Vegas Bay Diffuser.

2.4.2.1.1 Las Vegas Bay Tunnel - Phase1

The LVBT1 would begin at the LVBT1 working shaft located at the EI terminus and would proceed in an easterly direction for 14,500 ft (4,420 m) to the LVBT2 working shaft located on Reclamation land (Figure 2.3-1). The LVBT1 would have a 14 ft (4 m) diameter. The LVBT1 would be drilled through competent bedrock and would pass beneath property owned or managed by Reclamation, BLM, and Lake Las Vegas Golf Course.

2.4.2.1.2 Las Vegas Bay Tunnel – Phase 2

The LVBT2 would begin at the LVBT2 working shaft and would proceed in an easterly direction for approximately 25,000 ft (7,620 m) to the PRS shaft (Figure 2.3-1). The LVBT2 would have a diameter of 14 ft (4 m). The LVBT2 would be drilled through competent bedrock and would be approximately 515 ft (157 m) deep at the LVBT2 working shaft and 250 ft (76 m) deep at the PRS shaft. The LVBT2 would pass beneath property owned or managed by Reclamation and NPS.

2.4.2.1.3 Las Vegas Bay Diffuser Section

The Las Vegas Bay Diffuser Section would begin at the PRS shaft and would proceed in a northeasterly direction to the shoreline (Figure 2.3-1). The Diffuser Section would exit the PRS shaft as a single 11 ft (3 m) diameter pipeline that would be installed using a cut-and-cover construction technique for approximately 400 ft (122 m) to the high-water line of Lake Mead. The multiple pipeline segments, which begin at the high-water line, would be constructed (using dredging techniques) from the high-water line elevation, to an elevation of 1,000 ft (305 m). The remainder of the subaqueous pipeline would be laid on the Lake floor. The length of the pipeline from the PRS to the diffuser would be 10,700 ft (3,261 m).

2.4.2.2 Ancillary Facilities and Structures

Ancillary facilities and structures for the Las Vegas Bay LCS would be required for the O&M of the pipeline. The Las Vegas Bay LCS ancillary facilities and structures are described in this section.

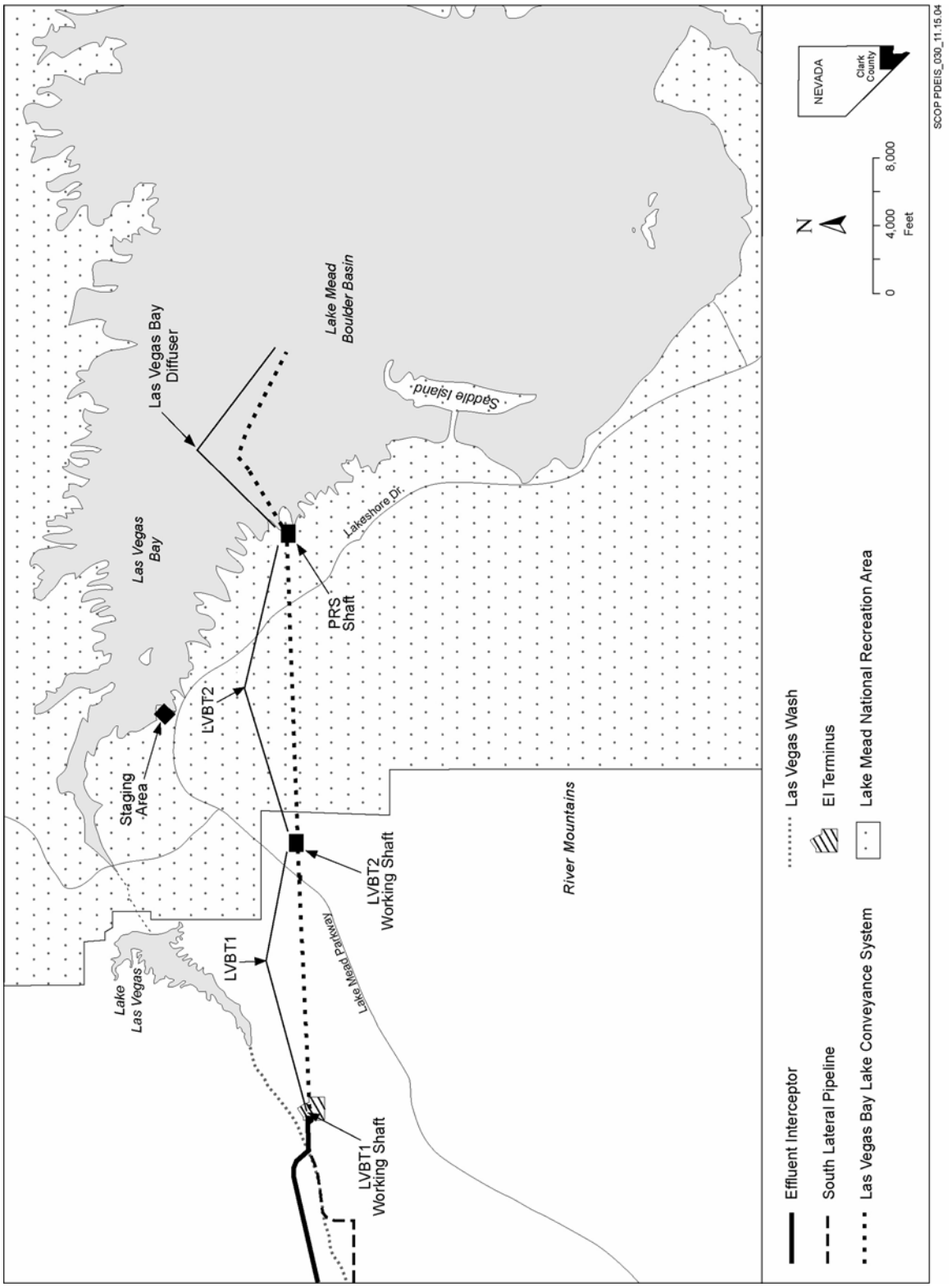


Figure 2.4-1 Las Vegas Bay Lake Conveyance System.

2.4.2.2.1 Working and Retrieval Shafts

The LVBT1 working shaft would be approximately 70 ft (21 m) deep and located on the EI Terminus site. Electrical power and water would be provided from the EI Terminus facility.

The LVBT2 working shaft would be approximately 515 ft (157 m) deep and located on Reclamation land. Electric power and water would be provided to this site using existing power and water lines.

The Las Vegas Bay PRS shaft would be approximately 250 ft (76 m) deep and located on NPS land. Electric power and water would be provided to this site using existing power and water lines.

2.4.2.2.2 Maintenance and Access Roads

General construction, operation, and maintenance access to the Las Vegas Bay alignment and shaft locations would be via the major highways in the area, which include US 95, US 93, US 515, Lake Mead Parkway, and Lakeshore Drive. The working and PRS shafts would be accessible by existing unpaved roads (Figure 2.4-2 and 2.4-3).

2.4.2.2.3 Diffuser

The diffuser for the Las Vegas Bay Alternative would be the same as described for the Boulder Islands North and South alternatives in Sections 2.2.2.2.3 and 2.3.2.2.3. The diffuser ports would be located within Lake Mead on pylons anchored to the Lake bottom at an elevation of approximately 880 ft (268 m). The diffuser would be located approximately 4,000 ft (1,219 m) and 2,500 ft (762 m) from the nearest shoreline in the vicinity of Las Vegas Bay when Lake levels are at 1,178 ft (359 m) and 1,000 ft (305 m), respectively.

2.4.2.3 Land Requirements

A permanent subsurface utility easement approximately 40 ft (12 m) wide would be needed along the entire Las Vegas Bay LCS alignment. In addition, construction activities would require 8.3 acres (3 hectares) at the LVBT2 working shaft and 2.5 acres (1 hectare) at the PRS shaft. After completion of construction activities, a permanent easement of 300 x 300 ft (91 x 91 m) at the working shaft and 180 x 75 ft (55 x 23 m) at the PRS shaft would be needed.

The Las Vegas Bay Diffuser Section of the alignment would require a 200 ft (61 m) wide temporary construction easement for approximately 400 ft (122 m) from the PRS to the high-water line of Lake Mead. Then a 1,000 ft (305 m) wide temporary construction easement would be needed to provide adequate working area for equipment, pipe, and trench spoils for the dredged segment of the pipeline. A 150 ft (46 m) wide permanent easement from the PRS to the shoreline would be needed once construction activities are complete.

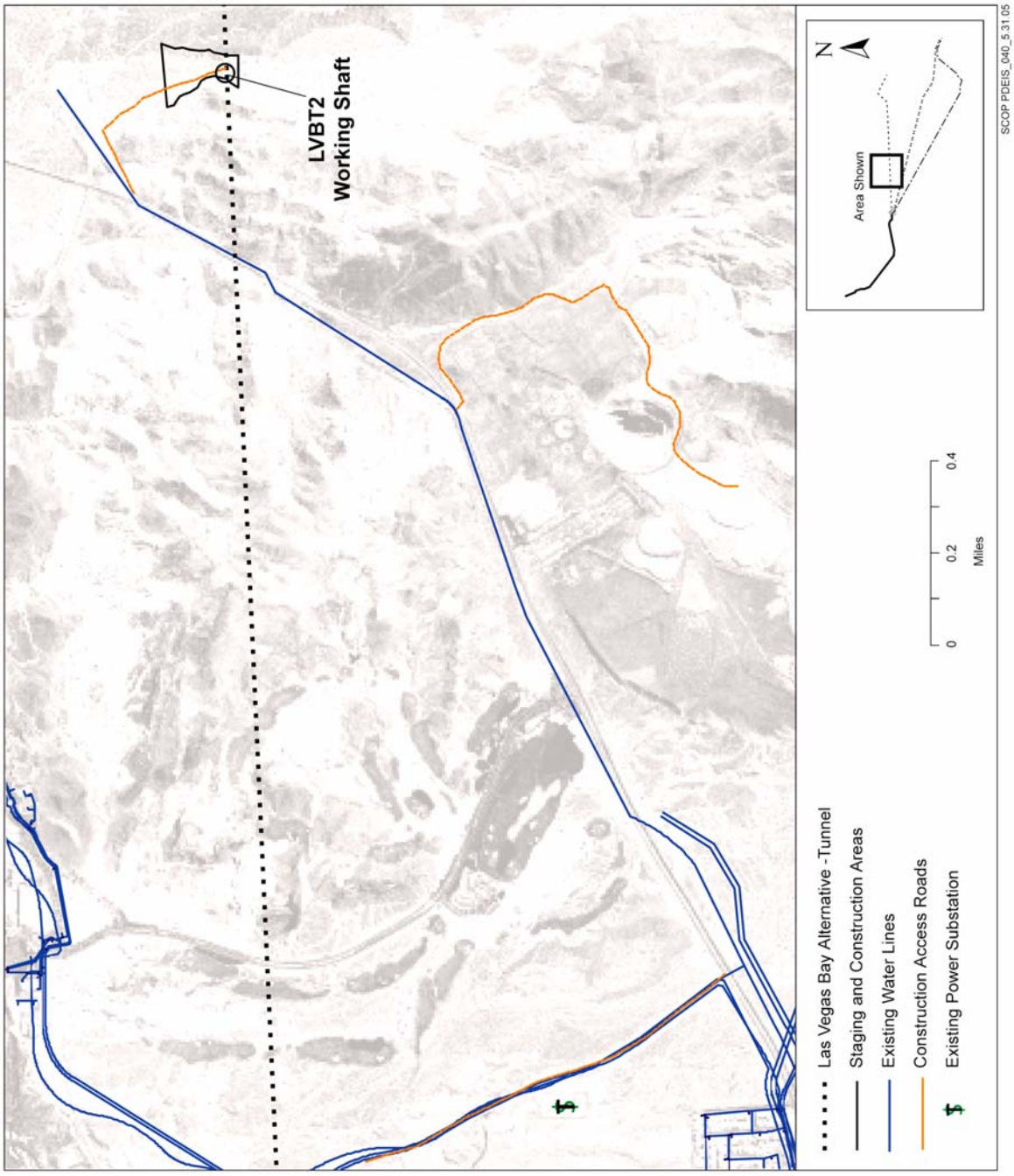


Figure 2.4-2 LVBT2 Working Shaft.

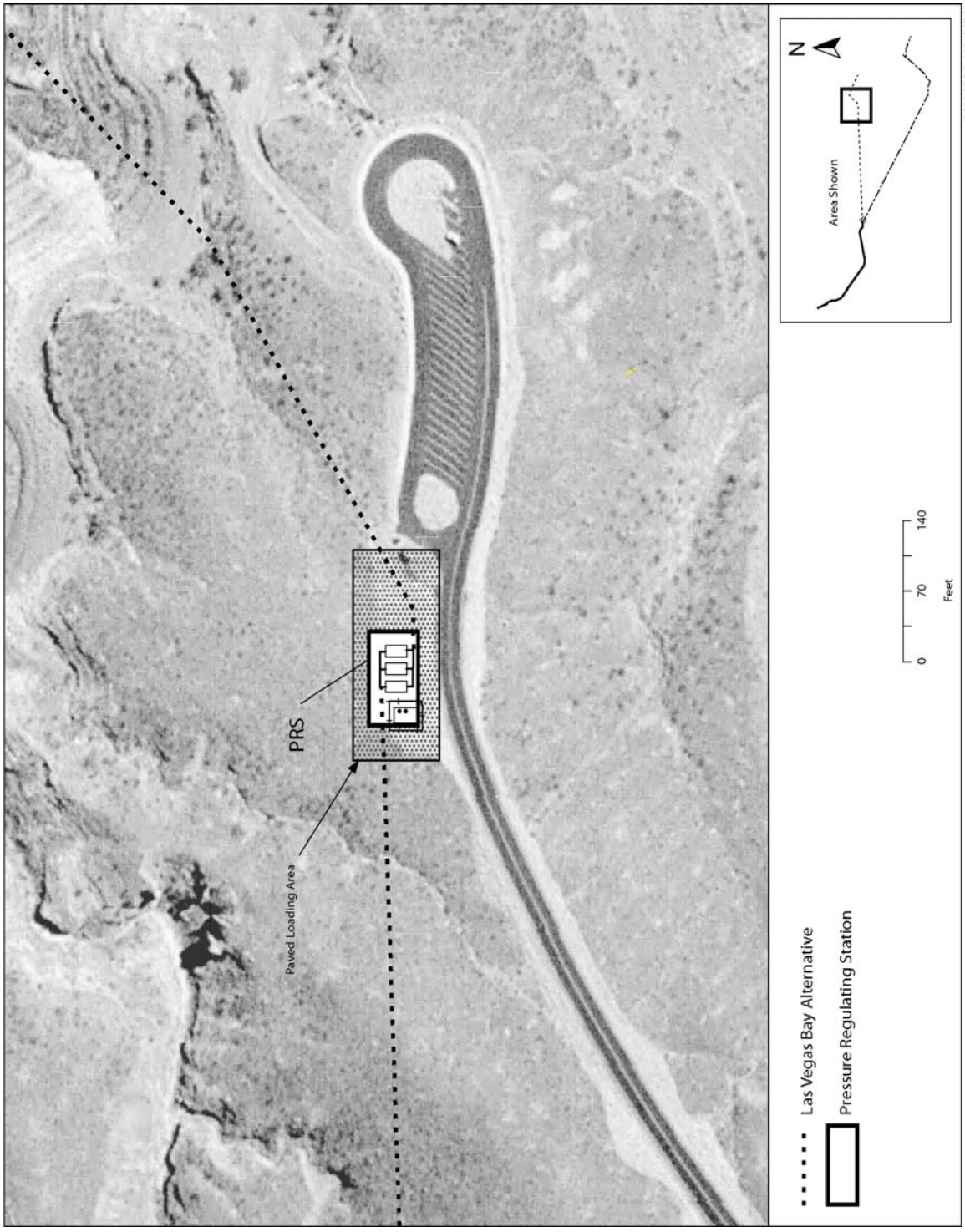


Figure 2.4-3 Las Vegas Bay Pressure Regulating Station.

2.4.2.4 Construction

Construction activities, durations, and types of equipment needed for each segment of the Las Vegas Bay LCS are presented in Table 2.4-1. Construction equipment, materials, and delivery durations for each segment of the alignment are shown on Table 2.4-2. The number of trucks that would deliver the materials is also shown on Table 2.4-2.

Table 2.4-1 Construction Activities, Duration, and Equipment for the Las Vegas Bay Lake Conveyance System.

Segment	Construction Activities	Construction Duration (months)	Equipment
Las Vegas Bay Tunnel – Phase 1 (LVBT1)	• Mobilization (material and equipment delivery) • Shaft excavation and blasting • Tunnel excavation • Tunnel lining and grouting • Final shaft lining • Connection to EI	39	• Cranes • Muck-loading equipment • Drills • Compressors • Trucks • Dozers • Graders • Backhoe • Construction trailers • Tunnel-boring machine
Las Vegas Bay Tunnel – Phase 2 (LVBT2)	• Mobilization (material and equipment delivery) • Shaft excavation and blasting • Tunnel excavation • Tunnel lining and grouting • Final shaft lining • PRS construction	64	Same as LVBT1
Las Vegas Bay Diffuser Section	• Mobilization • Pipeline Construction • Dredging • Subaqueous pipeline construction	12 [1]	• Barges • Barge-based cranes • Clamshell dredge • Tug or workboat • Turbidity curtain • Shore-based crane • Backhoe • Dozer • Trucks

Note:
[1] Six month time frame from October to March.

Table 2.4-2 Material and Equipment Deliveries for the Las Vegas Bay Lake Conveyance System

Segment	Material & Equipment	Duration	Truckloads
LVBT1	• Equipment		
	- Miscellaneous	• 3 months	• 20 per day
	- Construction trailers	• Once during mobilization and once during demobilization	• 10 (delivered then retrieved)
	• Materials		
	- Pipe	• 35 months	• 20 per day
	- Shaft lining and backfill	• 3 months	• 50 per day
	- Grout	• 12 months	• 50 per day
	- Pipe and pipe embedment materials for connection to EI (at EI Terminus)	• 31 months	• 50 per day
LVBT2	• Equipment		
	- Miscellaneous	• 3 months	• 20 per day
	- Construction trailers	• Once during mobilization and once during demobilization	• 10 (delivered then retrieved)
	• Materials		
	- Pipe	• 35 months	• 20 per day
	- Shaft lining and backfill	• 3 months	• 50 per day
	- Grout	• 12 months	• 50 per day
	- Pipe and pipe embedment materials for connection to Las Vegas Bay Diffuser Section	• 31 months	• 50 per day
Las Vegas Bay Diffuser Section	• Equipment		
	- Miscellaneous	• 6 months	• 20 per day
	• Materials		
	- Pipe	• 12 months	• 20 per day
	- Backfill	• 6 months	• 50 per day

Employment for project construction under the Las Vegas Bay Alternative would consist of approximately 8,808 workers for each year of construction from 2005 until 2009. Once the EI is constructed, the number of workers needed would be lowered to approximately 7,564 workers. The number of workers required each year does not reflect an additional 8,808 and 7,564 people per year, rather it is expected that this is the total level of employment required per year to sustain the construction, construction support, and other commercial growth rate.

Construction activities and equipment for the Las Vegas Bay Diffuser segment are different than for the other segments of the alignment as shown on Table 2.4-2. Multiple pipes would exit the PRS shaft and later connect with the diffuser. The segment of the pipeline between the PRS and the shoreline would be installed using cut-and-cover techniques and dredging techniques. The remainder of the diffuser section would be fused onshore, floated into position by barges and slowly filled and allowed to sink to the bottom of Lake Mead. The dredging equipment would be staged from barges and the pipeline lowered into the dredged trench. A turbidity curtain would be installed in the areas that require dredging. The turbidity curtain would be the same as described for the Boulder Islands North LCS in Section 2.2.2.4.

The type of equipment, method of launching equipment, and construction materials for the Las Vegas Bay Diffuser segment of the alignment would be the same as those described for the Boulder Islands North Alternative in Section 2.2.2.4. The configuration of the diffuser is described in Section 2.2.2.2.3. A staging area with a floating dock would be located at the old marina as shown on Figure 2.4-4. Small quantities of fuel would be transported by boat to equipment located on the barges. A fueling facility would be provided at the old marina.

2.4.2.5 Spoils and Backfill Materials

The amount of spoils generated from each segment of the Las Vegas Bay LCS is presented in Table 2.4-3. The tunnel spoils/cuttings would be 2 to 6 inches (5 to 15 cm) or less in size. The spoils would be hauled from the working shaft via existing paved and unpaved roads.

2.4.2.6 Operation of the Las Vegas Bay Lake Conveyance System

The Las Vegas Bay LCS would be operated in a manner similar to that of the Boulder Islands North Alternative. The descriptions of operations and the Boulder Basin AMP are provided in Section 2.2.2.6.

2.5 Process Improvements Alternative

The Process Improvements Alternative has been added to the analyses presented in this EIS based on comments received from the public. Although the Process Improvements Alternative meets the definition of 'No Action' described in CEQ's Forty Questions, and is considered an extension of the No Action Alternative, it is analyzed and presented in this EIS as a separate alternative at the request of the public.

Under the Process Improvements Alternative, the CWC would not construct pipelines to transport effluent from the treatment facilities. Highly treated effluent would continue to be discharged to the Las Vegas Wash at the existing discharge locations, and effluent flows would continue to enter the Las Vegas Bay for mixing and diffusion in an uncontrolled fashion.

The three agencies responsible for municipal wastewater treatment and discharge would expand their facilities to handle the increasing quantities of wastewater through 2050 (Table 2.1-1) as described in Section 2.1.

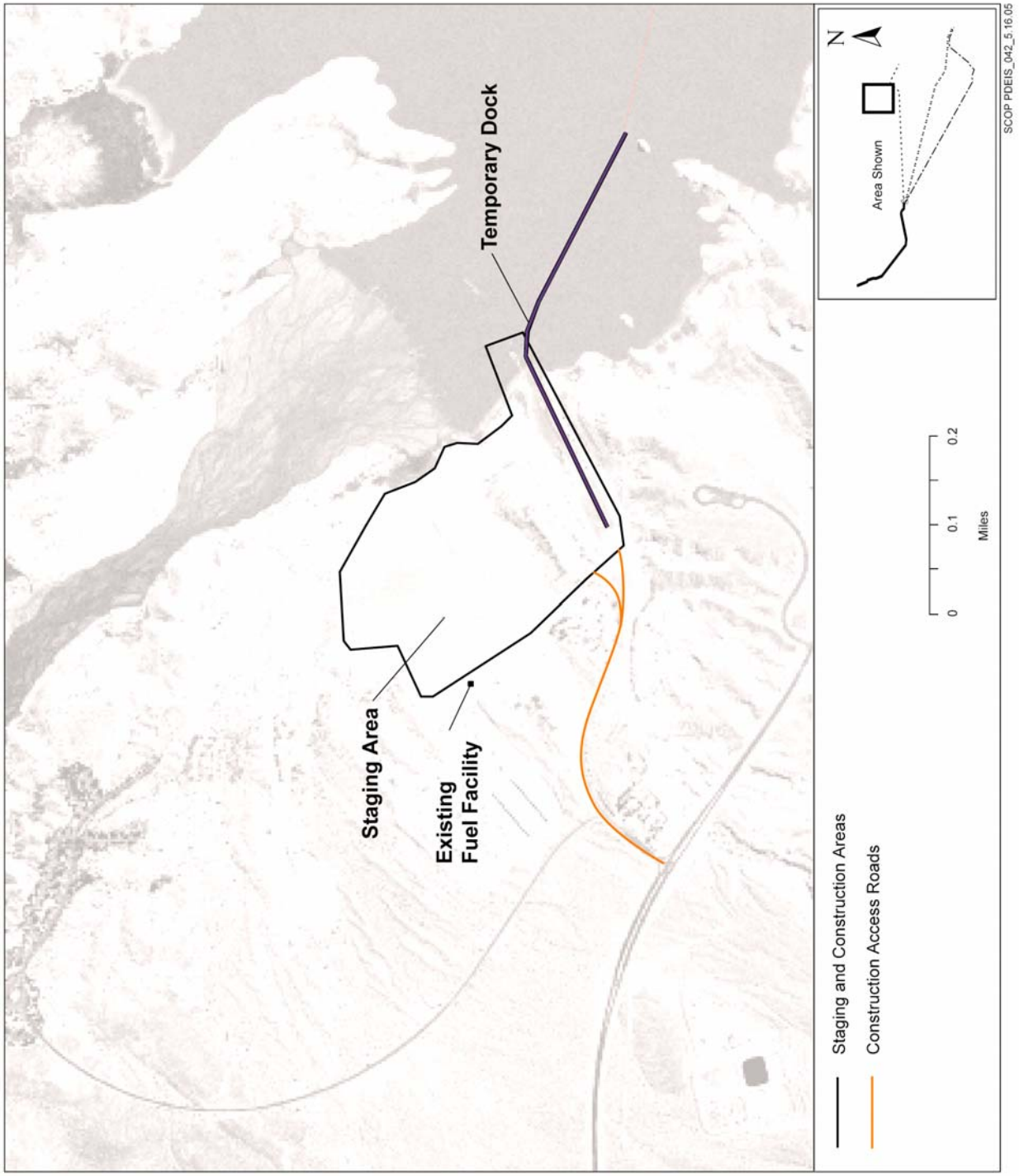


Figure 2.4-4 Old Marina Staging Area.

Table 2.4-3 Spoils Removed for the Las Vegas Bay Lake Conveyance System.

Segment	Spoils Removed (cubic yards)	Backfill / Grout (cubic yards)	Truckloads [1]
LVBT1 Working Shaft	1,300	900	110
LVBT1	95,000	12,300	5,365
LVBT1 Retrieval Shaft	3,000	2,000	250
LVBT2 Working shaft	9,400	150	478
LVBT2 and Diffuser Section	151,000	19,500	8,525
Las Vegas Bay PRS shaft	7,000	4,800	590
Total	**266,700**	**39,650**	**15,318**

Note:
[1] Approximate truckloads, depending upon the contractors choice of rock-hauling trailers, this table assumes 20 cubic yards per truckload. Backfill/grout was estimated at 20 cubic yards per truckload.

In addition to current, conventional treatment processes and plant optimization that are described in Section 2.1, best available technologies would be implemented to attempt to maintain an effluent TP loading of 334 lbs/day or lower loading as the Lake levels decrease. Microfiltration (MF) or ultrafiltration (UF) membranes are described in the following sections as examples of the types of technology that may be implemented to achieve the target effluent TP levels. However, as technologies change and improve, other technologies may be implemented.

Predictive water quality modeling indicates a TP loading of 434 lbs/day, including an effluent TP loading of 334 lbs/day and a non-point source phosphorus loading of 100 lbs/day entering the Las Vegas Bay would have a 16 percent probability of exceeding the water quality standard for chlorophyll at the flow rate predicted to occur in 2050 if the level of Lake Mead remains above 1,100 ft. However, the modeling indicates that when Lake Mead levels decrease to 1,000 ft, the effluent TP loading would need to be approximately 100 lbs/day to not result in water quality standard exceedances in the Las Vegas Bay. A TP concentration of 0.035 mg/L and 0.027 mg/L would need to be achieved by the treatment plants in 2030 and 2050, respectively, to avoid water quality standard exceedances. There may be differing professional opinions, but based on the knowledge and expertise of the Wastewater Treatment Specialists and Engineers consulted, in

2006 it was determined that RO may be the only technology that can reliably achieve combined effluent TP levels of between 0.02 and 0.05 mg/L on an annual average basis. Therefore, if Lake Mead levels decrease to 1,000 ft, RO would need to be implemented to achieve a combined effluent TP concentration between 0.02 and 0.05 mg/L on an annual average basis. However, RO results in a significant loss of return flow credits for southern Nevada and creates a large waste stream that makes the implementation of RO infeasible. Further discussion of the elimination of RO as an alternative is presented in Section 2.7.12.

The Process Improvements Alternative would cost approximately $205,483,592 in capital costs and $29,751,688 per year in O&M costs. The breakdown of capital costs include:

- $80,138,601 for implementation of MF/UF at the CLV treatment facility,
- $106,851,468 for implementation of MF/UF at the CCWRD treatment facility, and
- $18,493,523 for implementation of MF/UF at the COH treatment facility.

2.5.1 City of Las Vegas

Section 2.1.1.2 describes the optimization of the CLV WPCF. The CLV WPCF can reliably achieve 0.14 mg/L on an annual average basis as the lowest possible reliable effluent TP concentration through optimization of the plant. In addition to plant optimization, the WPCF would need to add chemicals and implement the use of MF or UF membranes to reliably achieve TP concentrations of 0.05 mg/L on an annual average basis. The MF/UF membranes would be used to treat the effluent from the sand filters.

Implementation of MF/UF membranes at the CLV WPCF would require modification of existing infrastructure and implementation of new infrastructure. Modification to existing infrastructure would include insertion of piping to insert the MF/UF membrane step following the existing sand filters and before disinfection. New infrastructure to implement MF/UF membranes would include:

- An influent structure,
- MF/UF equipment,
- Concrete tanks for housing the membranes, and
- Containment for the chemicals and cleaning system.

In addition to the MF/UF membranes, additional alum must be added to remove TP (down to a concentration of 0.05 mg/L on an annual average basis). This would generate additional chemical sludge. At a flow of 91 mgd, the additional alum sludge generated to further remove soluble phosphorus would be 170 tons (wet) of sludge per day. The increased chemical sludge would continue to be disposed of in the same manner that it is now. Chemical is added ahead of the filters, and the solids are recycled back into the liquid stream with the remaining filter backwash water. Disposal of the sludge would continue as described in Section 2.1.1.1.

Should it become necessary for the CLV WPCF to achieve between 0.02 and 0.05 mg/L TP on an annual average basis, additional treatment processes would be needed. Other technologies, not

currently known or available, would be needed to reliably achieve TP levels of between 0.02 and 0.05 mg/L (annual average).

2.5.2 Clark County Water Reclamation District

Section 2.1.2.2 describes the optimization of the CCWRD facilities. The CCWRD can reliably achieve 0.08 mg/L as the lowest possible reliable effluent TP concentration on an annual average basis through optimization of the plant. In addition to plant optimization, new pressure MF/UF membranes or submerged MF/UF membranes would be required to reliably achieve TP concentrations of 0.04 mg/L (annual average). The CCWRD would evaluate the use of MF/UF membranes, instead of filters, in its next 40 mgd plant expansion (about 30 mgd of new MF/UF membranes). The new MF/UF membranes would be installed in the existing flocculation basins and tertiary filters.

The implementation of MF/UF membranes at the CCWRD facilities would not require additional land. The use of MF/UF membranes would generate a waste stream that would contain solids. Approximately 830 lbs/day of sludge would be produced assuming a flow of 110 mgd. The waste stream would be recycled back into the liquid stream with the remaining filter backwash water. Digested sludge is dewatered by centrifuge, biosolids are taken to a landfill, and solids-processing sidestreams are recycled back to the plant influent. The facility currently produces approximately 540 tons (wet) of additional sludge per day.

As previously described, it would appear that the existing facilities with the recent optimization steps taken by CCWRD can achieve an effluent ortho-phosphorus concentration of 0.02 mg/L on a yearly average. However, the monthly variation during the 2005 and 2006 period ranged between 0.005 and 0.048 mg/L. With the addition of a microfiltration process, the effluent TP would typically be below 0.05 mg/L; consequently no additional process technology is required beyond the microfiltration units.

2.5.3 City of Henderson

Section 2.1.3.2 describes the optimization of the COH WRF. The COH WRF can reliably achieve 0.10 mg/L as the lowest possible reliable effluent TP concentration on an average annual basis through optimization of the plant. In addition to plant optimization, the WRF would need to implement additional technologies, not currently known or available, to reliably achieve TP concentrations of between 0.02 and 0.10 mg/L (annual average).

2.6 Alternatives Development

The alternatives that are analyzed in this EIS were developed over several years through the preparation of technical studies, water quality modeling, and interaction with numerous agencies and members of the public. A brief history of the project is presented in Section 1.3. This section describes the process and activities that have lead to the selection of the alternatives that are analyzed in this EIS.

The process began in 1994. Table 2.6-1 presents the timeline of events that resulted in the development of 11 alternatives that were studied in the Alternate Discharge Study.

2.6.1 Alternate Discharge Study

Numerous solutions to address the increasing effluent quantities in the Valley have been considered beginning with the 11 alternatives identified in the *Needs Assessment Study* and continuing through the Alternate Discharge Study, and finally the alternatives development for the EIS.

The potential alternatives identified in the *Needs Assessment Study* were evaluated during the Alternate Discharge Study. One goal of the Alternate Discharge Study was to move from a list of 11 alternate discharge options to one, viable, preferred alternative. This was accomplished by meeting with key stakeholders to identify a range of issues, perceptions, and concerns. Informal interviews were conducted during which these stakeholders were invited to provide their own and/or their agency's perspectives.

The stakeholders included local, state, and federal government agency representatives as well as local environmental groups. All 28 members of the LVWCC were included. Additionally, the CWC interviewed key downstream users, the MWD, the State of Arizona, and the BLM.

One objective of the interviews was to identify potential constraints. Constraints are issues or problems that could cause an alternative to be more difficult, costly, time consuming, or completely infeasible. The constraints discussed in Section 2.7 were identified during the stakeholder interviews or were issues developed by the ADST. These constraints were used in the decision process to select alternatives that best meet the objectives of the study. The options remaining from the list were used as a foundation for the alternatives studied further in this document.

2.6.2 Clean Water Coalition Citizens Advisory Committee

As discussed in Section 1.6.2, the governing board of the CWC established the CWCCAC to gather public input on water- and wastewater-related issues impacting the southern Nevada watershed and parts of the lower Colorado River. One of the CWCCAC's objectives was to help determine the best alternative for the long-term wastewater discharge outfall location.

The CWCCAC process was made up of the following elements:

- Identification of CWCCAC Purpose,
- Development of an understanding of the regional wastewater and water resource systems,
- Identification of CWCCAC Areas of Concern,
- Development of the CWCCAC Problem Statement to be solved,

Table 2.6-1 Chronology of Events for Development of the SCOP Alternatives.

Date	Event	Result
September 1994	Identification of need to address increased water supplies and facilities.	Advisory committee of Integrated Resources Planning Advisory Committee (IRPAC) formed.
June 1995	IRPAC completed Phase I recommendations regarding water resources, facilities, conservation, planning and finance.	Recommend maximizing reclaimed water where feasible.
November 1995	IRPAC completed Phase II recommendations regarding drinking water, rates, funding and revenue sources.	Recommend increase in sales tax for new wastewater facilities in the region.
July 1995	Wastewater agencies began planning process to evaluate processes needed to meet future water supplies and facilities.	Six alternatives were developed for future discharge scenarios.
July 1997	*Needs Assessment Study* evaluation of the six alternatives completed.	Recommended continued treatment and discharge to Las Vegas Wash, and a feasibility study of alternate discharge locations at Virgin Basin and Boulder Basin.
July 1997	Water Quality Citizens Advisory Committee (WQCAC) formed.	Recommended that the wastewater agencies reduce flows to the Las Vegas Wash by pursuing alternate discharge locations.
June 1998	WQCAC issued recommendations to study water quality in nine areas including the formation of the LVWCC.	The LVWCC was formed to develop a comprehensive plan for the Las Vegas Wash. One of the study teams was the Alternate Discharge Study Team (ADST).
October 1998	LVWCC formed study teams, including ADST.	LVWCC ADST formed a list of 18 alternate discharge options and selection criteria.
October 1999	Alternate Discharge Study Phases I and II commissioned to narrow choices.	Narrowed choices to 11 alternatives.

- Development of an understanding of the potential solution elements,
- Development of evaluation criteria based on areas of concern,
- Application of weights and rating of alternative discharge locations against evaluation criteria, and
- Development and presentation of CWCCAC recommendations to the CWC.

The CWCCAC commenced by outlining their purpose, which was:

To support the Clean Water Coalition in their efforts to identify and implement long-term solutions for the treatment, discharge and reuse of our community's wastewater by studying the nature of our wastewater needs, examining possible solutions to our challenges, evaluating the effect and impact of the proposed solutions and making recommendations to the CWC Board of Directors for implementation.

The CWCCAC's information-gathering process included:

- Taking a tour of the wastewater treatment facilities and Lake Mead;
- Observing presentations of scientific data and results;
- Participating in discussions regarding numerous technical issues; and
- Coordinating with many agencies including NDEP, SNWA, and the three CWC member agencies (CCWRD, CLV, and COH).

Once the CWCCAC felt comfortable that they understood and had explored all the issues, they developed weighted criteria by which all the SCOP alternatives would be rated. Key criteria, water modeling results, comparison of estimated costs of alternatives, and the alternative rating results are presented in the CWCCAC Recommendations Report, which is available upon request.

In an effort to more thoroughly present information to the CWCCAC and allow adequate opportunity for evaluation, a Financial Workgroup was created whose members are volunteers from the CWCCAC. This group met every month in advance of the CWCCAC meetings and reviewed all information in-depth relating to the purpose of the CWCCAC. The Financial Workgroup performed the initial evaluation and ranking of the project criteria and proposed alternatives, which were then taken to the full CWCCAC for review, modification, and acceptance. The Financial Workgroup also developed the draft overall recommendations, which were then discussed, modified, and finalized by the full CWCCAC. The CWCCAC made six recommendations. Many of these recommendations are in progress or have been completed.

- Systems Integration: Promote and participate in a planning process for identifying and integrating all the water resource elements in the Las Vegas Wash/Lake Mead system. In progress.
- Alternate Discharge Location: Identify the preferred alternate discharge location for the community's effluent that addresses the needs of our stakeholders in the areas of water quality, increasing flow projections, and future regulatory standards. Completed.
- Verification of Results and Approach: Prior to the implementation of the SCOP and its associated programs, an independent review of the approach to date and results should be conducted to verify the findings. Completed.
- Financial Considerations: A funding plan should be developed that considers the ability of the local rate payers and businesses to bear its costs, examines a variety of funding mechanisms, and considers the needs of or impacts to all affected stakeholders. In progress.
- Balance Water Resources: The CWC should support efforts to optimize and balance all water resources in southern Nevada. In progress.

- Public Outreach: In tandem with the development of a final wastewater solution, develop a comprehensive outreach plan to foster partnerships with all stakeholders in the acceptance and implementation of the project (CWCCAC 2004). In progress.

2.7 Alternatives Considered but Eliminated from Further Analysis

A NEPA review specifies the purpose and need for an action, describes the action that the federal agency proposes to meet that purpose and need, and identifies reasonable alternatives. A potential alternative might be eliminated from detailed consideration for many reasons including, but not limited to, if the alternative does not meet the purpose and need for the project, would take too long to implement, would be prohibitively expensive, or would be highly speculative in nature and thus is considered unreasonable. This section identifies the alternatives that were eliminated from further consideration and provides a brief explanation of the reasons for elimination. These alternatives include the following:

- Alternate Alignments for the EI,
- Off-channel wetlands,
- Floating wetlands,
- Impoundment for creation of wetlands,
- North shore pipeline and wetlands,
- North shore pipeline and outfalls,
- Aeration,
- Discharge downstream of Hoover Dam,
- Discharge upstream of Hoover Dam,
- Discharge in the vicinity of Callville Bay,
- Discharge effluent near the Narrows, and
- Implementation of RO.

2.7.1 Alternate Alignments for the Effluent Interceptor

A variety of alignments and construction methods were considered during development of alternatives for the EI. This section presents a summary of the option(s) considered for each reach of the EI. The potential impacts to environmental resources for the evaluated alignments would be similar to the impacts described for the EI-alignments in Section 4.0. Exceptions or additions to those impacts are identified as they pertain to each segment described.

2.7.1.1 Reach 1 Alternatives

Three alternative alignments for Reach 1 were considered but eliminated from further analysis. The three alignments not carried forward are shown on Figure 2.7-1. As shown, each of the three

alignment alternatives begin at the CLV outfall connection structure then follow a different alignment to a common connection point utilizing various combinations of cut-and-cover pipeline construction and tunneling. From the connection point, Reach 1 then continues to the vicinity of the CCWRD connection structure in a manner identical for all three alternatives, which are described in more detail below.

2.7.1.1.1 Alternative R1-1

The alignment for Alternative R1-1 would begin at the CLV treatment plant and go east along Desert Inn Road to a point just west of Hollywood Boulevard, at which point it would continue south parallel to Hollywood Boulevard until it reaches the CCWRD AWT (Figure 2.7-1). The majority of Alternative R1-1 would be constructed by tunneling (6,070 ft [1,850 m]). The remaining 770 ft (235 m) would be constructed using cut-and-cover techniques. The 6,840 ft (2,085 m) alignment would begin with a connection to the existing CLV outfall channel and cross Desert Inn Road to the south ROW line. A tunnel would be constructed beginning at the Desert Inn Road south ROW line and the Las Vegas Wash, following an alignment in the easterly direction to a point about 250 ft (76 m) east of the intersection of Desert Inn Road and Hollywood Boulevard. A second tunnel shaft would be constructed at this location. The alignment then continues in a southerly direction east of Hollywood Boulevard to the common connection point. From this point, the pipeline is constructed using cut-and-cover techniques, following the southern edge of Telephone Line Road in a southeasterly direction within CCWRD-owned land to the vicinity of the CCWRD connection point.

Alternative R1-1 was eliminated because:

- Construction costs resulting from the increased length of tunnel would be higher than other alternatives, and
- Existing SNWA facilities would be impacted.

2.7.1.1.2 Alternative R1-2

A combination of cut-and-cover pipeline construction and tunneling would be required for Alternative R1-2. The alignment would begin with a connection to the existing CLV outfall channel, cross Desert Inn Road following the southern boundary of the Desert Inn Road ROW within CLV property, continuing to the west bank of the Las Vegas Wash. The EI, using cut-and-cover construction, would follow the west bank of the Las Vegas Wash, adjacent to the flood control easement, in a southeasterly direction to approximately 450 ft (137 m) north of the southern property line of the CLV parcel. There would be a tunnel shaft at this location. The tunnel would run in an easterly direction, crossing the Las Vegas Wash and the Woodside Homes Development. The tunnel continues east (aligned along a proposed street within the Woodside Homes Development property) to a point 250 ft (76 m) east of Hollywood Boulevard.

There would be a second tunnel shaft at this location. The alignment then continues in a southerly direction east of Hollywood Boulevard to the common connection point. From this point, the pipeline would be constructed using cut-and-cover techniques, following the southern

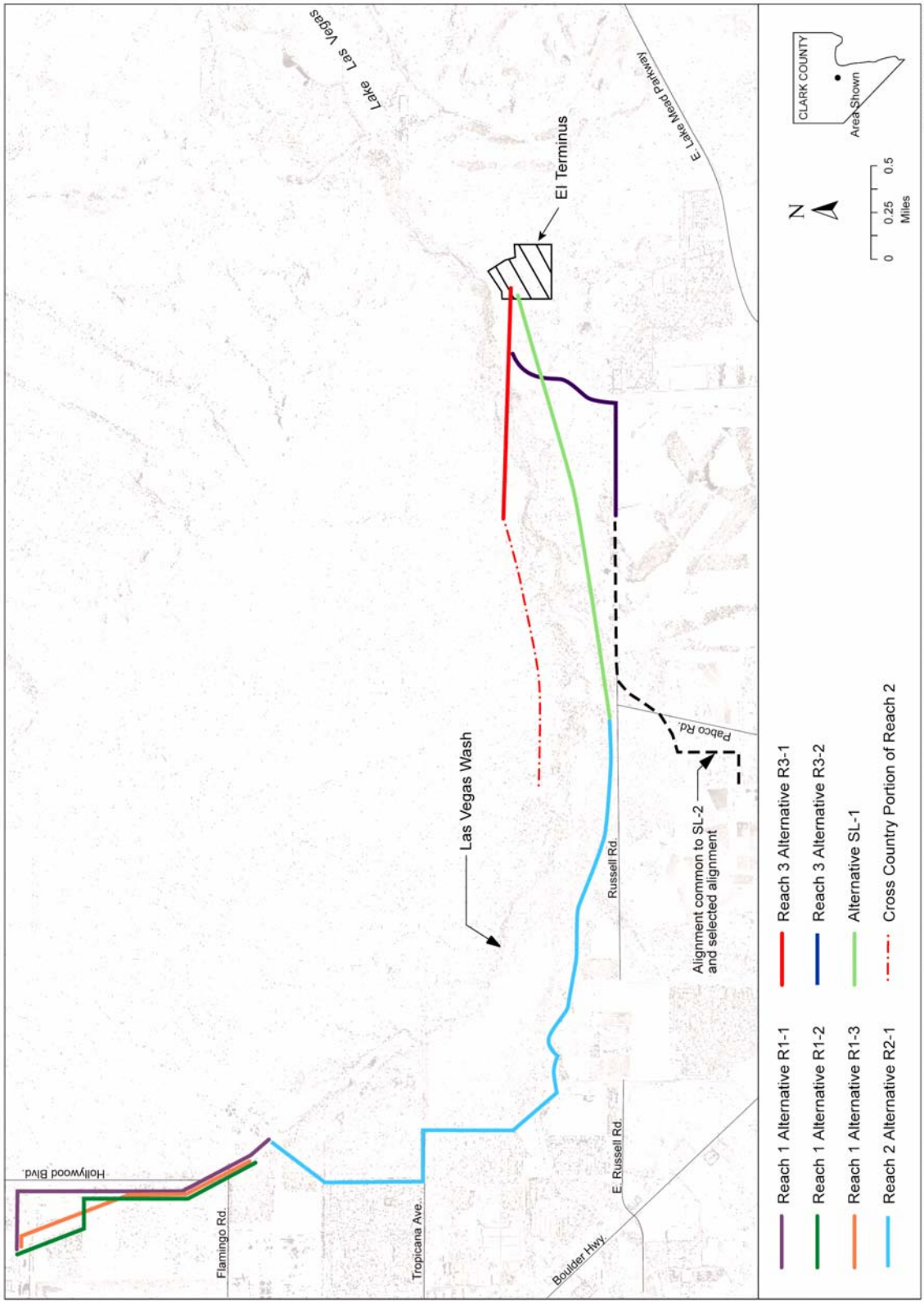


Figure 2.7-1 Effluent Interceptor Alignments Eliminated.

edge of Telephone Line Road in a southeasterly direction within CCWRD-owned land to the CCWRD connection point.

Alternative R1-2 was eliminated because:

- Construction costs resulting from the increased length of tunnel would be higher than other alternatives,
- Private property would need to be purchased or easements would need to be acquired, and
- Existing SNWA facilities would be impacted.

2.7.1.1.3 Alternative R1-3

The East Bank alignment would begin with a connection to the existing CLV outfall channel and would cross Desert Inn Road to the south ROW line. The EI would follow the south ROW of Desert Inn Road easterly, crossing under the Las Vegas Wash to the east bank. The EI would then head in a southeasterly direction following the east bank of the Las Vegas Wash to the vicinity of the SNWA Whitney Lateral, go under the Whitney Lateral, and continue along Hollywood Boulevard to the connection with the CCWRD AWT and CP.

Alternative R1-3 was eliminated because:

- Additional ROWs and easements would be required,
- Crossing the Las Vegas Wash at the location where the proposed Desert Inn Bridge would cross the Las Vegas Wash would expose the EI to future scour from the bridge, and
- Private property would need to be purchased or easements would need to be acquired.

2.7.1.2 Reach 2 Alternatives

Three alternatives for Reach 2 were considered but eliminated from further analysis. One alternative, R2-1, was an alignment located to the south of the Las Vegas Wash. The other two alternatives addressed the restoration of the cross-country portion of the northern Reach 2 alignment.

2.7.1.2.1 Alternative R2-1

The South alignment for Reach 2 would leave the CCWRD plant facilities and proceed south along the westerly boundary of the CCWRD property. The alignment would turn east generally following the southerly boundary of the Wetlands Park to a connection point in the vicinity of the COH WRF.

Alternative R2-1 was eliminated because:

- The south alignment is 3 miles (5 km) longer than the other alignments,
- There would be extensive disruption to city streets and utilities,
- There would be extensive disruption to the Nature Preserve in the Wetlands Park,
- There would be the increased potential to encounter contaminated shallow groundwater, and

- A larger pipe diameter would be needed because of the minimal slope along the southern portion of the Las Vegas Wash.

2.7.1.2.2 Alternative R2-2 and Alternative R2-3

Alternatives R2-2 and R2-3 concern the restoration of the construction area through the cross-country portion of Reach 2 (Figure 2.7-1). This portion of Reach 2 is located within the Wetlands Park. Alternative R2-3 would trench through the cross-country portion of Reach 2, and a maintenance road would be constructed over the pipeline scar. Alternative R2-2 would tunnel the full length of the cross-country portion of Reach 2 resulting in minimal surface disturbance in the area. These two alternatives were eliminated from further analysis because Clark County Parks and Community Services preferred the selected alternative, which includes trenching through the cross-country portion of the alignment, restoring the alignment to its original grade, and constructing a chat trail on the pipeline alignment.

2.7.1.3 Reach 3 Alternatives

Two alternative alignments for Reach 3 were considered but eliminated from further analysis. The two alignments not carried forward are shown on Figure 2.7-1.

2.7.1.3.1 Alternative R3-1

Alternative R3-1 would consist of a tunnel alignment that crosses under the Las Vegas Wash at an oblique angle (Figure 2.7-1). This alternative was not carried forward because engineering and tunneling experts determined that it is preferable to cross the Las Vegas Wash at a perpendicular angle.

2.7.1.3.2 Alternative R3-2

The South alignment (Alternative R3-2) would start at the connection with the COH WRF outfall and Reach 2 of the EI (Figure 2.7-1). Reach 2 of the EI would cross the Las Vegas Wash via a tunnel approximately 0.25 mile (0.4 km) upstream of the Pabco Road ECS to meet the COH connection at the existing COH WRF outfall. The alignment would then head in an easterly direction via open excavation to the vicinity of the C-1 Channel. The EI would cross under the C-1 Channel at a depth of approximately 50 to 60 ft (15 to 18 m) and continue in a tunnel to the EI Terminus. The depth of the tunnel would be determined by reaching competent rock, which could be approximately 130 to 150 ft (40 to 46 m) below the surface.

Alternative R3-2 was eliminated because:

- Contaminated groundwater would be encountered,
- Existing utilities conflict with the alignment,
- A larger diameter pipeline would be needed to cross under the Las Vegas Wash prior to connecting with the COH flows, and

- A longer tunneling segment would be required to cross beneath the C-1 Channel and the Henderson Landfill.

2.7.1.4 South Lateral Pipeline Alternatives

One South Lateral Pipeline alternative, was considered but eliminated from further analysis. The alignment not carried forward is shown on Figure 2.7-1 as "Alternative SL-1". This alternative was not carried forward in the EIS because of the potential to unearth debris from the Henderson Landfill during construction. Additional reasons for eliminating this alignment include adverse impacts to the proposed COH golf course, longer alignment distance, and hydraulic restrictions.

2.7.2 Off-channel Wetlands

Effluent would be removed from the Las Vegas Wash and channeled through constructed wetlands before returning to Lake Mead. Storm flows and urban runoff would continue to flow in the Las Vegas Wash. There are four options for the points of diversions and returns that could be included in any combination:

- Divert effluent directly from the treatment facilities to the off-channel wetlands,
- Divert effluent indirectly from the Las Vegas Wash to the off-channel wetlands,
- Return flows from the wetlands to the Las Vegas Wash, and
- Return flows from the wetlands to the Las Vegas Bay.

The Off-channel Wetlands Alternative would require a combined effluent delivery system, construction of 5 to 10 miles (8 to 16 km) of pipeline, and construction of pumping stations. Approximately 1,000 to 4,000 acres (405 to 1,619 hectares) of treatment wetlands would be required to accommodate the projected effluent quantities.

This alternative was eliminated because:

- This option would require a large amount of land permanently.
- Wetlands constructed in uplands could affect the threatened and endangered desert tortoise and Las Vegas bear poppy *(Arctomecon californica)*.
- Evaporation and transpiration losses from wetlands vegetation would reduce the amount of return flow credits, as less effluent would be returned to Lake Mead.
- Wetlands would require continuous and, essentially, permanent monitoring to ensure sustained function and value.
- Wetlands would require periodic and continuous maintenance. This could include harvesting and disposal of vegetation if monitoring showed bioaccumulation of toxics such as salts or metals.
- Wetlands have the potential to increase undesirable species such as mosquitoes and midge flies.
- Wetlands would need to be designed to contend with infrequent but severe storm flows.

- Wetlands are reported to potentially increase TDS, Total Organic Carbon (TOC), and coliform bacteria. This could result in decreased water clarity in the Las Vegas Bay. In addition, there is the possibility for accumulation of toxic compounds.
- Humidity would increase in the vicinity of the constructed wetlands.
- Vegetation biomass would increase causing a fire hazard when dried either seasonally or during maintenance.
- This option does not meet the requirement for flexibility in management of effluents that is a primary component of the purpose and need for the proposed action.

2.7.3 Floating Wetlands

Wetlands would be constructed to float in the inner Las Vegas Bay and provide some nutrient removal. Effluent would continue to flow through the Las Vegas Wash. Approximately 2,500 acres (1,012 hectares) of floating wetlands would be required for nitrogen removal from the projected effluent quantities. Seasonal aeration (mixing) would be required for waters greater than 27 ft (8 m) deep.

This alternative was eliminated because:

- Safety would be a concern for persons attempting to climb on the wetlands platforms or boat in the vicinity.
- Wetlands would require continuous and, essentially, permanent monitoring to ensure sustained function and value.
- Wetlands would require periodic and continuous maintenance. This could include harvesting and disposal of vegetation if monitoring showed bioaccumulation of toxics such as salts or metals.
- Floating wetlands of this size, in a fluctuating lake system, and in this climate, are considered technologically experimental.
- Increased recreation in the Las Vegas Bay such as fishing and boating may impact the razorback sucker, a threatened and endangered species found in the Las Vegas Bay.
- The continued discharge of highly treated effluent to the Las Vegas Wash does not meet the requirement for flexibility in management of effluents that is a primary component of the purpose and need for the proposed project.
- Fluctuations in Lake Mead water levels would require the wetlands be moved to the optimal depth and effluent plume location. Sharply decreased water levels could necessitate the wetlands be towed where the Lake depth could exceed the zone of their effective influence.

2.7.4 Impoundment for Creation of Wetlands

A low-level dam would be constructed at the lowest part of the Las Vegas Wash higher than the maximum Lake level. The purpose of the dam would be to impound water, allowing wetlands to form naturally upstream. The number of acres of wetlands and riparian habitat formed would depend upon the placement of the impoundment, but due to topography in the area, it does not

appear that they would exceed 100 acres (40 hectares). Effluent would continue to flow through the Las Vegas Wash. A combination concrete and riprap dam would likely be necessary to handle the wide range of flows. The area of wetlands created would be dependent upon the height of the dam.

This alternative was eliminated because:

- Wetlands created would not be sufficient to address the entire effluent stream.
- Wetlands constructed in uplands could affect the threatened and endangered desert tortoise and Las Vegas bear poppy.
- Evaporation and transpiration losses from wetlands vegetation would reduce the amount of return flow credits, as less effluent would be returned to Lake Mead.
- Wetlands would require continuous and essentially permanent monitoring to ensure sustained function and value.
- Wetlands would require periodic and continuous maintenance. This could include harvesting and disposal of vegetation if monitoring showed bioaccumulation of toxics such as salts or metals.
- Silt removal would be required following storm events.
- Wetlands have the potential to increase undesirable species such as mosquitoes and midge flies.
- The impoundment may not survive a 100-year storm event. In smaller storms, the structure would be overtopped and the wetlands would be inundated and possibly submerged. This could serve as a sediment trap that adversely affects the wetlands.
- Wetlands are reported to potentially increase TDS, TOC, and coliform bacteria. This could result in decreased water clarity in the Las Vegas Bay. In addition, there is the possibility for accumulation of toxic compounds.
- The continued discharge of highly treated effluent to the Las Vegas Wash does not meet the requirement for flexibility in management of effluents that is a primary component of the purpose and need for the proposed project.

2.7.5 North Shore Pipeline and Wetlands

Effluent would be removed from the Las Vegas Wash and delivered to Lake Mead via discharge into a series of washes along the northern perimeter of the Las Vegas Bay and Boulder Basin. Flow through these washes would be similar to flow through the Las Vegas Wash except that the flow would be diverted through a currently undetermined number of washes, thereby increasing the flow through each. The anticipated need for ECSs in each wash may result in the creation of wetlands.

This alternative would require construction of 15 to 20 miles (24 to 32 km) of large-diameter pipe, pumping stations, and a combined-effluent delivery system. In addition, ECSs would be needed to prevent erosion in the washes.

This alternative was eliminated because:

- A large amount of land would be needed.
- Wetlands constructed in uplands could affect the threatened and endangered desert tortoise and Las Vegas bear poppy.
- Wetlands would require continuous and, essentially, permanent monitoring to ensure sustained function and value.
- Wetlands would require periodic and continuous maintenance. This could include harvesting and disposal of vegetation if monitoring showed bioaccumulation of toxics such as salts or metals.
- Wetlands have the potential to increase undesirable species such as mosquitoes and midge flies.
- Wetlands would have to be designed to contend with infrequent but severe storm flows.
- Wetlands are reported to potentially increase TDS, TOC, and coliform bacteria. This could result in decreased water clarity in Las Vegas Bay. In addition, there is the possibility for accumulation of toxic compounds.
- Humidity would increase in the vicinity of the constructed wetlands.
- Vegetation biomass would increase causing a fire hazard when dried either seasonally or during maintenance.
- Algal blooms may result from adding nutrient-rich effluent to Lake Mead bays along the north shore that currently have relatively low nutrient loads.
- Grade control and erosion protection would be required on the washes that are conveying surface flow effluent to Lake Mead.

2.7.6 North Shore Pipeline and Outfalls

Effluent would be removed from the Las Vegas Wash and delivered to bays on the north shore of the Las Vegas Bay and Boulder Basin via a pipeline. The effluent would enter Lake Mead through a series of shallow outfalls. This alternative would include the construction of 15 to 20 miles (24 to 32 km) of large-diameter pipe, construction of pumping stations, and a combined-effluent delivery system.

This alternative was eliminated because:

- Installation of the pipeline would disturb large areas and disrupt the recreational experience for LMNRA users.
- Algal blooms may result from adding nutrient-rich effluent to Lake Mead bays along the north shore that currently have relatively low nutrient loads.
- Fluctuations in Lake Mead water levels would require that the outfalls be carefully designed so that mixing would be maximized year-round.

2.7.7 Aeration

An aeration system would be constructed within the inner Las Vegas Bay. The purpose of this alternative is to improve water quality through aeration and mixing. Effluent would continue to flow through the Las Vegas Wash. This alternative would require construction of a submerged diffused aeration system, an on-shore air pumping system, and could require extensive underwater construction.

This alternative was eliminated because:

- Safety would be a concern for persons diving or boating in the vicinity.
- Compressors for aeration would require regular maintenance. In addition, if the system is covered with sediment periodic, dredging may be required.
- Aeration technology is considered experimental for a project this large, in a fluctuating lake system, and in this climate.
- Fluctuations in Lake Mead water levels would require the system be moved to the optimal depth and effluent plume location. Sharply decreased water levels could result in the aeration system being too shallow or not submerged.
- Recreation in the Las Vegas Bay would be adversely affected by noises generated at the on-shore facility containing air compressors. There are also concerns about the visual impacts of air bubbles breaking the surface.
- The continued discharge of highly treated effluent to the Las Vegas Wash does not meet the requirement for flexibility in management of effluents that is a primary component of the purpose and need for the proposed project.
- Boating and fishing opportunities within the Las Vegas Bay may be impacted if the area over the submerged piping needs to be protected from boat anchors for the safety of the equipment and the boaters.

2.7.8 Discharge Downstream of Hoover Dam

Effluent would be conveyed in a common pipeline and tunnel system to an underwater discharge point downstream of Hoover Dam (Figure 2.7-2). It was identified early in the alternatives selection process that the discharge of highly treated effluent below Hoover Dam may impact Lake Mohave. Therefore, Lake Mohave was modeled by J.E. Edinger Associates using the 2-Dimensional CE-QUAL-W2 hydrodynamic and water quality model. Through the modeling and review of historical data, it was determined that Lake Mohave has not historically provided significant uptake for TP delivered through the Hoover Dam. The additional load from an effluent discharge below Hoover Dam is likely to be passed relatively unchanged to the downstream reservoir (Lake Havasu). Modeling also indicate that the dischargers would not be able to meet temperature and other water quality standards.

The Lake Mohave alternative would require a combined effluent delivery system of 20 to 25 miles (32 to 40 km) of large-diameter tunneled pipeline. The tunnel alignment would be near Gold Strike Canyon, a popular hiking and recreational area. Tunnel construction along Gold

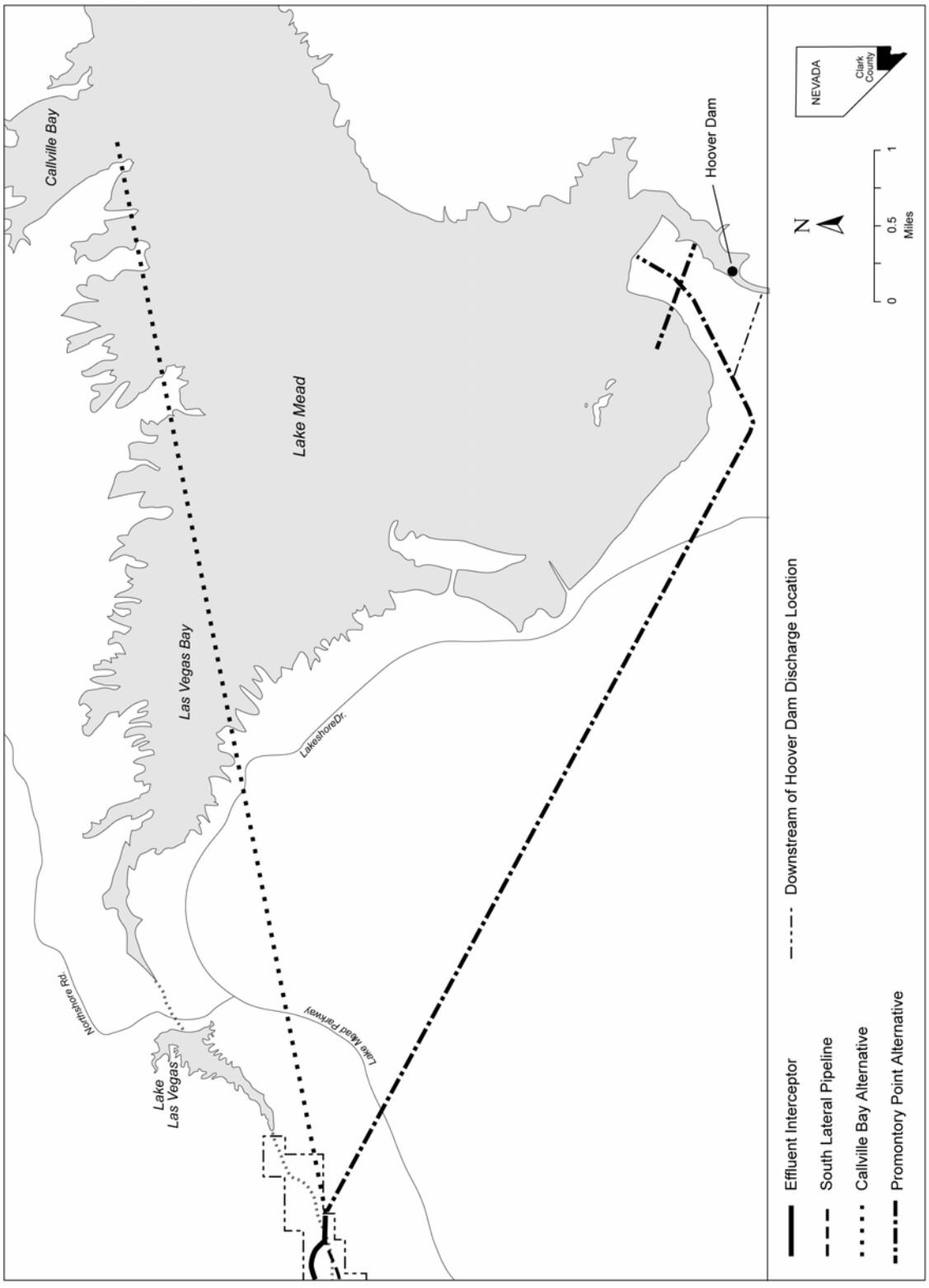


Figure 2.7-2 Lake Conveyance System Alternatives Eliminated.

Strike Canyon would be disruptive to recreational users of Gold Strike Canyon and Lake Mohave. In addition, there is a designated wilderness area, which is approximately 1 mile (1.6 km) below Hoover Dam. This wilderness area contains habitat for the desert bighorn sheep.

Tunnel construction would be challenging because of the presence of geothermal hot springs. Hot springs reach the ground surface just downstream of Hoover Dam along the banks of the Colorado River. If hot water is encountered during tunnel operations, specialized equipment and provisions would need to be used.

The construction activities would require an access road through Gold Strike Canyon to the site. In addition, a deep shaft and PRS would need to be constructed in the steep canyon walls. The pipeline and facilities would be located in a relatively pristine environment; impacts to habitat and wildlife would be significant.

In addition to the modeling findings and the constructability issues, the Discharge Downstream of Hoover Dam Alternative was eliminated for the following reasons:

- Temperature and other water quality standards in Lake Mohave would be exceeded.
- Downstream users such as Lake Mohave (and its fish hatchery), the Colorado River Indian tribes, California, Arizona, and Mexico would experience adverse impacts. Because the modeling indicated little to no nutrient assimilation in Lake Mohave, the MWD expressed concerns that a 'downstream' alternative would adversely impact the water quality they currently see at their intakes near Parker Dam in Lake Havasu.
- Construction activity and effluent discharge would occur within close proximity of the recreational areas just downstream of the Hoover Dam.
- All construction activities would be within the viewshed of the Hoover Dam tourist area.
- Construction of this alternative would be prohibitively expensive.
- There is a high probability that the tunnel alignment would pass through several geothermal hot springs. These hot springs could be disrupted during construction and with the presence of the pipeline. In addition, there is the possibility that the geothermal hot springs would raise the temperature of the effluent.
- The topography around Gold Strike Canyon is steep and irregular, which presents construction and operation difficulties.
- There is a high probability of encountering traditional cultural properties (TCPs). The area downstream of Hoover Dam is important to the Hualapai and Southern Paiute peoples, and many of the canyons and hot springs have significance to both tribes. The area around Sugarloaf Mountain and Gold Strike Canyon are considered TCPs. This would require extensive consultation with the affected tribes.
- Portions of the alignment and discharge location would be within the Hoover Dam Historic District. In addition, the Hoover Dam and immediate vicinity have been named a National Historic Landmark.

Impacts to sensitive biological resources may be significant. There would be possible disruption to cliff habitat and associated wildlife species during construction. A number of springs may be impacted that are habitat for the relict leopard frog (*Rana onca)*, which is a candidate for listing

as threatened or endangered. In addition, the area immediately behind Hoover Dam, and south through Black Canyon into Lake Mohave proper, contains one of the last remnant populations of the razorback sucker and this area is currently designated critical habitat. Being the last, large population in the Lower Colorado River system, the Lake Mohave population of razorback suckers is very important to the recovery of the species.

The NPS *Lake Management Plan* (2002) included the Black Canyon as a "primitive zone", which means among other things that there are no roads, structures, facilities, or commercial services present, plus the area has natural-appearing landscape with pristine views.

2.7.9 Discharge Upstream of Hoover Dam in the Vicinity of Promontory Point

The Promontory Point Alternative would consist of a long tunnel with diffuser ports at three different locations out of Promontory Point (Figure 2.7-2). This alternative was modeled using the 3-Dimensional ELCOM and CAEDYM hydrodynamic and water quality model. In addition, the impacts that this alternative would have on Lake Mohave and the downstream users was evaluated using the 2-Dimensional CE-QUAL-W2 hydrodynamic and water quality model. Modeling results indicated that the Promontory Point epilimnetic or hypolimnetic discharge alternative would have similar water quality impacts to those experienced with the Discharge Downstream of Hoover Dam Alternative (Section 2.7.8). The Hoover Dam influence on Lake Mead is of such magnitude that effluent discharged at Promontory Point would be pulled through the Hoover Dam and into Lake Mohave with little or no nutrient assimilation. The MWD objected due to the adverse impact to the water quality at the MWD intakes. A Promontory Point discharge would alter MWD's formula for mixing Colorado River water with state or federal water from northern California, causing an increase in MWD's water treatment costs.

In addition to the water quality impacts, constructing the Promontory Point Alternative would be difficult. The tunnel alignment passes through the River Mountains in a southeasterly direction towards Hemenway Wash and then in an easterly direction towards Promontory Point. The tunnel would be approximately 16 miles (26 km) long and require two deep shafts: one near the Hacienda Hotel, and one on Promontory Point where the diffusers would be constructed. The PRS shaft at Promontory Point would be extremely deep. The shafts would be located within the National Historic Landmark Boundary, and the shafts would be difficult and expensive to design and construct. In addition, this alignment has the potential to encounter geothermal activity. Hot springs reach the ground surface along the banks of the Colorado River. If hot water were encountered during tunnel operations, specialized equipment and provisions would need to be used.

In addition to the modeling results, engineering considerations, and pipeline costs, the Promontory Point Alternative was eliminated for the following reasons:

- Impacts to downstream users. Because the modeling indicated little to no nutrient assimilation, MWD was concerned that this alternative would adversely impact the water quality they currently see at their intakes near Parker Dam in Lake Havasu.

- The effluent would be discharged within close proximity of the Hoover Dam overlook and visitor area just upstream of the Hoover Dam.
- Portions of the alignment and discharge location would be within the Hoover Dam Historic District. The Hoover Dam and immediate vicinity have been named a National Historic Landmark and any portion of the proposed project that would encroach upon the Hoover Dam Historic District would invoke additional regulations.
- There is a high probability of encountering TCPs.
- Construction could be prohibitively expensive due to deep shaft construction near the Hacienda Hotel; deep shaft and PRS construction near the tip of Promontory Point, a historically sensitive area; and the potential presence of geothermal hot springs.

2.7.10 Discharge in the Vicinity of Callville Bay

Effluent would be conveyed in a common pipeline and tunnel system to an underwater discharge point in the vicinity of Callville Bay (Figure 2.7-2). This alternative would require a combined-effluent delivery system, construction of 20 to 25 miles (32 to 40 km) of large-diameter pipe and tunnels, and construction of pumping stations.

The Callville Bay receiving area was modeled by Flow Science using the 3-Dimensional ELCOM and CAEDYM hydrodynamic and water quality model. Water quality modeling results for the Callville Bay Alternative indicate that the mixing and assimilative capacity of the receiving waters is not optimal and that there is an increased potential for algal production from adding relatively nutrient-rich effluent to the enclosed bays and coves in this area.

In addition to the modeling findings, the alternative was eliminated for the following reasons:

- The Callville Bay discharge is upstream of the SNWA raw-water intake structures.
- The NPS-operated raw-water intake near the Callville Bay marina is located on a floating barge that pulls water from approximately 14 ft (4 m) below the surface. A Callville Bay discharge would impact the water quality at the NPS water intake.
- The effluent would be discharged within close proximity of a high-use recreational area within an enclosed bay.
- Construction costs would be high.

2.7.11 Discharge Effluent near the Narrows

Effluent would be conveyed to a shallow discharge location upstream of the Narrows. This alternative would require a combined-effluent delivery system, construction of 25 to 30 miles (40 to 48 km) of large-diameter pipe, and construction of several pumping stations.

This alternative was eliminated because:

- Algal blooms may result from adding nutrient-rich effluent to Lake Mead bays along the north shore that currently have relatively low nutrient loads,

- Water quality monitoring results for the Narrows indicates that the mixing and assimilative capacity of the receiving waters is not optimal, and
- The construction of one pipeline for discharge through a single point does not leave any room for flexibility.

2.7.12 Implementation of Reverse Osmosis

The implementation of RO was considered because should it become necessary for the CLV WPCF and the COH WRF to achieve between 0.02 and 0.05 mg/L TP on an annual average basis, additional treatment processes would be needed. There may be differing professional opinions, but based on the knowledge and expertise of the Wastewater Treatment Specialists and Engineers consulted, in 2006 it was determined that RO may be the only technology that can reliably achieve combined effluent TP levels of between 0.02 and 0.05 mg/L on an annual average basis. Therefore, if Lake Mead levels decrease to 1,000 ft, RO would need to be implemented at the CLV and COH facilities to achieve a combined effluent TP concentration between 0.02 and 0.05 mg/L on an annual average basis. Implementation of RO at the CLV and COH facilities is described as an example of the type of technology that may be used to reliably achieve TP levels of between 0.02 and 0.05 mg/L (annual average).

An RO system would require the previously described MF/UF membrane system to pre-treat the influent to the RO system. Pretreatment with MF/UF membranes would allow use of polyamide RO membranes, which have lower overall operating costs and improved performance compared to the older-style cellulosic derivatives. Addition of acid and anti-scalant would also be used as a pretreatment for RO to prevent scaling by calcium carbonate and other sparingly soluble salts. Brine or reject-water containment and a means for its treatment/disposal would be required. In addition, post-treatment pH adjustment and/or alkalinity addition is needed for corrosion control. Pre-chloramination of membranes may also be recommended; some field results treating municipal wastewater effluent show that operating MF/UF membranes and RO membranes with a low (2 to 5 mg/L) chloramine residual helps control biological and organic fouling of membranes that can reduce productivity and increase operating costs. Reverse osmosis design requires consideration of flux, recovery, hydraulics, operational flexibility, and capital and O&M costs.

As explained for addition of MF/UF, the piping would need to be modified to accommodate MF/UF and RO units in series following the existing sand filters and before disinfection.

This alternative resulted in two significant impacts, and was therefore eliminated from further consideration. First, implementation of RO would create a brine or reject-water stream. Reverse osmosis membranes concentrate dissolved material. This concentrate, or brine is discharged without recycling to avoid precipitation on the membrane surface. The brine stream would consist of all particles, dissolved materials, and other contaminants removed from the effluent flow. Treatment technologies for disposal of brine or reject water streams are being developed, but currently there are no ideal low-cost methods of brine disposal for inland facilities. Therefore, the disposal of the reject water stream that would be created by the use of RO would be a significant impact because viable disposal options are not currently available, and they could require large land areas and costly processes.

The second significant impact resulting from the implementation of RO is the loss of input water. Approximately 15 to 20 percent of input water would be lost as reject water. Therefore, between 33 and 44 mgd of input water would be lost, reducing the return flow credits by between approximately 12,000 and 16,000 million gallons per year. The loss of return flow credits is a significant adverse impact to southern Nevada because water usage in Nevada cannot be sustained without at least maintaining their current return flow credits.

2.8 Environmentally and Agency-preferred Alternative

The environmentally preferred alternative is the alternative that would meet the requirements of section 101 of NEPA. This alternative would satisfy the following requirements:

- Fulfill the responsibilities of each generation as trustee of the environment for succeeding generations.
- Ensure for all generations safe, healthful, productive, and aesthetically and culturally pleasing surroundings.
- Attain the widest range of beneficial uses of the environment without degradation, risk of health or safety, or other undesirable or unintended consequences.
- Preserve important historic, cultural, and natural aspects of our national heritage, and maintain, wherever possible, an environment that supports diversity and variety of individual choice.
- Achieve a balance between population and resource use that would permit high standards of living and a wide sharing of life's amenities, and
- Enhance the quality of renewable resources, and approach the maximum attainable recycling of depletable resources.

In summary, the environmentally preferred alternative is the alternative that causes the least damage to the biological and physical environment, and best protects, preserves, and enhances historic, cultural, and natural resources.

Identification of the agency-preferred alternative allows the public to understand what actions the agency would like to implement.

The No Action Alternative, while it eliminates the need for construction on federally managed lands, would result in water quality standard exceedances in the Las Vegas Bay. The water quality standard exceedances may result in increased algae production, which may have an adverse effect on recreation in the Las Vegas Bay area of Lake Mead. In addition, the No Action Alternative does not provide the flexibility needed to manage the increasing effluent flows in the Valley. For these reasons, the No Action Alternative is not preferred from an environmental perspective.

The impacts resulting from the Las Vegas Bay, Boulder Islands South, and Boulder Islands North alternatives are similar. The three pipeline alternatives would result in minor, temporary impacts to surface water, biological resources, recreation, noise, air quality, visual resources, and traffic during construction. The Las Vegas Bay Alternative is not preferred from an environmental perspective because although water quality standards would not be exceeded, modeling indicates

that effluent discharged in the Las Vegas Bay would not undergo as much dilution as discharge in the vicinity of the Boulder Islands.

Although the Process Improvements Alternative has been analyzed, after reviewing the additional information and analyses, the Final EIS concludes that the Process Improvements Alternative cannot meet key elements of the purpose and need of the project, including the needs to ensure compliance with water quality standards for Lake Mead at a Lake level of 1,000 ft, and to provide the management flexibility to respond to future water quality issues and regulatory requirements.

The Boulder Islands South and Boulder Islands North alternatives result in similar impacts. However, the Boulder Islands South Alternative would generate a larger quantity of spoils that would require disposal. The increased spoil quantity results in an increased number of trucks needed to haul the spoils to designated disposal areas. In addition, the Boulder Islands South Alternative has the potential to affect more archaeologically significant sites than the other alternatives. For these reasons, the Boulder Islands South Alternative is not preferred from an environmental perspective.

The Boulder Islands North Alternative is the environmentally preferable alternative because, overall, it would best meet the requirements of section 101 of NEPA. It would provide the flexibility needed to manage the increasing effluent flows in the Valley, without degradation of Reclamation and NPS resources. In addition, this alternative would use effluent flows through the pipeline to generate electrical power that would be used by the AMSWTF. The generation of hydroelectric power is considered an environmentally responsible action and a beneficial impact of the Boulder Islands North Alternative.

2.9 Comparison of Alternatives by Resource and Potential Impacts

Chapter 4.0 presents an analysis of the impacts resulting from the No Action Alternative, Boulder Islands North Alternative, Boulder Islands South Alternative, Las Vegas Bay Alternative, and Process Improvements Alternative. Table 2.9-1 provides a comparison of alternatives by resource and potential impact.

Table 2.9-2 provides a summary of the mitigation measures that may be implemented to reduce or eliminate the potential impacts to resources. Although mitigation measures are typically implemented to minimize or eliminate significant impacts, Table 2.9-2 also includes actions that would be taken to minimize or eliminate insignificant impacts. Additional mitigation measures and details are provided in the appropriate sections of Chapter 4.

Table 2.9-1 Summary of Environmental Impacts.

Resource	No Action (No Pipeline)	EI-Alignment A	EI-Alignment B	Boulder Islands North LCS	Boulder Islands South LCS	Las Vegas Bay LCS	Process Improvements (No Pipeline)
Water Resources							
Surface Water	No significant impact.	Insignificant increase in erosion potential during construction.	Insignificant increase in erosion potential during construction.	Insignificant increase in erosion potential during construction. Dredged material would be contained, therefore, no significant impact would occur.	Insignificant increase in erosion potential during construction. Dredged material would be contained, therefore, no significant impact would occur.	Insignificant increase in erosion potential during construction. Dredged material would be contained, therefore, no significant impact would occur.	No significant impact.
Groundwater	No impact.	Dewatering during construction may result in lowering water levels in domestic wells, and subsidence. This may result in a significant impact.	Dewatering during construction may result in lowering water levels in domestic wells, and subsidence. This may result in a significant impact.	No impact.	No impact.	No impact.	No impact

Table 2.9-1 Summary of Environmental Impacts (continued).

Resource	No Action (No Pipeline)	EI-Alignment A	EI-Alignment B	Boulder Islands North LCS	Boulder Islands South LCS	Las Vegas Bay LCS	Process Improvements (No Pipeline)
Surface Water Quality	Increases in chlorophyll levels throughout Boulder Basin. This may be a significant adverse impact. Water quality standards would be exceeded at Lake levels of 1,000 ft for 2030 and 2050 effluent flows. This may be a significant adverse impact. Increase in effluent total phosphorus(TP) through Hoover Dam of 1 part per billion (ppb) with 2030 flows and 2 ppb with 2050 flows. This increase would result in an insignificant impact downstream of Hoover Dam.	Dilution of constituents from groundwater and urban runoff would be reduced. This would be a significant adverse impact if concentrations exceed water quality standards.	Dilution of constituents from groundwater and urban runoff would be reduced. This would be a significant adverse impact if concentrations exceed water quality standards.	Water-quality standards would not be exceeded. Increased dilution of effluent-related constituents compared to baseline and No Action Alternative. Reduced quantities of nutrients would enter the inner Las Vegas Bay. Increase in effluent TP through Hoover Dam of 1 ppb with 2030 flows and 2 ppb with 2050 flows. This increase would result in an insignificant impact downstream of Hoover Dam.	Water quality standards would not be exceeded. Increased dilution of effluent-related constituents compared to baseline and No Action Alternative. Reduced quantities of nutrients would enter the inner Las Vegas Bay. Increase in effluent TP through Hoover Dam of 1 ppb with 2030 flows and 2 ppb with 2050 flows. This increase would result in an insignificant impact downstream of Hoover Dam.	Water quality standards would not be exceeded. Increased dilution of effluent-related constituents compared to baseline and No Action Alternative, but not as much dilution as the Boulder Islands Alternative. Increase in effluent TP through Hoover Dam of 1 ppb with 2030 flows and 2 ppb with 2050 flows. This increase would result in an insignificant impact downstream of Hoover Dam.	Dilution of constituents from groundwater and urban runoff would be increased. This is a beneficial impact. Effluent-related constituents entering Lake Mead would be reduced, but this would not significantly change water quality in Boulder Basin or downstream of Hoover Dam.

Table 2.9-1 Summary of Environmental Impacts (continued).

Resource	No Action (No Pipeline)	EI-Alignment A	EI-Alignment B	Boulder Islands North LCS	Boulder Islands South LCS	Las Vegas Bay LCS	Process Improvements (No Pipeline)
Biological Resources	Increased flows would likely result in an insignificant expansion of riparian plant and wetland communities.	Construction activities would temporarily impact vegetation and wildlife including the desert tortoise. This would be an Insignificant impact. Operation of the EI may result in the transition from wetland communities to drier, more salt tolerant, riparian communities in the Las Vegas Wash. Increased selenium concentrations due to decreased dilution may pose a bioaccumulation hazard to wildlife in the Las Vegas Wash. This may be a significant adverse impact.	Construction activities would temporarily and insignificantly impact vegetation and wildlife including the desert tortoise. Operation of the EI may result in the transition from wetland communities to drier, more salt tolerant, riparian communities in the Las Vegas Wash. Increased selenium concentrations due to decreased dilution may pose a bioaccumulation hazard to wildlife in the Las Vegas Wash. This may be a significant adverse impact.	Construction activities would temporarily and insignificantly impact biological resources. Effluent-related constituents that may adversely impact aquatic resources would be reduced in the Las Vegas Bay, as would the nutrient source. The reduction in nutrients to the Las Vegas Bay may adversely impact the quality of sport fishing in the Las Vegas Bay.	Construction activities would temporarily and insignificantly impact biological resources. Effluent-related constituents that may adversely impact aquatic resources would be reduced in the Las Vegas Bay, as would the nutrient source. The reduction in nutrients to the Las Vegas Bay may adversely impact the quality of sport fishing in the Las Vegas Bay.	Construction activities would temporarily impact biological resources. Effluent-related constituents that may impact aquatic resources would continue to enter the Las Vegas Bay.	Increased flows would likely result in an insignificant expansion of riparian plant and wetland communities.

Table 2.9-1 Summary of Environmental Impacts (continued).

Resource	No Action (No Pipeline)	EI-Alignment A	EI-Alignment B	Boulder Islands North LCS	Boulder Islands South LCS	Las Vegas Bay LCS	Process Improvements (No Pipeline)
Cultural Resources	No impact to identified National Register of Historic Places (NRHP) sites. The discovery of numerous buried cultural features in areas not far from the proposed cut-and-cover segment of Reach 2 indicate that although surface artifacts were not observed in the vicinity of the EI, subsurface artifacts may be present and may be affected by construction activities.	No significant impacts.	No significant impacts.	No cultural resources would be impacted by the terrestrial portion of the LCS. The submerged sections of the Boulder Islands North Alternative would cross submerged portions of the SCIRR sites 26CK4046B, the service road site 26CK7254, and portions of the aggregate storage piles which are part of site 26CK7285. These sites may also be affected by the installation of the turbidity curtain. These activities would have adverse impacts on the integrity of the sites. If the sites cannot be avoided, the NPS would consult with the Nevada SHPO and the Advisory Council on Historic Preservation to determine appropriate mitigation measures.	Three above-ground elements of Site 26CK7115 are located near the SRMT3-East working shaft. The impacts from the submerged sections of this alternative would be the same as those described for the Boulder Islands North Alternative.	No impact.	No impact to identified NRHP sites.

Table 2.9-1 Summary of Environmental Impacts (continued).

Resource	No Action (No Pipeline)	EI-Alignment A	EI-Alignment B	Boulder Islands North LCS	Boulder Islands South LCS	Las Vegas Bay LCS	Process Improvements (No Pipeline)
Recreation	Increased levels of chlorophyll in the inner Las Vegas Bay may result in temporary algae blooms that deter recreational use. On the other hand, additional nutrients may have a beneficial impact on sport fishing.	Minor impacts during construction.	Minor impacts during construction. Trails and pedestrian bridge would be beneficial.	Temporary and minor impacts at Lakeshore Drive and Lake Mead Resort areas during construction. No long-term adverse impacts. The reduction of nutrients entering the Las Vegas Bay may adversely impact the quality of sport fishing in the Las Vegas Bay.	Temporary and minor impacts at Boulder Beach area during construction. No long-term adverse impacts. The reduction of nutrients entering the Las Vegas Bay may adversely impact the quality of sport fishing in the Las Vegas Bay.	Temporary and minor impacts at Sunset Scenic Overlook and Las Vegas Bay areas during construction.	Decreased levels of nutrient loadings to the Las Vegas Bay may have an adverse impact on sport fishing.
Hazardous Materials	No impact.	Perchlorate-contaminated groundwater may be encountered during construction.	Perchlorate-contaminated groundwater may be encountered during construction.	No impact.	No impact.	No impact.	Additional sludge from the use of MF/UF membranes would require transport and disposal to a landfill. This is an insignificant impact.
Noise	No significant impact.	Impacts would be temporary and insignificant during construction.	Impacts would be temporary and insignificant during construction.	Impacts would be temporary and insignificant during construction.	Impacts would be temporary and insignificant during construction.	Impacts would be temporary and insignificant during construction.	No significant impact.
Air Quality	No impact.	Impacts would be temporary and insignificant during construction.	Impacts would be temporary and insignificant during construction.	Impacts would be temporary and insignificant during construction.	Impacts would be temporary and insignificant during construction.	Impacts would be temporary and insignificant during construction.	No impact.

Table 2.9-1 Summary of Environmental Impacts (continued).

Resource	No Action (No Pipeline)	EI-Alignment A	EI-Alignment B	Boulder Islands North LCS	Boulder Islands South LCS	Las Vegas Bay LCS	Process Improvements (No Pipeline)
Earth Resources	No impact.	No significant impact.	No significant impact.	No significant impact.	No significant impact.	No significant impact.	No impact.
Land Use	No impact.	No significant impact.	No significant impact.	No significant impact.	No significant impact.	No significant impact.	No impact.
Visual Resources	No impact.	No significant adverse impact.	No significant adverse impact. Chat trail would provide new access to viewing areas within the Wetlands Park.	Impact would be temporary and insignificant at the Lakeshore Drive and Lake Mead Resort areas during construction. Views of construction areas within the LMNRA would be impacted until restoration is complete.	Impact would be temporary and insignificant in the Boulder Beach area during construction. Views of construction areas within the LMNRA would be impacted until restoration is complete.	Impact would be temporary and insignificant at the Sunset Scenic Overlook during construction. Views of construction areas within the LMNRA would be impacted until restoration is complete.	No impact.
Socio-economics [1]	Mitigation would be implementation of the Process Improvements Alternative.	Cost: $87 million.	Cost: $87 million.	Cost: $594 million (includes EI costs).	Cost: $590 million (includes EI costs).	Cost: $540 million (includes EI costs).	Cost: $205 million for capital costs plus $30 million annually for O&M costs.
Environmental Justice	No impact.	No impact.	No impact.	No impact.	No impact.	No impact.	No impact.

Table 2.9-1 Summary of Environmental Impacts (continued).

Resource	No Action (No Pipeline)	EI-Alignment A	EI-Alignment B	Boulder Islands North LCS	Boulder Islands South LCS	Las Vegas Bay LCS	Process Improvements (No Pipeline)
Transport-ation and Traffic	No significant impact.	Impact would be temporary and insignificant.	Impact would be temporary and insignificant.	Impact would be temporary and insignificant.	Temporary closure of AR-76 may be required. Impact would be temporary and insignificant.	Impact would be temporary and insignificant.	No impact.
Paleonto-logical Resources	No impact.	No impact.	No impact.	No impact.	No impact.	No impact.	No impact.

Note
[1] Costs do not include $29 million for plant optimization, which is included in all the alternatives.

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Table 2.9-2 Summary of Mitigation Measures.

Resource	Effluent Interceptor (Both Alignments)	Boulder Islands North LCS	Boulder Islands South LCS	Las Vegas Bay LCS	Process Improvements
Water Resources					
Surface Water	Open trench excavation will not cross two major ephemeral washes at any one time.	Open trench excavation will not cross two major ephemeral washes at any one time.	Same as Boulder Islands North LCS.	Same as Boulder Islands North LCS.	None required.
Groundwater	Groundwater will be monitored and if contamination is suspected, analyzed, and disposed of per NDEP guidance. Groundwater levels in the area will be monitored. Backfill with suitable permeability will be used.	None required.	None required.	None required.	None required.
Surface Water Quality	Although the Boulder Basin AMP is not a mitigation measure because it is part of the proposed alternative, flows to the Las Vegas Wash may be adjusted to minimize impacts from increasing non-effluent related concentrations of constituents such as selenium that result from less dilution with effluent flows. NDEP would regulate parameter concentrations if necessary.	Although the Boulder Basin AMP is not a mitigation measure because it is part of the proposed alternative, flows to the Las Vegas Wash may be adjusted to minimize impacts from increasing non-effluent related concentrations of constituents such as selenium that result from less dilution with effluent flows. NDEP would regulate parameter concentrations if necessary.	Same as Boulder Islands North LCS.	Same as Boulder Islands North LCS.	None required.

Table 2.9-2 Summary of Mitigation Measures (continued).

Resource	Effluent Interceptor (Both Alignments)	Boulder Islands North LCS	Boulder Islands South LCS	Las Vegas Bay LCS	Process Improvements
Biological Resources	Pre-construction surveys for terrestrial species identified in EIS will be conducted. A USACE Mitigation and Monitoring Plan will be implemented.	Pre-construction surveys for terrestrial species identified in EIS will be conducted. A USACE Mitigation and Monitoring Plan will be implemented. Construction activities within 100 yards (91m) of a razorback sucker spawning area will not be allowed from December 1 to May 1. Although the Boulder Basin AMP is not a mitigation measure because it is part of the proposed alternative, flows to the Las Vegas Wash may be adjusted to minimize impacts to biological resources.	Same as Boulder Islands North LCS.	Same as Boulder Islands North LCS.	None required.
Cultural Resources	Pre- and post-construction assessments will be conducted. Avoidance of some sites will be required. A qualified monitor will be present during construction activities to protect resources in the event that subsurface cultural resources are encountered.	A Programmatic Agreement has been initiated that ensures the required mitigation measures are implemented to minimize or eliminate the potential impact to cultural resources.	Avoidance of some sites will be required for the terrestrial segments of the LCS. In addition, a qualified construction monitor will be present during construction at some sites. A Programmatic Agreement has been initiated that ensures the required mitigation measures are implemented to minimize or eliminate the potential impact to cultural resources.	None required.	None required.

Table 2.9-2 Summary of Mitigation Measures (continued).

Resource	Effluent Interceptor (Both Alignments)	Boulder Islands North LCS	Boulder Islands South LCS	Las Vegas Bay LCS	Process Improvements
Recreation	Public will be routed around or away from construction areas.	Public will be routed around or away from construction areas. Coordination with Clark County Parks and Community Services to ensure the activities are conducted within the Clark County Wetlands Park Master Plan guidelines. Some construction activities within the LMNRA will be limited to October through March. Notices to Mariners will be published prior to construction activities, Aids to Navigation for Inland Waterways will be implemented, and at least one-way boat traffic near the Lake Mead Resort Marina will be maintained during construction activities.	Public will be routed around or away from construction areas. Coordination with Clark County Parks and Community Services to ensure the activities are conducted within the Clark County Wetlands Park Master Plan guidelines. Some construction activities within the LMNRA will be limited to October through March.	Same as Boulder Islands South LCS.	None required.
Hazardous Materials	Groundwater suspected of containing perchlorate will be analyzed and disposed of in accordance with NDEP guidelines.	None required.	None required.	None required.	None required.
Noise	None required.	None required.	None required.	None required.	None required.
Air Quality	Applicable permits will be obtained.	Applicable permits will be obtained.	Same as Boulder Islands North LCS.	Same as Boulder Islands North LCS.	None required.
Earth Resources	Restoration plans for disturbed areas will be prepared and implemented.	Restoration plans for disturbed areas will be prepared and implemented.	Same as Boulder Islands North LCS.	Same as Boulder Islands North LCS.	None required.

Table 2.9-2 Summary of Mitigation Measures (continued).

Resource	Effluent Interceptor (Both Alignments)	Boulder Islands North LCS	Boulder Islands South LCS	Las Vegas Bay LCS	Process Improvements
Land Use	None required.	Notices to Mariners will be published prior to construction activities, Aids to Navigation for Inland Waterways will be implemented, and at least one-way boat traffic near the Lake Mead Resort Marina will be maintained during construction activities.	None required	None required	None required.
Visual Resources	None required.	Restoration plans for disturbed areas will be prepared and implemented.	Same as Boulder Islands North LCS.	Same as Boulder Islands North LCS.	None required.
Socioeconomics	None required.	None required	None required.	None required.	None required.
Environmental Justice	None required.	None required	None required.	None required.	None required.
Transportation and Traffic	Construction traffic management plans will be prepared and implemented.	Construction traffic management plans will be prepared and implemented. Routes through LMNRA would be coordinated with the NPS.	Same as Boulder Islands North LCS.	Same as Boulder Islands North LCS.	None required.
Paleontological Resources	None required.	None required.	None required.	None required.	None required.

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Chapter 3

Affected Environment

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3.0 Affected Environment

This chapter contains the description of the existing environmental conditions in the vicinity of the proposed project alternatives. During EIS preparation, the most up-to-date and accurate information available was used to describe the existing environment. The information serves as a baseline from which to identify and evaluate environmental changes resulting from the proposed alternatives. The baseline year for the information presented in this section is 2002, 2003, 2004, and 2005 depending on data availability.

The environmental resources discussed in this chapter include water resources, biological resources, cultural resources, recreation, hazardous materials, noise, air quality, earth resources, land use, visual resources, socioeconomics, environmental justice, transportation and traffic, and paleontological resources.

3.1 Water Resources

This section focuses on water resources in the vicinity of the proposed alternatives. Surface water and drainage, groundwater, and water quality are described in this section.

3.1.1 Surface Water & Drainage

The Las Vegas Wash is the primary conveyance corridor of surface water runoff for the Valley. The Las Vegas Wash Watershed encompasses the CLV, CNLV, COH, and portions of unincorporated Clark County. The watershed is bounded on the north by the Sheep Mountains, on the west by the Spring Mountains, on the south by the McCullough Mountains, and on the east by the River and Frenchman mountains (Figure 3.1-1). The total area of the watershed at the upstream end of Lake Las Vegas is approximately 1,550 square miles (4014 square km) (Clark County Regional Flood Control District [CCRFCD] 2002). The Las Vegas Wash discharges to Lake Mead and the Colorado River system.

The terrain of the Las Vegas Wash Watershed is comprised of steep mountain slopes around the perimeter that transition to alluvial fans at the base of the mountains. The alluvial fans then drain to braided washes and sheet flow areas with some areas containing large incised washes that are tributaries to the Las Vegas Wash. The major tributaries to the Las Vegas Wash include Range Wash, Northern Las Vegas Wash, Flamingo/Tropicana Wash, Duck Creek/Blue Diamond Pittman Wash, and the C-1 Channel (Figure 3.1-2). These major tributaries drain through developed areas prior to their confluence with the Las Vegas Wash. In developed areas, many of the tributaries have been modified from their natural condition to include structural improvements such as concrete, riprap, and gabion linings as well as modification of the channel geometry. The tributaries are ephemeral with the exception of nuisance flow draining from adjacent developments.

There are numerous surface water channels that cross the project area and are subject to periodic flooding during major rainfall/runoff events. The majority of these surface-water channels within

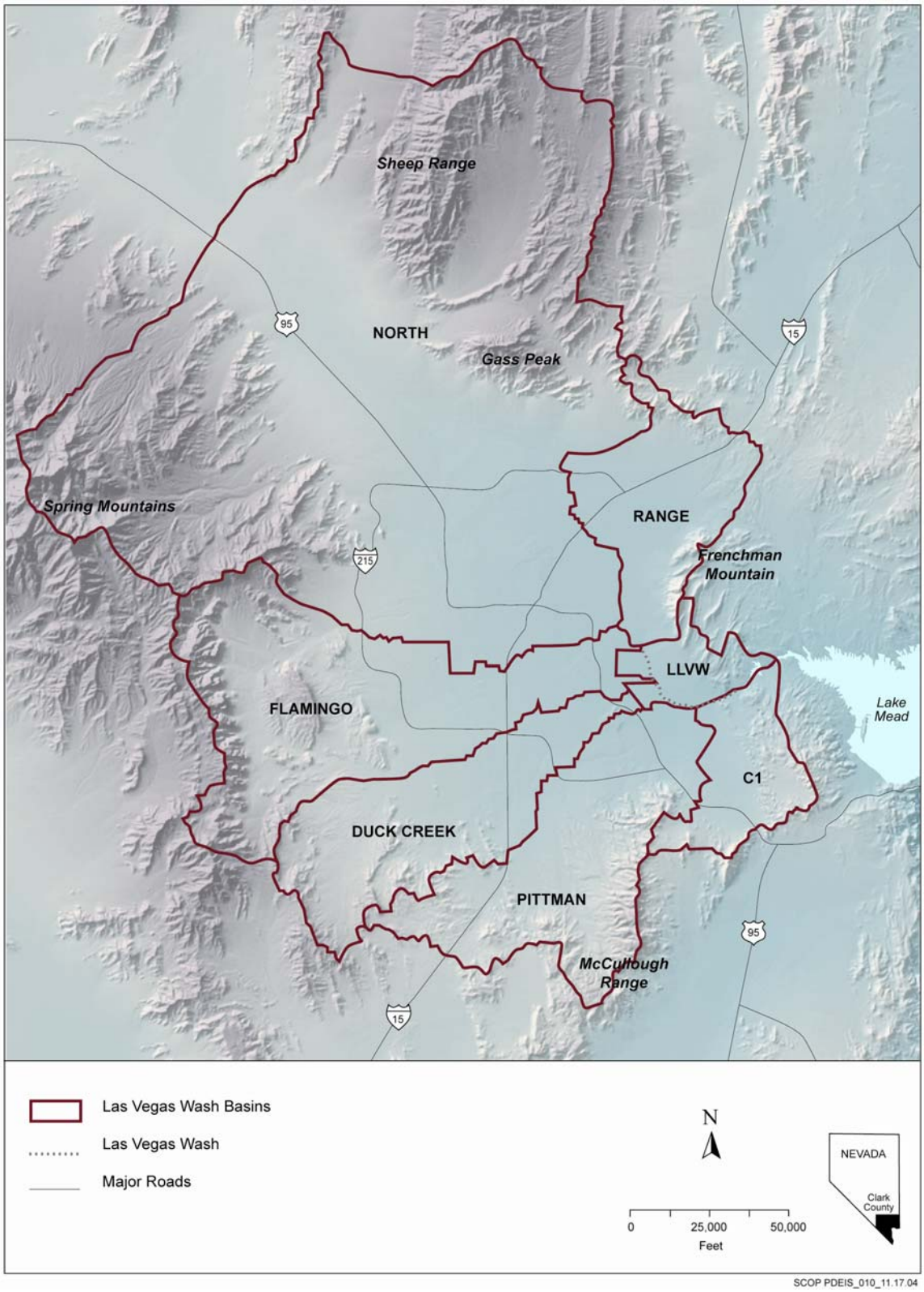


Figure 3.1-1 Hydrographic Basins.

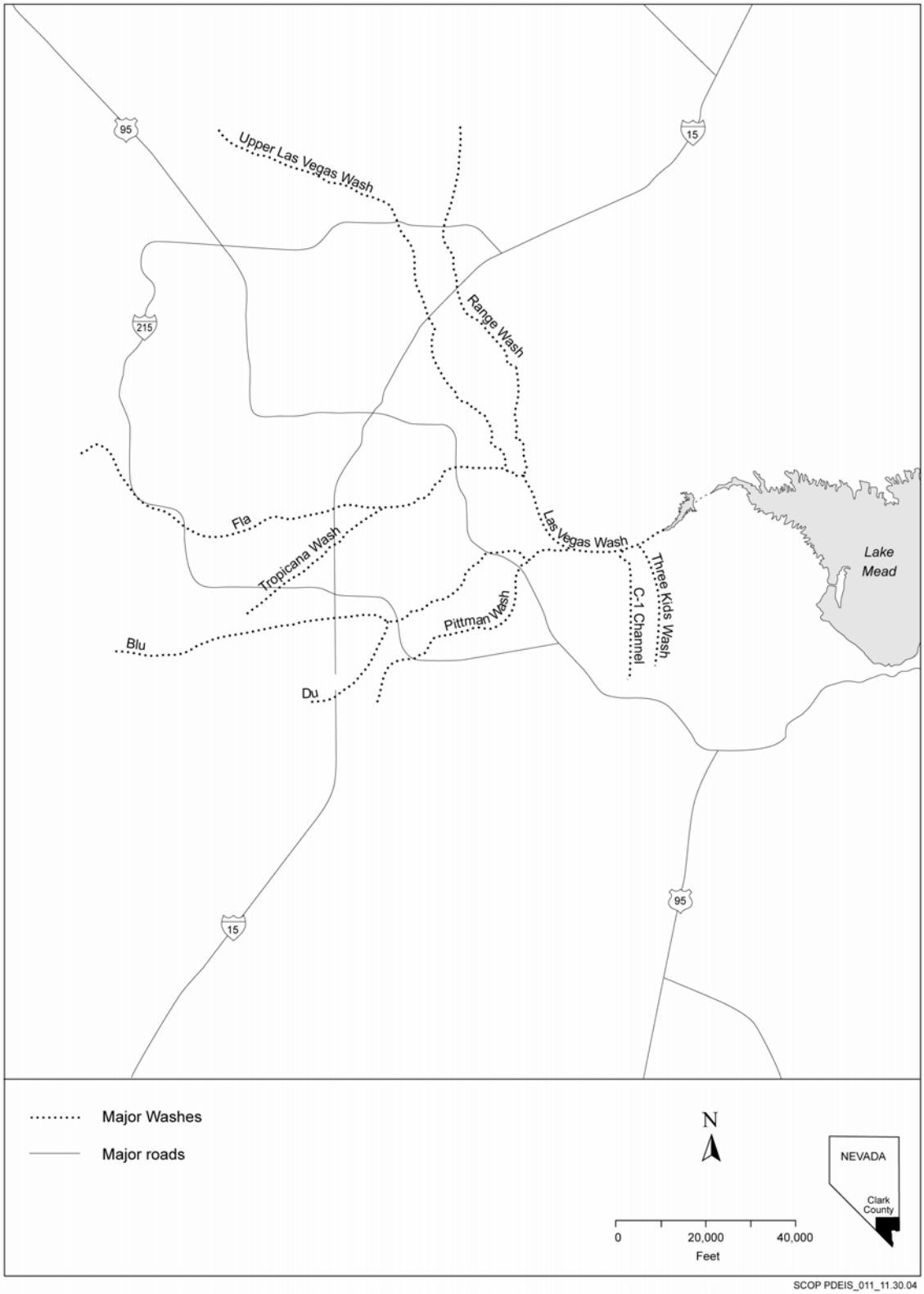


Figure 3.1-2 Major Tributaries.

the project area have not been heavily disturbed by urban development and human activity, and still exist in their natural desert condition. These natural ephemeral channels within the project area are in addition to the Las Vegas Wash, which is the main surface-water conveyance corridor through the project area.

The USACE regulates the discharge of dredged or fill material into waters of the United States. As applied to this particular project, waters of the United States by definition include interstate waters, tributaries of interstate waters, and wetlands adjacent to interstate waters and tributaries (33 CFR 328). The Las Vegas Wash is a tributary to the Colorado River (at Lake Mead), which is an interstate water.

The term "waters of the United States" applies to the jurisdictional limits of the authority of the USACE. The limits of jurisdiction of the USACE extend to the ordinary high water mark. The ordinary high water mark is generally defined as the clear, natural line on the shore or channel bank established by water fluctuations. In arid stream systems, the USACE defines ordinary high water based on physical features, including development of a channel bed and bank resulting from the most frequent or repeating hydrologic discharges.

Lakes, rivers, streams, wetlands, and other potential waters of the U.S. within the project area were identified based on review of the 1:24,000-scale U.S. Geological Survey (USGS) topographic quadrangle maps, the U.S. Fish and Wildlife Service (USFWS) National Wetland Inventory maps, previous wetland delineation reports, and a field reconnaissance survey conducted by PBS&J in May 2003. Potential waters of the U.S., including intermittent drainages that cross the proposed project alignments are identified on Figure 3.1-3 and Figure 3.1-4.

PBS&J conducted field surveys in December 2005 and January 2006 to determine the presence of waters of the United States within the areas proposed for surface disturbance (cut-and-cover) activities. The results of the jurisdictional determination were reported in the *Waters of the U.S. Jurisdictional Determination Report for the Systems Conveyance and Operations Program* (May 2006). The potential waters of the United States within the cut-and-cover portions were located in the field. Using the USACE's hydrology, geomorphology, and vegetation criteria, the washes identified within the in the field do not have a definable bed and bank and contain upland vegetation throughout. The washes were determined to be non-jurisdictional and the USACE concurred with the findings on July 17, 2006.

3.1.1.1 Las Vegas Wash Flow Contributors

The Las Vegas Wash conveys flow from several different sources:

- Nuisance water from developed areas,
- WWTP discharge,
- Groundwater seepage, and
- Rainfall runoff.

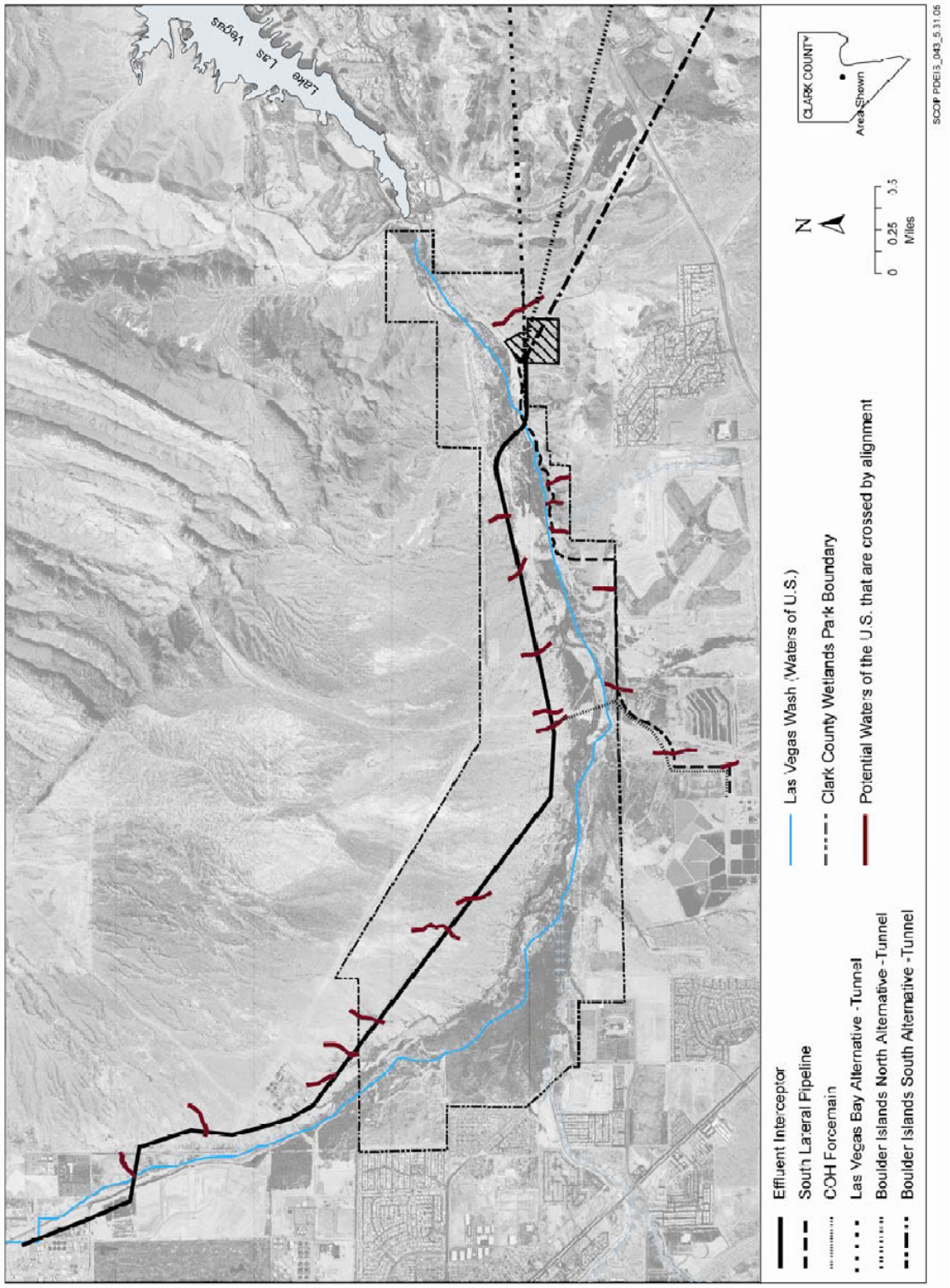


Figure 3.1-3 Potential Waters of the United States – Effluent Interceptor Segment.

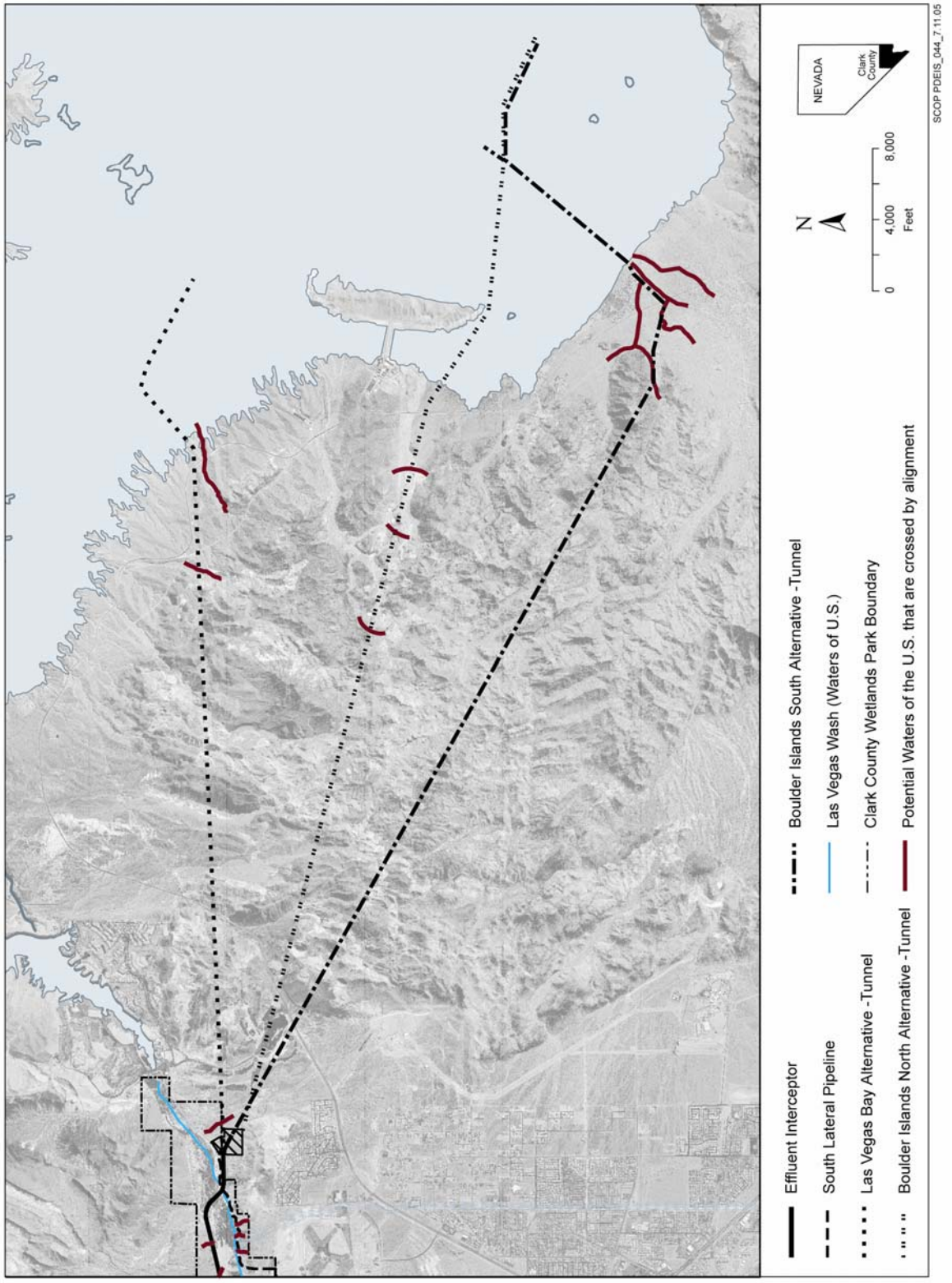


Figure 3.1-4 Potential Waters of the United States – Lake Conveyance System Segment.

The Las Vegas Wash is a perennial stream due to the flow contribution from these sources. The majority of the perennial or base flow comes from the WWTP discharges. However, the quantity of base flow is insignificant when compared to the flow rate during major rainfall/runoff events. The average discharge from the three WWTPs combined is approximately 252 cfs (7 cubic meters per second [cms]) (Black & Veatch 2004b). The average total base flow is approximately 283 cfs (8 cms) (Black & Veatch 2004b). The 100-year peak flow developed for the 2002 Las Vegas Valley Flood Control Master Plan Update is 16,000 (453 cms) to 22,000 cfs (623 cms) (CCRFCD 2002). During the storm event of July 8, 1999, a peak flow of 11,000 cfs (311 cms) was recorded at the intersection of the Las Vegas Wash and Vegas Valley Drive, and a peak flow of 16,000 cfs (453 cms) was recorded at Lake Las Vegas (CCRFCD 2002).

A complex formula is used to calculate Nevada's return flow credits. The values used in the formula are based on several factors, including flow volumes in the Las Vegas Wash. The flow contributors described previously are taken into account during calculation of Nevada's return flow credits.

3.1.1.2 Las Vegas Wash Flooding

As discussed in the previous section, the projected and historical flow rates of the Las Vegas Wash for the 100-year frequency flood event are significant. The 100-year frequency flood event is defined as having a 1-percent chance of occurrence in any given year. The Federal Emergency Management Agency (FEMA) and local entities regulate activity on the Las Vegas Wash within the 100-year frequency flood event floodplain to plan for and protect life and property from flooding. The FEMA has delineated and published maps, which are developed from computer-based hydraulic models, showing the 100-year floodplain for the Las Vegas Wash. The FEMA designated that the 100-year floodplain width varies significantly from Vegas Valley Drive to Lake Las Vegas (Figure 3.1-5). The floodplain for the Las Vegas Wash is approximately 200 ft (61 m) wide between Vegas Valley Drive and Desert Inn Road and is completely contained in an improved channel. The floodplain is approximately 500 to 2,500 ft (152 to 762 m) wide between Desert Inn Road and Pabco Road with much of the water being conveyed in the overbank areas adjacent to the main channel (FEMA 2002). Below Pabco Road, the Las Vegas Wash becomes more incised with floodplain widths of less than 800 ft (244 m) (FEMA 2002).

Flow velocities vary widely throughout the Las Vegas Wash with average velocities in the range of 1 to 15 fps (0.3 to 5 mps) (FEMA 2002). Flow velocities less than 5 fps (1 mps) generally occur in overbank areas. Flow velocities greater than 5 fps (1 mps) generally occur in the main channel. Velocities in excess of 15 fps (5 mps) may occur for short distances where the channel is very steep, usually in areas where headcutting is occurring (see Section 3.1.1.3).

3.1.1.3 Las Vegas Wash Erosion

The Las Vegas Wash was relatively stable in terms of erosion and degradation prior to the presence of modern humans in the Valley. Prior to this presence, the Las Vegas Wash watershed was virtually undisturbed. Under natural conditions, runoff from major rainfall events likely transported a large amount of sediment to the Las Vegas Wash due to sparse ground cover, steep channel slopes, and non-cohesive erodable soils, which encompass the majority of the upstream watershed. A substantial amount of this transported sediment was deposited in the less steep, wide, shallow floodplain of the Las Vegas Wash. The large influx of sediment offset channel

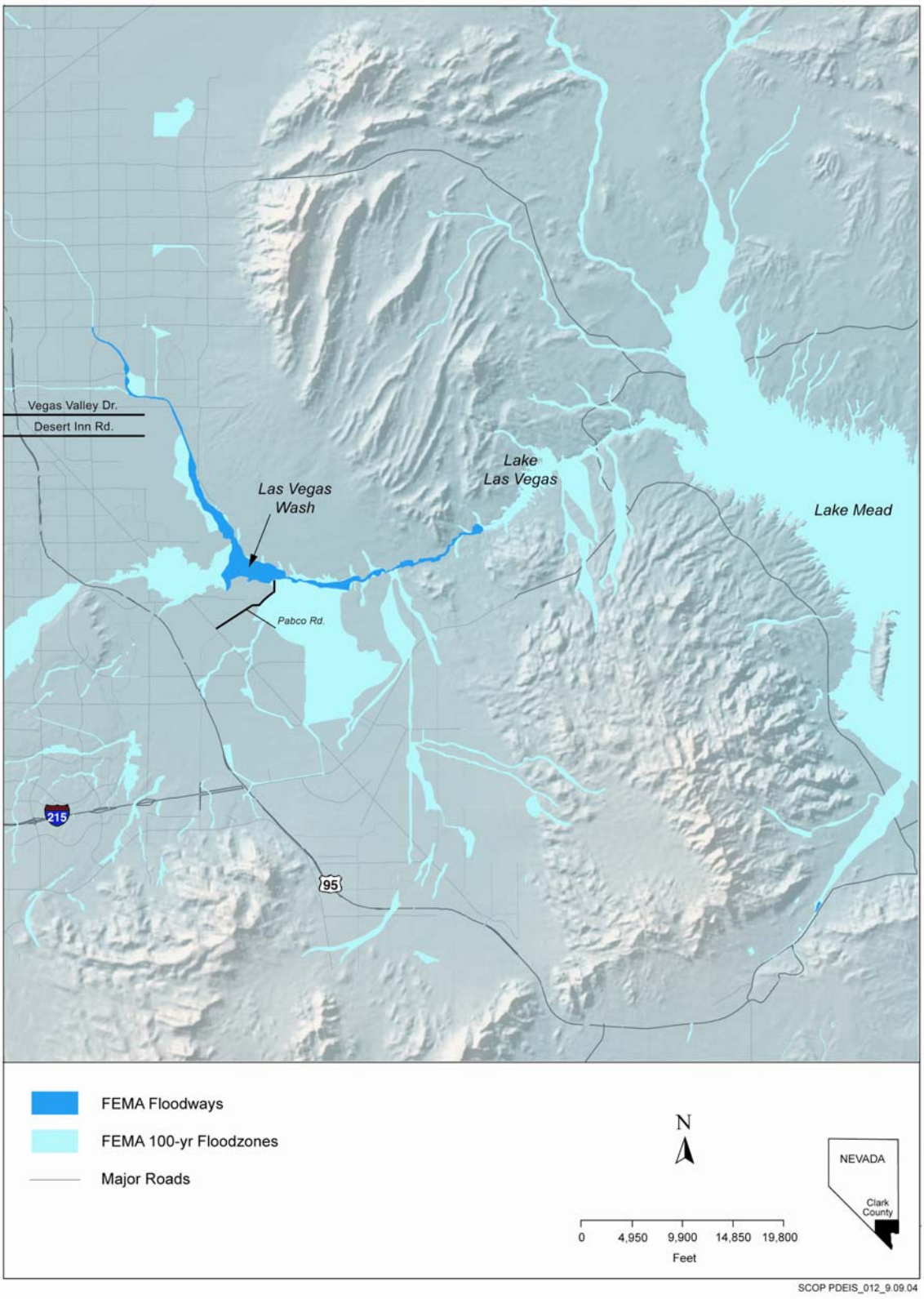


Figure 3.1-5 Floodplain Map.

degradation and lateral bank migration as soil material was removed from the Las Vegas Wash and was replaced with sediment transported from the upstream watershed. This balance between the sediment inflow from the upstream watershed and sediment discharge at the downstream end of the Las Vegas Wash along with the infrequent rainfall/runoff events would have a tendency to substantially limit the amount of overall channel degradation and lateral bank migration that could occur over a relatively short period of geological time (several hundred years). Though lateral migration of the stream banks and channel degradation likely occurred prior to the presence of modern humans, it was a slow process that occurred over thousands of years. The influence of human activity in the watershed has drastically changed this balance of sediment inflow and discharge to the Las Vegas Wash. The result is an acceleration of erosion, increase in lateral bank migration, channel degradation, and the formation of an incised channel. Three major causes of the accelerated erosion are:

- Development in the watershed reducing soil infiltration of rainfall and increasing volume of runoff;
- Construction of detention basins, structurally lined tributary channels, buildings and pavements covering or retaining erodable soil in the upstream watershed and reducing the influx of sediment in the Las Vegas Wash; and
- Introduction of a large continuous base flow in the Las Vegas Wash from WWTP effluent that is discharged carrying virtually no sediment (clear water) and is highly erosive over a period of several decades.

The effluent flows are likely the primary cause of the accelerated erosion in the Las Vegas Wash. This continuous base flow is discharged into the Las Vegas Wash carrying minimal, if any, sediment and subsequently becomes highly erosive due to its ability to scour and transport sediment from the channel bed and banks. The channel banks become taller, steeper, and in most cases, unstable, as the channel bed is degraded by the transport of sediment in the continuous base flow. Material from the channel banks then begins to detach and fall into the channel to be carried away by the base flow. The channel degrades, deepens, and gets wider. In addition, the unstable channel banks become more susceptible to erosion when major flood events occur. Headcuts (sections of the channel that are much steeper than the segments of the channel upstream and downstream) form as the channel erodes and short segments of the channel become steeper and unstable. In many cases the headcuts become vertical drops or waterfalls in the channel. The headcuts are extremely unstable due to the high flow velocities that occur from the vertical or near vertical drops. As a result, the headcuts generally migrate upstream relatively quickly, deepening and widening the channel as they go. As the channel deepens and widens it impacts the vegetation and wildlife adjacent to the channel. Many segments of the Las Vegas Wash contain wetland areas in the overbanks adjacent to the channel. These wetlands are dependent on the shallow depth to groundwater and the perennial flow in the Las Vegas Wash. The majority of these overbank wetlands were created by the perennial flow in the Las Vegas Wash from treatment plant effluent discharges, which began in the 1950s. However, as the effluent discharges increased over the years and the Las Vegas Wash channel degraded, the wetlands began to drain. Eventually most of the wetlands were left without a constant source of water, and perished.

Since periodic monitoring of channel degradation began in 1975, the channel bed elevation in many reaches of the Las Vegas Wash has dropped 10 to 30 ft (3 to 9 m), depending on the distance upstream of Lake Las Vegas (Reclamation and Clark County Parks and Recreation 1998). This rate of channel degradation is projected to continue for many years until the channel slope is reduced to approximately 0.4 percent, or the current conditions in the Las Vegas Wash are modified to eliminate the causes of the degradation (Reclamation and Clark County Parks and Recreation 1998). In response to the channel degradation and the associated impacts, SNWA has developed a plan to reduce or stop channel degradation in the Las Vegas Wash, and to restore some of the failing wetland areas. The SNWA proposes to construct a series of 26 ECSs and 27,000 ft (8,230 m) of bank protection in or adjacent to the Las Vegas Wash between Las Vegas Bay and the Harmon Avenue alignment (CCRFCD 2002). The SNWA has already completed the construction of seven permanent ECSs and one temporary ECS upstream of Lake Las Vegas. The NPS has completed three ECSs downstream of Lake Las Vegas for a total of 10 permanent and 1 temporary ECSs currently installed (Figure 3.1-6). Several thousand feet of bank protection has also been installed by SNWA along the Las Vegas Wash. The ECSs and bank protection have reduced channel degradation and erosion in the Las Vegas Wash.

Significant erosion downstream of Lake Las Vegas occurred prior to and after the construction of Lake Las Vegas. Headcuts in this reach of the Las Vegas Wash are as deep as 24 ft (7 m) (Reclamation 2001). Erosion continues as in other reaches of the Las Vegas Wash due to the perennial flows. Most of the sediment that has eroded over the years has been deposited at the downstream end of the Las Vegas Wash in Lake Mead. The Las Vegas Wash has deposited approximately 1,850 acre-ft of sediment in Lake Mead at the inner Las Vegas Bay (Figure 3.1-7) (USGS 2001).

3.1.2 Groundwater

The Valley is a fault-bounded structural and hydrologic basin containing up to 15,000 ft (4,572 m) of late Tertiary and Quaternary basin fill that includes sediments deposited in alluvial, playa, and paludal environments. These sediments consist of coarse-grained alluvial-fan deposits flanking the Valley margins that interfinger with fine-grained units toward the middle of the Valley.

3.1.2.1 Groundwater Aquifers

The accessible portions of the Las Vegas basin valley fill contains three aquiformations. From younger to older these are: the Las Vegas Wash Aquitard, the Las Vegas Springs Aquifer, and the Duck Creek Aquifer (Donovan 1996). The Las Vegas Wash Aquitard extends from land surface to between 150 and 500 ft (46 and 152 m) depth. The underlying Las Vegas Springs Aquifer has variable thickness averaging 500 ft. Most municipal and domestic water is obtained from this aquiformation, and its most productive areas are in the west-central and northwest portions of the Valley. Some municipal wells also tap the upper portions of the subjacent Duck Creek Aquifer, which (locally) may exceed 900 ft (274 m) in thickness.

Each of these aquiformations contain interbedded boulder to pebble conglomerate, sandstone, siltstone, and claystone of variable thickness. The proportion of finer-grained sediment increases away from the flanking mountains toward the valley center, and is also higher near some faults.

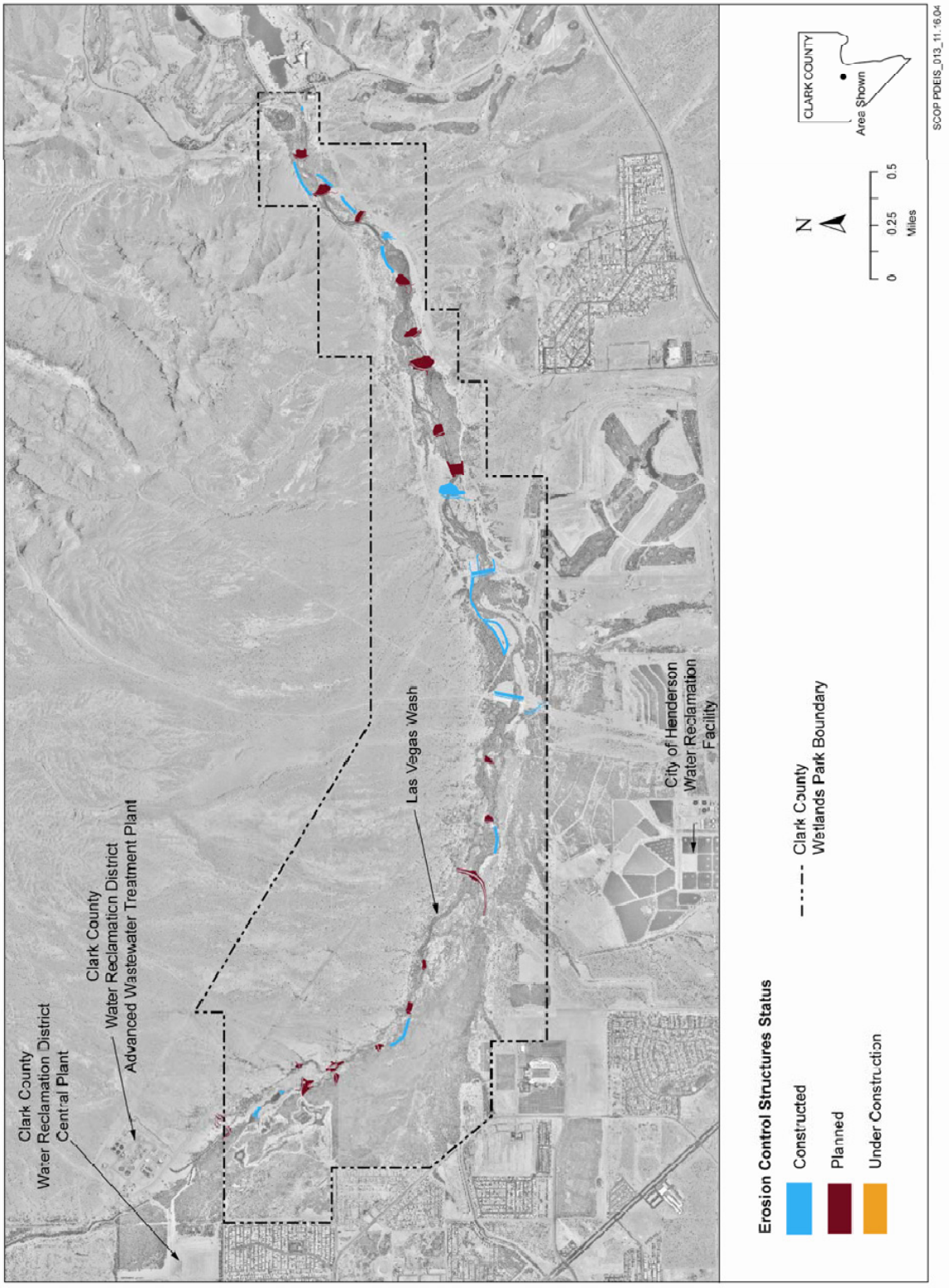


Figure 3.1-6 Erosion Control Structures.

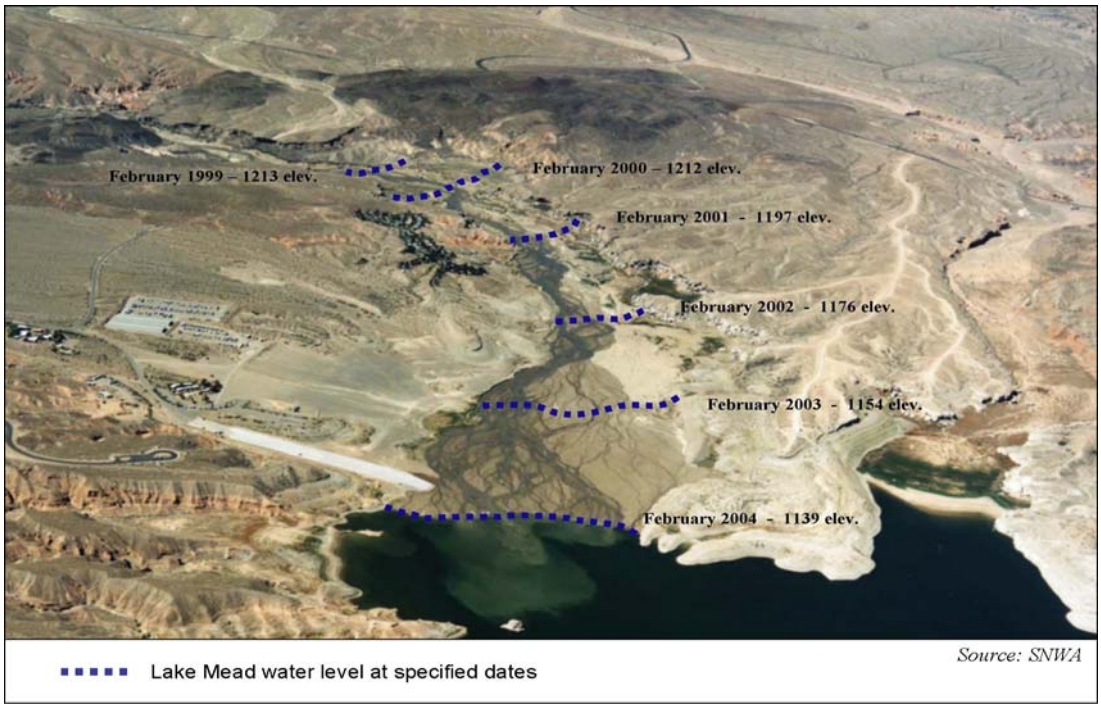


Figure 3.1-7 Las Vegas Bay Delta.

3.1.2.2 Groundwater Recharge

There are three main sources of groundwater recharge in the Valley. The first is natural recharge from snowmelt, runoff, and precipitation that falls on the flanking Spring and Sheep Mountains. A second source is deep-well artificial recharge to the drinking water aquifers. Since 1991, artificial recharge, largely by the LVVWD, has emplaced approximately 260,000 acre-ft into these aquifers, and has been an important factor in water-level stabilization and increase (LVVWD 2004).

The third source includes irrigation water, with a minor component of effluent discharge that enters the shallow groundwater system. Interaction between the shallow groundwater system, which is contained within the Las Vegas Wash Aquitard, and underlying aquifers, is slight. Prior to urbanization the shallow groundwater system was recharged by slow upward artesian flow from the Las Vegas Springs Aquifer. This flow has diminished in the area due to extraction of groundwater. However, increased irrigation has caused the shallow system to integrate and expand in some areas (Leising 2004).

3.1.2.3 Groundwater Flow

Groundwater flow in the Las Vegas basin is characterized by:

- Lateral movement of orographically recharged water,
- Impacts of water supply pumping and recharge, and
- Evapotranspiration.

The dynamic character of groundwater is shown not only in the variation of the water table levels but also by the horizontal movement of groundwater. The ease with which the water moves is related to the hydraulic conductivity of the aquifer. Hydraulic conductivity in the vicinity of the proposed EI alignments varies from 0.1 to 675 gallons per day per ft squared (gpd/ft^2) (0.38 to 2,555 liters per day per meters squared [Lpd/m^2]).

Groundwater levels along the EI alignments range in depth from 5 to 46 ft (2 to 14 m) below the ground surface (SNWA 2002). These groundwater levels were obtained from different wells located adjacent to the Las Vegas Wash. The different values for groundwater depth were averaged for each well to determine an average estimate of the groundwater depth in the vicinity of the proposed EI alignment. Figure 3.1-8 shows the location of the wells and the depth to groundwater in the vicinity of the proposed EI alignment. Additional data from different sources were used to create a potentiometric surface of the shallow groundwater system.

3.1.2.4 Groundwater Quality

Hydrochemical facies of native groundwater were categorized into three facies based on TDS and sulfate, bicarbonate, chlorine, magnesium, calcium, and sodium concentrations. The three facies are: the Spring Mountains, Red Rock alluvial fan, and McCullough Mountains.

The Spring Mountains facies underlies the northern and northwestern portions of the Valley and has low TDS (around 350 – 500 parts per million [ppm]). The Red Rock facies flanks the Spring Mountains facies on the south and extends into the southeastern portions of the Valley. This facies' TDS ranges from 600 ppm to about 1200 ppm, and contains more sulfate than the Spring Mountains facies. The McCullough Mountains facies is on the down-gradient end of the regional flow system in the extreme eastern and southeastern portions of the Valley. This facies is characterized by moderately high TDS (around 500 – 800 ppm), a predominance of sulfate over bicarbonate and moderate to high chloride and significant sodium concentrations. Data suggests that these three facies transect lithostratigrahic boundaries. Isotopic data suggest hydrostratigraphic connections between these facies where faults may act as conduits of flow from one facies to the other (Leising 2004).

In the vicinity of the proposed EI alignments, recent studies indicate that chloroform is present in groundwater but does not represent an environmental threat. Perchlorate concentrations range from 0 to 8,400 ppb. At certain periods of time, these concentrations exceeded the SNWA public notification level, which is 18 ppb. Nitrates, sulfates, and radionuclides were also detected in the shallow and near-surface aquifers (Converse Consultants 2002).

Selenium is a naturally occurring element in the soil that can potentially contaminate the groundwater. Groundwater samples were taken from six monitoring wells located near the Las Vegas Wash from March 2002 to February 2003. The concentration of selenium in the samples ranged from 3.9µg/L to 23.7µg/L (Cizdziel 2005). Currently, the Las Vegas Wash consists of approximately 7 percent resurfacing groundwater (Leising 2003). However, these groundwater seeps contribute approximately 22 percent of the selenium in the Las Vegas Wash (Cizdziel 2005). Other sources of selenium in the Las Vegas Wash include surface water from tributaries (approximately 36 percent) and treated wastewater effluent (approximately 43 percent).

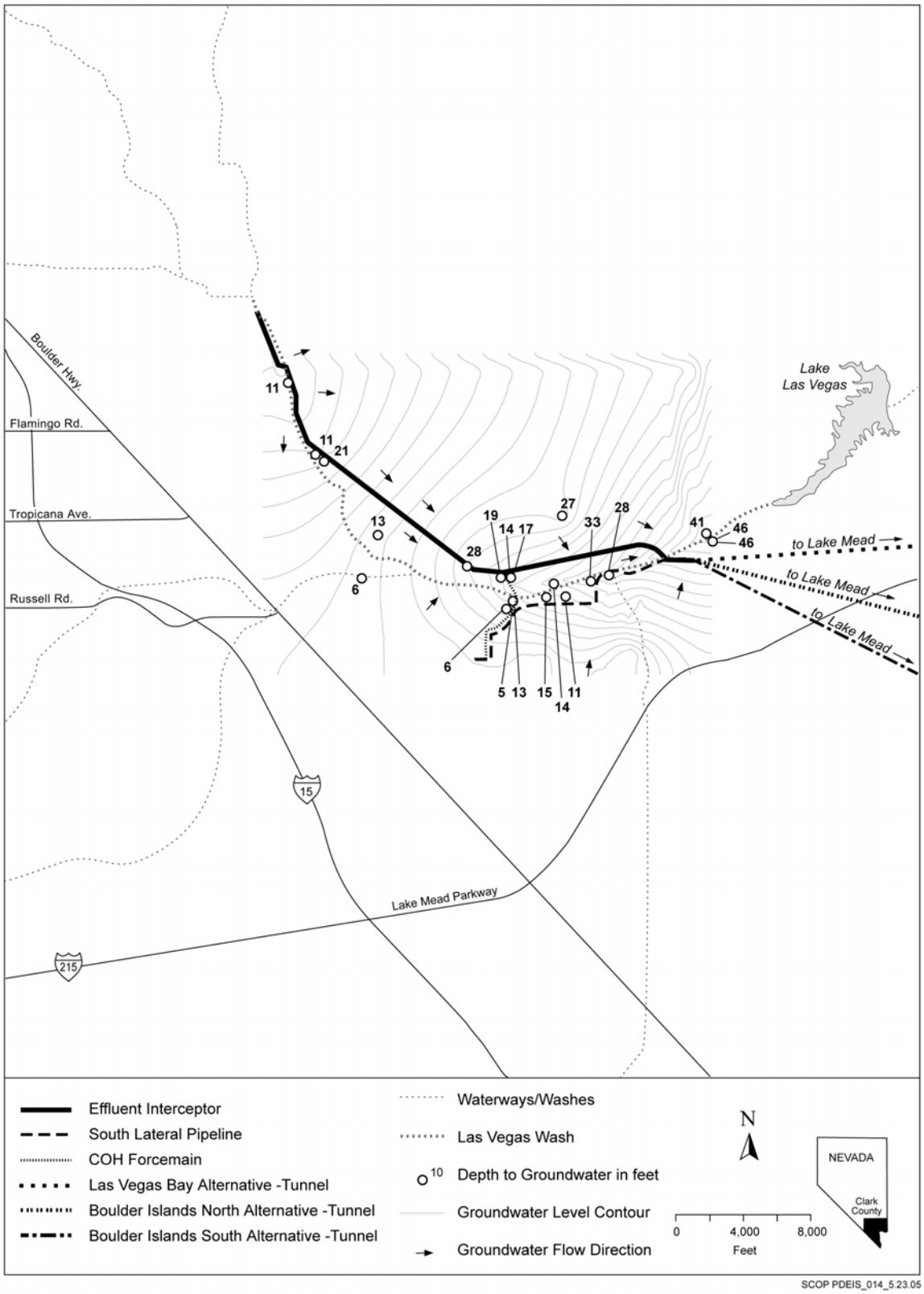


Figure 3.1-8 Location of Groundwater Wells, Depth to Groundwater, and Groundwater Flow in the Vicinity of the Effluent Interceptor.

3.1.3 Surface Water Quality

This section presents water quality standards, impairments and concerns, and baseline surface water quality in the Las Vegas Wash, Las Vegas Bay, at the SNWA intakes, and at Hoover Dam. Water quality data from 2002 is used as the water quality baseline in this EIS to ensure consistency with the concurrent water modeling being conducted for the SCOP.

The ELCOM/CAEDYM alternative runs were modeled using base conditions from 2002. Year 2002 was selected as the baseline year for the following reasons:

- Prior to year 2000, not much water-quality data is available for Lake Mead;
- A significant amount of data is available for years 2000, 2001, and 2002;
- Year 2001 was an atypical year concerning algal growth in Lake Mead, so it was eliminated from consideration;
- Year 2002 data is representative of typical conditions in Lake Mead including algal growth years; and
- Year 2002 lake elevation was lower, which is expected to be typical in the future.

Baseline water-quality data was obtained from several agencies, including the COH, CLV, CCWRD, SNWA, Reclamation, USFWS, and USGS. Flows and water quality data was obtained for the WWTPs' effluent, the Las Vegas Wash inflow (including tributary and groundwater inflow), the SNWA intakes, the BMI intake, the Hoover Dam discharge, and the Boulder Basin. Groundwater quality is discussed in Section 3.1.2.4.

3.1.3.1 Water Quality Standards

Standards for Water Quality for Nevada are contained in the *Nevada Administrative Code* (NAC), (Chapter 445A.118-445A. 225). The NDEP proposes standards (often based upon EPA criteria) that are then adopted by the State Environmental Commission into the NAC. Standards are also submitted to EPA for review and approval.

The NAC stipulates three key elements for water quality standards:

- Designated beneficial uses,
- Criteria to protect beneficial uses, and
- Anti-degradation provision (RMHQ).

As discussed in Section 1.4, water quality standards are legally enforceable and used to define the water quality goals that correspond with an intended beneficial use of a water body. In addition to the criteria to protect beneficial uses, RMHQs are also established. These RMHQs are set to prevent degradation of the water while beneficial use standards are the minimal requirements to protect the various beneficial uses. The RMHQs are established when the existing water quality (as evidenced by monitoring data) for each parameter is better than the criteria necessary to

protect the beneficial uses. The following four areas (Figure 3.1-9) within the project area are designated by the NAC as having beneficial uses:

- Las Vegas Wash from Telephone Line Road to the confluence of discharges from the CCWRD and the CLV WWTPs (Upper Las Vegas Wash) (NAC 445A.198),
- Las Vegas Wash from the confluence of Las Vegas Wash and Lake Mead to Telephone Line Road (Lower Las Vegas Wash) (NAC 445A.200),
- Lake Mead from the western boundary of the Las Vegas Bay Campground to the confluence of Las Vegas Wash (Inner Las Vegas Bay) (NAC 445A.196), and
- The remaining areas of Lake Mead (Lake Mead) (NAC 445A.194).

The beneficial uses of these four areas are listed in Table 3.1-1. The water quality standards for the RMHQs and beneficial uses of these four areas are listed in Table 3.1-2.

The NDEP has implemented revisions to the standards in response to lower Lake levels, because Lake locations identified in the standards are now on dry land. The proposed revisions identify monitoring locations that compensate for changes in Lake levels. The water quality standards revisions reflect a change in how monitoring stations are located in the inner Las Vegas Bay and Lake Mead. The relative positions of the monitoring stations are now more properly defined by locating them a fixed distance from the confluence between the Las Vegas Wash and Lake Mead (NDEP 2004a).

Table 3.1-1 Beneficial Uses.

Use	**Upper Las Vegas Wash**	**Lower Las Vegas Wash**	**Inner Las Vegas Bay**	**Lake Mead**
Irrigation	X	X	X	X
Watering of livestock	X	X	X	X
Recreation involving contact with the water				X
Recreation not involving contact with the water	X	X	X	X
Industrial supply			X	X
Municipal and/or domestic supply				X
Maintenance of a freshwater marsh	X	X		
Propagation of wildlife	X	X	X	X
Propagation of aquatic life	X[1]	X [1]	X [2]	X [2]

Notes:

[1] Excluding fish, does not preclude the establishment of a fishery.

[2] Including, without limitation, a warm water fishery.

Source: NAC, chapter 445A.194, 445A.196, 445A.198, and 445A.200.

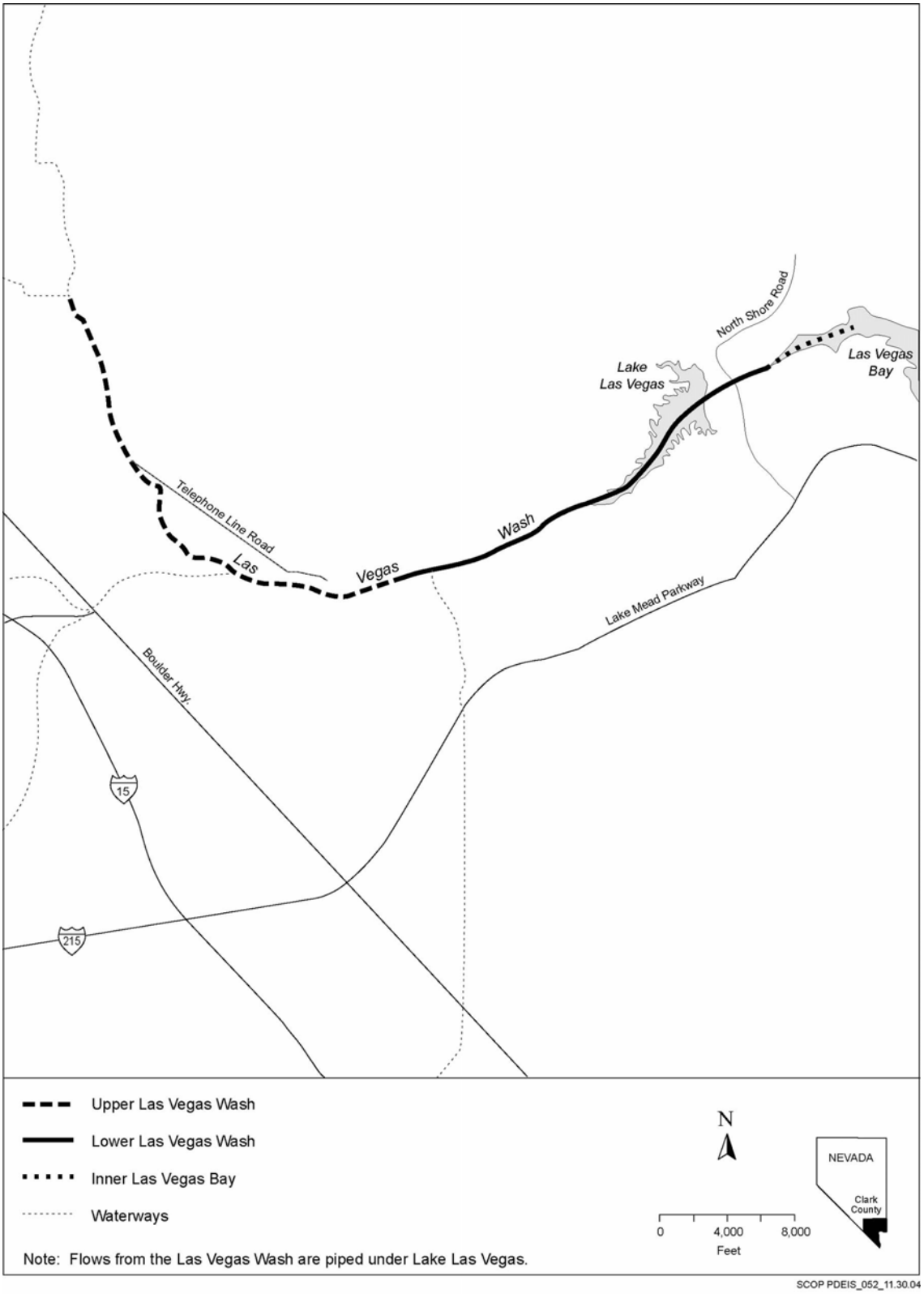


Figure 3.1-9 Areas Designated for Beneficial Use.

Table 3.1-2 Water Quality Standards.

	Las Vegas Wash (Upper and Lower)		Inner Las Vegas Bay		Lake Mead	
Parameter [1]	RMHQ	Beneficial Uses Criteria	RMHQ	Beneficial Uses Criteria	RMHQ	Beneficial Uses Criteria
Temperature (Degree Celsius [°C])	ΔT=0 [2]	—	ΔT=0 [2]	ΔT=2 [2]	ΔT=0 [2]	ΔT=2 [2]
pH (Standard Unit)	—	6.5-9.0	95% of Samples ≤ 8.9	6.5-9.0	95% of Samples ≤ 8.8	6.5-9.0
Dissolved Oxygen (DO) (mg/L)	—	Aerobic Conditions Desirable	—	≥ 5	—	≥ 5 [3]
Chlorophyll *a* (µg/L)	—	—	—	[4]	[4]	—
Un-ionized Ammonia as N (mg/L)	—	—	—	4-day Aver. ≤ 0.05 Single Value ≤≤ 0.45	—	4-day Aver. ≤ 0.05 Single Value ≤≤ 0.45
Total Dissolved Solids (mg/L)	95% of Samples: Upper LVW [5] ≤ 1,900, Lower LVW ≤ 2,400	≤ 3,000	[6]	≤ 3,000	[6]	≤ 1,000
Chloride (mg/L)	—	—	—	—	[7]	≤ 400 [7]
Sulfate (mg/L)	—	—	—	—	[7]	≤ 500 [7]
Total Suspended Solids (mg/L)	—	≤ 135 [8]	—	≤ 25	—	≤ 25
Nitrate-N (mg/L)	—	≤ 10	—	≤ 90	—	≤ 10
Nitrite-N (mg/L)	—	≤ 1	—	≤ 5	—	≤ 1
Total Inorganic Nitrogen (mg/L)	95% of Samples: Upper LVW ≤ 20, Lower LVW ≤ 17	—	95% of Samples ≤ 5.3	—	95% of Samples ≤ 4.5	—
Turbidity (NTU) [9]	—	—	≤ 10 of Natural Conditions	≤ 25	≤ 10 of Natural Conditions	≤ 25
Fecal Coliform (MPN/100mL) [10]	—	Point Source Only ≤ 200/400 [11]	—	Point Source Only ≤ 200/400 [11]	—	≤ 200/400 [11]
E. Coli 30-day Log Mean	—	—	—	—	— —	≤ 126 ≤ 235
Color (Platinum-Cobalt Scale Units)	—	—	—	—	≤ 10 of Natural Conditions	—

Notes: See following page.

Table 3.1-2 Notes:

[1] Unless mentioned otherwise, requirements or criteria refer to single value.

[2] ΔT means change in temperature. Maximum allowable increase in temperature above water temperature at the boundary of an approved mixing zone.

[3] In the epilimnion or average in water column during periods of non-stratification.

[4] The requirements for chlorophyll *a* are:

- Not more than one monthly mean in a calendar year at Station 3 may exceed 45 µg/L.
- The mean for chlorophyll *a* in summer (July 1-September 30) must not exceed 40 µg/L at Station 3, and the mean for 4 consecutive summer years must not exceed 30 µg/L. The sample must be collected from the center of the channel and must be representative of the top 5 m (16 ft) of the channel. "Station 3" means the center of the channel at which the depth is from 16 to 18 m (52 to 59 ft).
- The mean for chlorophyll *a* in the growing season (April 1-September 30) must not exceed 16 µg/L at LM4 and 9 µg/L at LM5. LM4 is located just outside of the Las Vegas Bay launch ramp and marina, next to buoy RW "1". LM5 is located next to buoy RW "A" with the southshore landmark of Crescent Island.
- The mean for chlorophyll *a* in the growing season (April 1-September 30) must not exceed 5 µg/L in the open water of Boulder Basin, Virgin Basin, Gregg Basin, and Pierce Basin. The single value must not exceed 10 µg/L for more than 5 percent of the samples.
- Not less than two samples per month must be collected between the months of March and October. During the months when only one sample is available, that value must be used in place of the monthly mean.

[5] LVW = Las Vegas Wash.

[6] Flow weighted annual average concentration ≤723 mg/L measured below Hoover Dam.

[7] The combination of this constituent with other constituents comprising TDS must not result in the violation of the TDS standards for Lake Mead and the Colorado River.

[8] Not applicable when flows are greater than 110 percent of average flow as measured at the nearest gauge.

[9] Nephelometric Turbidity Unit.

[10] Most Probable Number per 100mL (1 deciliter).

[11] Based on a minimum of not less than 5 samples taken over a 30-day period, the fecal coliform bacterial level must not exceed a log mean of 200 most probable number per 100 milliliters (MPN/100mL) nor must be more than 10 percent of the total samples taken during any 30-day period exceed 400 MPN/100 mL.

Source: NAC, Chapter 445A.195-201.

3.1.3.2 Water Quality Impairment and Concern

As discussed in Section 1.4, the TP TMDL and WLA were established to ensure attainment of the RMHQs for chlorophyll *a*. Chlorophyll *a*, the principal photosynthetic pigment in plants, is used as an indicator of algal biomass in water. Chlorophyll *a* is a reliable measure of algal concentrations because it is directly related to the quantity of algae present (NDEP 1987). Algae have the potential to change the apparent color of water when excessive amounts are present, and they may create undesirable surface scum that can impair recreational use and can create taste and odor problems. High algae densities can settle to the lake bottom and reduce dissolved oxygen (DO) levels.

The total ammonia TMDL and WLA were established to ensure attainment of the beneficial use standards for NH_3 (Section 1.4). Un-ionized ammonia can be toxic to fish. In water, ammonia occurs in two forms, NH_3 and ionized ammonia (NH_4+), which together form total ammonia (NH_4 -N). Un-ionized ammonia is calculated from the total ammonia concentration, pH, and temperature. The concentration of NH_3 increases as a function of increasing pH and increasing temperature (NDEP 1987, 1989).

The decreasing levels of Lake Mead are an issue of concern because of the reduced amount of water. This issue is discussed further in Section 3.1.3.4.1, Factors Affecting Water Quality.

The 5-mile (8-km) segment of the Las Vegas Wash between Telephone Line Road and Lake Mead is on Nevada's 2004 303(d) *Impaired Waters List* (NDEP 2004b). The pollutants or stressors of concern are total iron and TSS. The 303(d) list notes that data indicates a majority of the iron is in particulate form associated with sediment. Iron levels decreased following the construction of ECSs, and delisting for iron is in progress. The TSS in the Las Vegas Wash are no longer exceeding water quality standards (NDEP 2005). Selenium is listed as warranting further investigation between Telephone Line Road and Lake Mead (NDEP 2004b) due to total selenium concentrations exceeding the 96-hour average toxicity criterion of 5.0 µg/L only once every 3 years. However, the existing average concentration of selenium in the Las Vegas Wash is approximately 2.5 µg/L (COH 2002a). The largest source of the selenium (by mass) is treated wastewater effluent, which accounts for approximately 43 percent of the total mass (Cizdziel 2005). Groundwater seeps and tributaries to the Las Vegas Wash contribute the remainder of the selenium, approximately 22 percent and 36 percent respectively (Cizdziel 2005).

The Nevada's 2004 303(d) *Impaired Waters List* does not list TIN as a concern, but according to the *2003 Water Quality Report*, exceedances of the RMHQ for TIN have occurred several times in the Inner Las Vegas Bay and Lake Mead. The exceedances of TIN were small and occurred at low Lake levels as the Las Vegas Wash enters the Inner Bay. In a very short travel distance, the TIN was within Water Quality Standards. After review with NDEP, it was determined that the field measurement should occur throughout the entire water column, which will be representative of the original intent of the TIN water quality monitoring program. Also, the State Environmental Commission recently enacted a revised monitoring program that will take into account the rise or lowering of the Lake levels. Nitrogen is a nutrient that, along with phosphorus, can have a significant impact on the algal production of a lake. However, algal production in Las Vegas Bay and Boulder Basin are believed to be controlled by phosphorus, rather than nitrogen (Black & Veatch 2005a).

Perchlorate was detected in 1997 in Lake Mead. The source was traced to the Las Vegas Wash. The chemical has been seeping into the Las Vegas Wash from nearby manufacturing sites through the shallow groundwater system. There is currently no limit on perchlorate in the federal *Safe Drinking Water Act* (42 USC 300f et seq.; PL 93-523). However, on February 18, 2005, EPA issued a safety standard of 24.5 ppb for perchlorate. The SNWA uses the perchlorate concentration of 18 ppb as a public notification level. A remediation system was installed under the direction of NDEP in 2002 to intercept and treat the perchlorate entering the Las Vegas Wash. This system removes more than 2,500 lbs/day (1,134 kilograms/day [kg/day]) of perchlorate from the groundwater. Levels at the SNWA intake went from 11 to 12 ppb in 2003 to about 6 ppb in 2004, and 3 ppb in 2006. Future monitoring results will show the effect of this remedial action on the Las Vegas Wash and Lake Mead.

3.1.3.3 Las Vegas Wash

The Las Vegas Wash is the primary conveyance of surface water runoff for the Valley. The Las Vegas Wash drains 1,600 square miles (4,144 square km) of the Valley and channels urban

runoff and stormwater, shallow groundwater, and reclaimed water into the Las Vegas Bay. Factors affecting the water quality in the Las Vegas Wash and the baseline water quality conditions are discussed in this section.

3.1.3.3.1 Factors Affecting Water Quality

Treated effluent is a major component of the dry weather flow in the Las Vegas Wash. The wastewater is highly treated to meet NPDES permit requirements before discharging into the Las Vegas Wash. Continuous flows include treated effluent from the three treatment facilities and cooling water discharged from BMI, an industrial site located in Henderson.

Stormwater transports various contaminants such as bacteria, oil, grease, pesticides, herbicides, and nutrients in fertilizer from the land surface into the Las Vegas Wash. The high flows during storm events are very erosive and convey large amounts of sediment downstream into Lake Mead.

Dry weather urban discharge and intercepted shallow groundwater contribute about 15 percent of the annual flows in the Las Vegas Wash. The shallow groundwater contains high levels of TDS and many other substances including selenium and perchlorate. Dry-weather urban discharge is generally due to the excess water from urban uses, such as overwatering of landscapes. As the Valley's population grows, development results in increasing impervious cover, which in turn leads to increased urban runoff. However, improvements such as stormwater detention basins and ECSs reduce the erosive effects of stormwater runoff.

3.1.3.3.2 Baseline Water Quality Conditions

This section provides a description of the baseline water quality conditions of the Las Vegas Wash up to the confluence with Lake Mead. The COH provided the baseline water quality data for the Las Vegas Wash (Table 3.1-3) (COH 2002a). Baseline data for the Las Vegas Wash is based upon 2002 annual average data from monitoring station LW0.55, which is located downstream of Northshore Road (Figure 3.1-10). Station LW0.55 was used to determine the baseline water quality conditions in the Las Vegas Wash because it is the location where all the inflows into the Las Vegas Wash are combined and NDEP established TP and total ammonia WLAs to meet the Las Vegas Bay water quality standards as discussed in Section 1.4.

The pH values in the Las Vegas Wash are within the required range for sustaining designated beneficial uses and RMHQs. The dissolved oxygen levels are generally high as needed to meet the desired goal of an aerobic environment. Water quality is therefore appropriate for fish. However, the Las Vegas Wash is considered poor habitat for most fish because of the high flow velocities, suspended sediment, unstable bottom, and more recently, blockage by ECSs.

Algal levels are low in the Las Vegas Wash because there is not enough retention time of the water for algae to grow. Flows in the Las Vegas Wash are too rapid to promote algae growth.

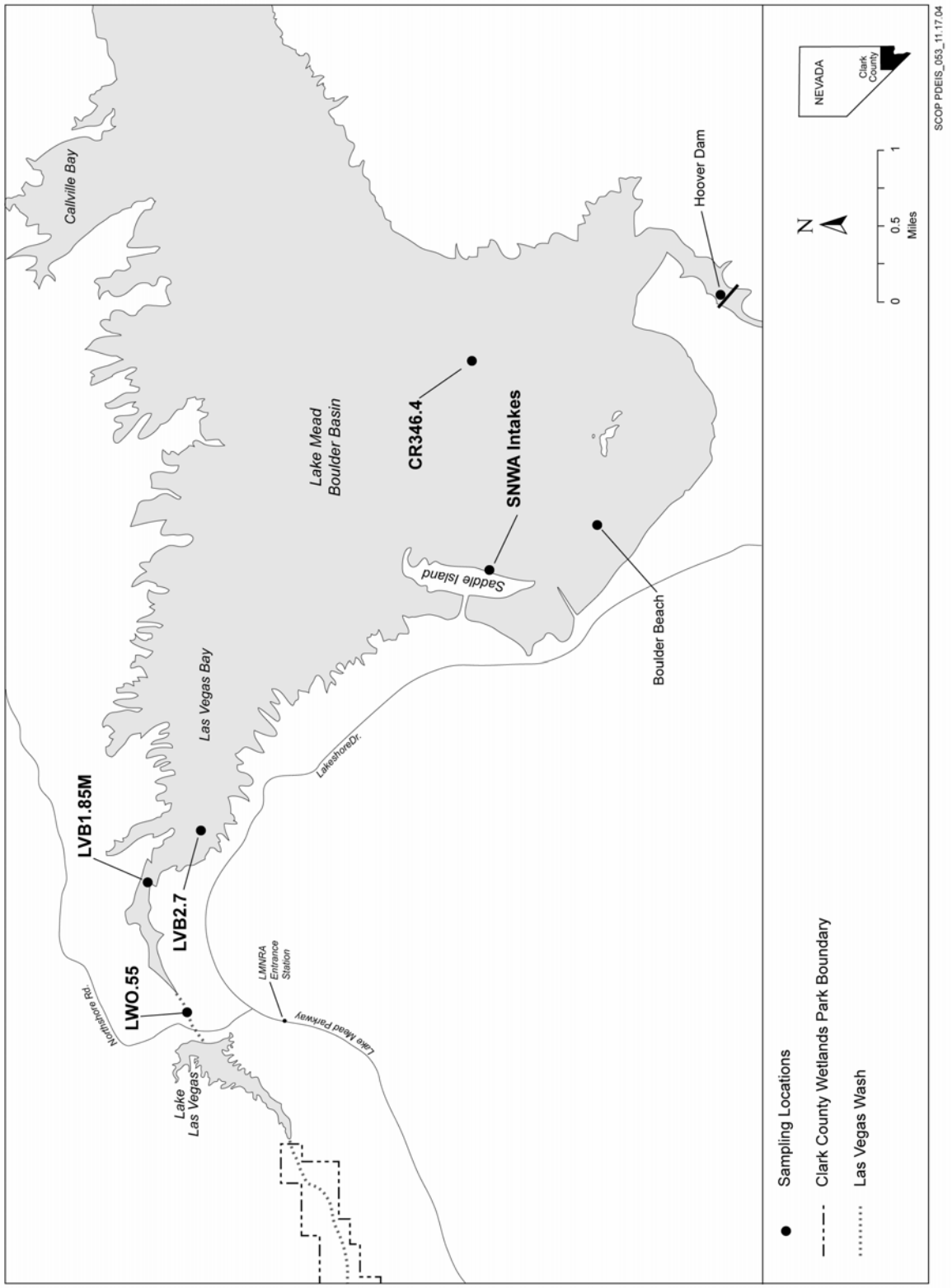


Figure 3.1-10 Water Quality Sampling Locations in Boulder Basin.

Table 3.1-3 Baseline Water Quality Conditions in the Las Vegas Wash.

Parameter	LW0.55
Temperature (°C) [degree Fahrenheit {°F}]	22.6 [72.7]
Perchlorate (µg/L)	NA[1]
Conductivity (µS/cm)	2344
Total Dissolved Solids (mg/L)	1,675
Dissolved Oxygen (mg/L)	8.9
Chlorophyll (µg/L)	NA
Total Phosphorus (mg/L)	0.2
Soluble Phosphorus (mg/L)	0.1
Total Inorganic Nitrogen (mg/L)	15
Nitrate (mg/L)	15.8
Total Ammonia Nitrogen (mg/L)	0.1
Un-ionized Ammonia (mg/L)	NA
Bromide (mg/L)	NA
Sulfate (mg/L)	633
Chloride (mg/L)	309
Fecal Coliform (MPN/100mL) [2]	231
pH	8.3
Selenium (µg/L)	2.5

Notes:

[1] NA = Not available.

[2] Most probable number per 100 ml (1 deciliter).

Source: COH 2002d.

High values of TSS occur during storm runoff events. Concentrations are usually low during dry weather when effluent dominates.

Effluent flows have low fecal coliform (FC) values due to disinfection at the treatment plants. The presence of FC bacteria in aquatic environments indicates that the water has been affected by the fecal material of man or animals. In the Las Vegas Wash, elevated FC levels have been attributed primarily to birds. The Las Vegas Wash is not used for swimming because of shallow water and high flow velocities.

Selenium present in the Las Vegas Wash originates from treated wastewater effluent, groundwater, and tributary waters. Although naturally occurring, selenium has been leached from soils at an accelerated rate throughout the southwestern U.S. due to irrigation practices and shallow groundwater flows. The current concentration of selenium in the Las Vegas Wash is

2.5 µg/L. Selenium concentrations are being monitored by the LVWCC at eight locations throughout the Las Vegas Wash.

Measured perchlorate concentrations along the Las Vegas Wash below Pabco Weir ranged from 4.8 to 832 µg/L. More discussion of this issue is provided in Section 3.1.3.4.

Samples from the Las Vegas Wash have been analyzed for NDMA. Analysis results for one sample indicated the presence of NDMA at the very lowest measurable concentration of 2 nanograms per liter.

3.1.3.4 Boulder Basin, Lake Mead

A discussion of the main factors affecting water quality and the baseline water quality conditions in the Boulder Basin of Lake Mead are presented in this section. It is based on a general understanding of lake limnology, observations in Boulder Basin, and modeling results that provide insights into the hydrodynamics and mixing of the system. Most of the information presented in this section is based on the *Lake Mead Modeling Report* (Black & Veatch 2005b). Additional information regarding the limnology of Lake Mead may be found in two research reports prepared by UNLV (UNLV 1980, 2002) and several published papers (LaBounty and Horn 1997). In addition, the CWC routinely monitors water quality in Lake Mead.

3.1.3.4.1 Factors Affecting Water Quality

The dominant factors that affect water quality in the Boulder Basin include various aspects of the limnology of Lake Mead and the primary inflows. These factors include:

- Lake stratification,
- Wind,
- Solar radiation,
- Lake surface elevation, and
- Las Vegas Wash and Colorado River inflow.

Lake Stratification

Thermal stratification is an important physical characteristic of Boulder Basin and dominates most aspects of lake mixing. Additional information about the stratification of Lake Mead is provided in Appendix D. The formation of thermal stratification is a direct result of increasing solar radiation and air temperature in the spring. In the winter, decreasing solar radiation and air temperature, combined with wind mixing, contributes to destratification of the lake. The upper, warmer water is called the epilimnion, the deeper, colder water is called the hypolimnion. The middle portion separating these two layers, where the rate of vertical temperature change is greatest, is called the metalimnion or thermocline.

In February, water temperatures in Boulder Basin are nearly uniform in the vertical direction at a value near 12 to 13 degrees Celsius (^{o}C) (53 to 55 degrees Fahrenheit [^{o}F]) and the Lake is

usually fully mixed. By summer, the thermocline is well defined and located at an approximate depth of 30 to 50 ft (9 to 15 m) below the surface. In the fall, surface water temperatures steadily decrease (to about 16°C [60°F]) due to decreased solar radiation. This deepens the thermocline to a depth of 160 ft (49 m) by November and causes wind mixing to be more effective. The stratification continues to weaken until the Lake destratifies in February.

Thermal stratification has profound effects on the mixing processes within Boulder Basin. Since there is little mixing between the epilimnion and hypolimnion during the stratified period, the concentrations of chemical components in either layer are mostly independent and unaffected by inflow loadings into the other layer for much of the year. In some ways, the stratified Lake behaves like two distinct water bodies. For example, if there is a summertime inflow of a substance into the epilimnion, the substance will be generally contained within the epilimnion. At the same time, the concentration of that substance in the hypolimnion will be essentially unchanged until the Lake destratifies in the winter and the substance becomes fully mixed throughout the depth of the reservoir. Until then, the substance concentration profile will show significant vertical stratification in the same way that there is vertical temperature stratification.

Wind

Wind is an important mixing mechanism in Boulder Basin. However, unless the thermal stratification is very weak, the vertical mixing is mostly limited to the epilimnion. Horizontal mixing in the epilimnion is affected by the wind direction. If the surface currents generally flow north and west (towards the inner Las Vegas Bay), the effluent plume from the Las Vegas Wash may build up within the Las Vegas Bay for a few days until the currents change. If the surface currents generally flow south and east (towards Hoover Dam), the flows from the Las Vegas Wash quickly spread horizontally into the open water. Wind also causes the thermocline to tilt, and produces deeper currents in the Lake that increase mixing.

Solar Radiation

Solar radiation is the driving force that creates thermal stratification in Boulder Basin and provides the energy required by phytoplankton for photosynthesis. The solar radiation is at a minimum in December/January and a maximum in July/August.

Lake Surface Elevation

Water surface elevations in Boulder Basin can have a direct effect on the water quality of its outflows. If the Lake elevation drops to extremely low levels, the SNWA and Hoover Dam intakes may withdraw water from the thermocline or epilimnion (instead of the hypolimnion, from which they have historically withdrawn water). Moreover, a lower water surface elevation may mean that there is less water available for dilution of constituents in the Las Vegas Wash and the Colorado River inflow, especially in the hypolimnion.

Las Vegas Wash and Colorado River Inflow

The Las Vegas Wash and the Colorado River are the two primary inflows into Boulder Basin. The average flow rate of the Colorado River between 2000 and 2002 was about 8,000 mgd

(12,320 cfs), which is almost 50 times that of the Las Vegas Wash. Due to its high inflow rate, the Colorado River serves as the primary dilution source for various water-quality constituents that enter Boulder Basin from the Las Vegas Wash.

The Las Vegas Wash flows enter Boulder Basin as a surface stream into the inner Las Vegas Bay. After entering the reservoir, the stream mixes with Lake water and settles to a depth controlled by its density relative to the density of the Lake water. The Las Vegas Wash inflow travels along the thermocline between April and October where it is vertically mixed within the epilimnion by strong winds. Between December and February, the inflow travels along the bottom of the reservoir. In November and March, the inflow intrudes into both the epilimnion and the hypolimnion.

The Colorado River flows enter Boulder Basin through the Narrows. Like the Las Vegas Wash inflow, it is believed that the Colorado River flows along the thermocline in summer, and deeper in the winter. Although the net flow goes through the Narrows downstream from the Virgin Basin into the Boulder Basin, there is evidence of a reverse flow from Boulder Basin upstream into the Virgin Basin that is related to high-velocity wind events that cause significant water movement upstream towards the Narrows.

3.1.3.4.2 Baseline Water Quality Conditions

Baseline water-quality conditions for the Boulder Basin are described in this section. Water quality is described for the Las Vegas Bay, Boulder Basin, Boulder Beach, SNWA intake area, and the Hoover Dam discharge area. Table 3.1-4 shows the baseline levels of various constituents in these areas based on 2002 water quality data. Figure 3.1-10 shows the locations of the water quality sampling sites in the Boulder Basin.

The water quality in Boulder Basin is characterized by the concentrations of its chemical and biological constituents. The parameters addressed include conductivity, perchlorate, bromide, sulfate, chloride, FC, TP, nitrogen, chlorophyll, Secchi depth, DO, and pH.

Conductivity. Conductivity indicates the level of the total amount of mineral substances that are dissolved in a sample of water. The concentration of TDS is computed from the correlations: TDS (mg/L) = 0.633 Conductivity (microsiemens per centimeter [µS/cm]) in Lake Mead; TDS (mg/L) = 0.68 Conductivity (µS/cm) in Las Vegas Wash. In Boulder Basin (particularly the Las Vegas Bay), the main source of conductivity is from the Colorado River flows. The Las Vegas Wash conductivity for 2000 to 2002 was generally around 2,500 µS/cm (1,583 mg/L TDS). In comparison, the average conductivity in the Colorado River inflow was about 850 µS/cm (538 mg/L TDS), but there was about 50 times more flow. The average conductivity in Boulder Basin from 2000 through 2002 was about 930 µS/cm (589 mg/L TDS).

Perchlorate. Perchlorate is an ionic substance made up of chlorine and oxygen that forms part of ammonium perchlorate, which is used in solid rocket fuel and explosives production. In solution,

Table 3.1-4 Baseline Water Quality Conditions in Boulder Basin
(1,178 ft for year 2002 with effluent flows of 150 mgd [231 cfs] and effluent TP = 292 lbs/day).[1]

Parameter	Inner Bay (LVB1.85M) [2]	Inner Bay (LVB2.7)	Boulder Basin (CR346.4)	Boulder Beach	Hoover Dam Discharge [3]	SNWA Intake [4]
Temperature (°C) [°F]	20.3 [68.6]	20.3 [68.5]	19.6 [67.2]	19.3 [66.7]	13.2 [55.7]	13.0 [55.3]
Perchlorate (µg/L)	45.2	46.7	12.9	13.9	6.6	5.8
Conductivity (µS/cm)	1085	1094	947	952	901	896
Total Dissolved Solids [5]	687	693	599	603	570	567
Dissolved Oxygen (mg/L)	8.7	8.7	8.3	8.3	7.7	7.5
Chlorophyll (µg/L) [6]	12.4	12.4	2.0	2.1	≤ 0.01	≤ 0.01
Total Phosphorus (mg/L)	0.018	0.018	0.005	0.005	0.005	0.004
Soluble Phosphorus (mg/L)	0.009	0.009	0.003	0.003	0.004	0.004
Total Nitrogen (mg/L)	1.6	1.7	0.4	0.4	0.3	0.4
Nitrate (mg/L)	1.6	1.6	0.4	0.4	0.3	0.3
Total Ammonia Nitrogen (mg/L)	0.012	0.013	0.01	0.011	0.014	0.019
Un-ionized Ammonia (mg/L)	0.0008	0.0008	0.0002	0.0004	0.0002	0.0003
Bromide (mg/L)	0.11	0.11	0.09	0.087	0.08	0.08
Sulfate (mg/L)	295	297	257	259	243	242
Chloride (mg/L)	107	108	85	85	79	78
Fecal Coliform (MPN/100mL) [7]	1.0	1.1	0.0	0.0	0.0	0.0
pH	8.1	8.1	8.0	8.0	7.7	7.7

Notes:

[1] Sampling depth is surface to 1 m (3.3 ft) for locations other than SNWA and Hoover Dam, which were sampled at intake depths, and except chlorophyll, which was sampled within the top 5 m (16 ft). All data is the mean annual average, except for chlorophyll, which includes the mean annual seasonal average (see note 5). This data is the 2002 calibration scenario modeling results, which is based upon actual sampling data used as input data for the model.

[2] M = Mobile. LVB1.85M is mobile and located at a depth of 16 to 18 m (52 to 59 ft) near the confluence of Las Vegas Wash and Lake Mead. All other locations are stationary.

[3] Hoover Dam discharge data is from upper and lower intakes combined.

[3] SNWA intake data is from the lower intake only.

[4] Total Dissolved Solids are calculated from the correlation TDS (mg/L) = 0.633 Conductivity (µS /cm).

[5] Chlorophyll data includes the mean annual seasonal average. Samples were taken at the top 5 m (16 ft).

[6] Most Probable Number per 100 ml (1 deciliter).

Source: Black & Veatch 2004c.

the ammonium perchlorate disassociates and the perchlorate ion is very stable and unreactive. At high doses, perchlorate is known to affect the function of the thyroid gland, which regulates hormone production.

In Boulder Basin, perchlorate loading is believed to come primarily from the groundwater (base flow) in the Las Vegas Wash. The average perchlorate concentration in the Las Vegas Wash inflow from 2000 through 2002 was about 400 µg/L. Due to dilution with the Lake water, perchlorate concentrations in the Lake average about 15 µg/L. As discussed earlier, remediation activities began in 1999 to intercept and treat the perchlorate entering the Las Vegas Wash. This system removes more than 2,500 lbs/day (1,134 kg/day) of perchlorate from the groundwater. Levels at the SNWA intake went from 11 to 12 ppb in 2003 to about 6 ppb in 2004, and 3 ppb in 2006.

Bromide. If ozone (O_3) is used in treatment processes, Bromide is a precursor to the formation of harmful disinfection by-products in municipal water supplies. Therefore, source waters with high bromide concentrations may require additional treatment to inhibit the formation of bromate.

The average bromide concentration is about 0.3 mg/L in the Las Vegas Wash and 0.08 mg/L in the Colorado River inflow. The bromide concentrations in Boulder Basin are close to that of the Colorado River inflow with little seasonal variation, mainly due to the fact that most of the bromide in the basin (on a mass loading basis) comes from the Colorado River where bromide concentrations remain steady.

Sulfate. Average sulfate concentrations are about 600 mg/L in the Las Vegas Wash inflow. In Boulder Basin, average measured sulfate concentrations at station CR346.4, near the surface, are around 220 mg/L, close to that of the Colorado River inflow.

Chloride. High chloride concentrations can give rise to detectable tastes in water. Average chloride concentrations are 300 mg/L in the Las Vegas Wash inflow and 70 mg/L in the Colorado River inflow. The chloride concentrations in Boulder Basin are between 80 and 100 mg/L.

Fecal Coliform. Fecal coliforms are bacteria found in the large intestines of humans and other animals, and also in soil and on the surfaces of plants and structures (Miller et al. 1966, EPA 1986, Haas et al. 1999). While a few strains of coliforms produce serious toxins, they are generally not harmful. The FC test is often used as an indicator of possible contamination by fecal matter and a measure of the potential for contamination by other pathogens. Treated effluent has been disinfected and therefore is not a significant source of FC. Stormwater runoff is often one of the biggest sources of FC. However, the bacteria rapidly settle or die off when they reach the Lake. In Boulder Basin, FC concentrations are usually very low, typically less than 2 most probable number per 100 milliliters (MPN/100mL).

Total Phosphorus. Phosphorus is an essential nutrient in lakes, but in high concentrations can cause excessive algal and aquatic plant growth. It is generally believed that phosphorus is the limiting nutrient in Boulder Basin. This means that all of the other components necessary for phytoplankton growth in Boulder Basin (e.g., nitrogen and carbon) are available in sufficient

quantities and it is a lack of phosphorus that limits aquatic plant growth. In this situation, when a limiting nutrient is added to the Lake, algae and plant growth will increase.

Historically, TP loadings from the Las Vegas Wash vary seasonally. Total phosphorus loading ranges from 800 to 1,200 lbs/day (363 to 544 kg/day) in the winter, and averages 200 lbs/day (91 kg/day) in the summer. This seasonal variation is a direct result of the effluent discharge permit requirements for TP that only limit effluent discharge loadings in the summer (April 1st through September 30th). However, in 2001, the treatment plants agreed to operate at 0.2 mg/L TP year round, which equals approximately 292 lbs/day (132 kg/day) of effluent TP with the current average effluent flows of 150 mgd. In the past, phosphorus loading was much higher and often exceeded 1,500 lbs/day (680 kg/day) year round.

While the concentrations of TP entering from the Narrows are significantly smaller than those from the Las Vegas Wash, the TP mass loading from the Narrows is comparable in magnitude to that from the Las Vegas Wash. Total phosphorus levels in the open waters of Boulder Basin are estimated to be about 0.004 to 0.011 mg/L (4 to 11 ppb).

Nitrogen. Nitrogen enters Boulder Basin through the Las Vegas Wash or from sources such as rainfall, groundwater, and the Colorado River. Some types of algae and bacteria are capable of nitrogen fixation, which converts nitrogen gas to forms of nitrogen that can be used by plants. There are several species of nitrogen existing in water including nitrate (NO_3), nitrogen dioxide (NO_2), NH_3, and organic nitrogen. The dominant form of nitrogen in Boulder Basin is NO_3 and thus, it can be used as an indicator for total nitrogen in the Lake.

During dry weather, the wastewater nitrate-nitrogen (NO_3-N) concentrations average about 15 mg/L in the Las Vegas Wash inflow and about 0.5 mg/L in Boulder Basin. Average NO_3-N concentrations upstream of the Narrows are typically about 0.2 mg/L in the summer and 0.35 mg/L in the winter.

Ammonia-nitrogen (NH_3-N) measurements are also taken at different locations within the Lake. Levels are typically below the reporting limits of either 0.04 or 0.08 mg/L. As a result, the distribution of NH_3-N in the reservoir is uniformly low.

Chlorophyll. As discussed previously, chlorophyll is a pigment found in aquatic plants and algae and can be used as a measure of the algae content in a water body. There are three different types of chlorophyll – *a*, *b*, and *c*. Chlorophyll *a* was the only type sampled and analyzed for the purposes of this project. Therefore, the terms chlorophyll and chlorophyll *a* are used interchangeably in this document. High chlorophyll concentrations indicate high algal densities, which are a result of elevated nutrients in the water. Figure 3.1-11 shows the modeled chlorophyll levels in Boulder Basin for the baseline year 2002. In Boulder Basin, algae begin to grow in the early spring (March), reach maximum densities in the summer, and die in the winter. In 2001, a large algal bloom caused the average chlorophyll concentration to approach 5 µg/L and above in the basin.

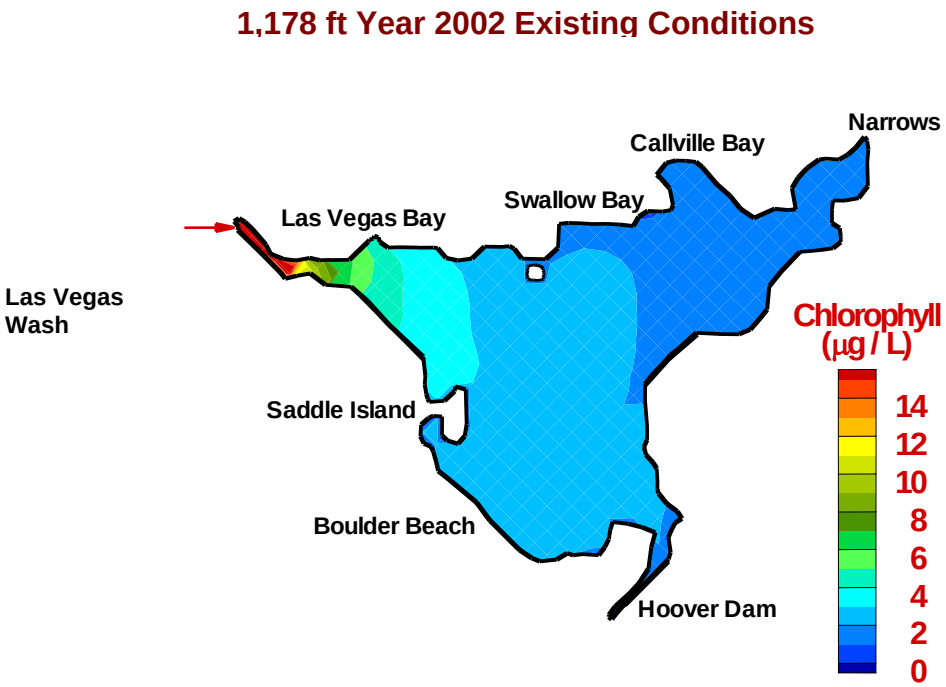
Chlorophyll levels in the inner Las Vegas Bay are significantly higher than those in the open waters of Boulder Basin. The TP WLA limited the three WWTPs to a total discharge of 334 lbs/day (151 kg/day) of TP from March to October. At current flows, this translates to a TP

concentration of about 0.2 mg/L. In Boulder Basin, the average chlorophyll concentration was 2 to 3 µg/L in years 2000 and 2002.

Secchi Depth. Secchi depth is a measure of the water transparency in a lake to a specific depth, and is influenced by inorganic or organic turbidity. Secchi depth is expected to correlate with organic turbidity from algae growth except near the Las Vegas Wash. When chlorophyll levels increase from algae growth then clarity (or Secchi depth) is reduced. Secchi depth is typically low in the inner Las Vegas Bay and higher in the open water of Lake Mead.

Dissolved Oxygen. Most aquatic life depends on DO for growth and reproduction. Dissolved oxygen is consumed in respiration by plants and animals or in the process of decay by dead plants and other organisms. It can be produced by plant photosynthesis when sufficient light and nutrients are available and replenished through surface aeration by wind and wave action. In Boulder Basin, DO levels are generally high. Dissolved oxygen is usually abundant in the epilimnion, especially in the summer when plant photosynthesis is high. Dissolved oxygen in the hypolimnion is also generally high, except in some bottom locations where there is decomposition of organic materials in the sediment.

pH. The pH value of water is a measure of acidity or alkalinity and can vary considerably from natural causes. The majority of Boulder Basin is alkaline, meaning that the pH is above 7.0. The average pH in the epilimnion and hypolimnion in 2002 was 8.0.



Note: Chlorophyll Top 5m and Growing Season (April 1 — Sep 30) Average

Figure 3.1-11 Baseline Chlorophyll Levels in Boulder Basin.

3.2 Biological Resources

The Mojave Desert ecoregion encompasses approximately 80,000 square miles (207,199 square km) across portions of southeastern California, northwestern Arizona, southern Nevada, and southwestern Utah (Larson 1977). This region is marked by extreme conditions. The climate is arid, accompanied by temperatures ranging from 20°F (-7°C) to more than 100°F (38°C). Overall precipitation is very low, averaging 4 to 6 inches (10 to 15 cm) per year, with erratic rainfall patterns that tend to be localized (Bradley and Deacon 1965). Most precipitation occurs during summer monsoons with autumn being the driest season.

The methodology used to develop the biological resources baseline in the project area included agency coordination, literature review, and field investigations. The methodology and a detailed discussion of the resources found in the project area are presented in Appendix E.

3.2.1 Vegetation

Four plant communities, Mojave creosote bush scrub, desert saltbush scrub, Mojave wash scrub, and desert riparian scrub were identified within the project area, along with ruderal vegetation, which comprises previously disturbed lands. A summary of the vegetation types are presented in Appendix E.

The Mojave creosote bush scrub, the most common vegetation community found in the project area, occurs in approximately 36 percent of the project area. Creosote bush (*Larrea tridentata*) and white bursage (*Ambrosia dumosa*) are the dominant shrubs in this community and a variety of annual grasses and forbs comprise the herbaceous understory.

The Mojave wash scrub occurs in approximately 8 percent of the project area. Common species associated with this community include catclaw acacia (*Acacia greggii*), cheesebush (*Hymenoclea salsola*), and mesquite (*Prosopis* sp.).

The least dominant community, the desert saltbush scrub occurs in approximately 2 percent of the project area. This community includes littleleaf saltbush (*Atriplex polycarpa*) and four-wing saltbush (*Atriplex canescens*).

Lands in the project area that have been physically altered by prior and ongoing surface disturbance are barren or support ruderal vegetation composed primarily of invasive, non-native annual grasses and forbs, such as Russian thistle (*Salsola tragus*) and red brome (*Bromus madritensis*). Approximately 43 percent of the project area contains ruderal vegetation, which are weedy and commonly introduced plants growing where the vegetational cover has been disturbed.

3.2.1.1 Wetlands and Riparian Communities

Wetland and riparian communities are considered valuable natural resources that provide habitat for a variety of common and special status plant and wildlife species. Hydrophytic vegetation occurring along the Las Vegas Wash is dominated by herbaceous species growing within the channel and on the banks several feet upslope of the waters edge. Common wetland plant species found within the banks of the Las Vegas Wash include cattail (*Typha domingensis*), bulrush

(*Scirpus* spp.), pale smartweed (*Polygonum lapathifolium*), common reed (*Phragmities australis*), and yellow nut-sedge (*Cyperus esculentus*) (SWCA 2000b). Plant species occurring along the side slope of the upper portions of the Las Vegas Wash embankment include big saltbush (*Atriplex lentiformis)*, common sunflower (*Helianthus annus*), sacred datura (*Datura meteloides*), cocklebur (*Xanthium strumarium*), and exotics such as giant reed (*Arundo donax*) and tamarisk (*Tamarix ramosissima*). A map showing the vegetation communities along the Las Vegas Wash is presented as Figure E-1 in Appendix E.

Desert riparian scrub occurs in approximately 9 percent of the project area. The term riparian describes a unique physical environment and associated plant vegetation that occurs along banks of freshwater bodies, watercourses, and surface-emergent aquifers and adjacent areas. The riparian scrub vegetation community located within the floodplain of the Las Vegas Wash is a monoculture comprised predominantly of tamarisk, an aggressively invasive exotic species that commonly occurs along floodplains, riverbanks, stream courses, salt flats, marshes, and irrigation ditches in arid regions of the southwestern U.S. (Mozingo 1987). The understory vegetation is composed of big saltbush with a few concentrations of honey mesquite (*Prosopis glandulosa* var. *torreyana*), common reed, arrow weed (*Pluchea sericea*), seep willow (*Baccharis salicifolia*), sandbar willow (*Salix exigua*), Anderson desert thorn (*Lycium andersonii*), rabbit's foot grass (*Polypogon monspeliensis*), and exotics such as perennial whitetop (*Lepidium latifolium*) and giant reed. Though the dominant plant is tamarisk in the Las Vegas Wash floodplain, native plants thrive in areas where tamarisk has been removed or suppressed due to hydrology, typography, or other physical means.

3.2.1.2 Special Status Plant Species

Five special status plant species were reported to potentially occur in or near the project area based on information obtained through the literature search and agency coordination (Appendix E). All five species are federal species of concern, four are protected by the state of Nevada due to rarity, salvage restriction, or other factors, and three are covered by the *Clark County Multiple Species Habitat Conservation Plan* (MSHCP). None are federally listed or proposed for listing as endangered or threatened under the ESA. The scientific and common names, protection status, and indication of presence or absence of suitable habitat for special status plant species in the project area are included in Table 3.2-1.

Results of the botanical surveys conducted in spring 2003, 2004, and 2005 determined that two of the five plant species of concern, the Las Vegas bearpoppy and the rosy twotone beardtongue (*Penstemon bicolor* ssp. *Roseus*), have potential to occur in the project area. The threecorner milkvetch (*Astragalus geyeri* var. *triquetrus*) and sticky buckwheat (*Eriogonum viscidulum*) have been previously recorded as occurring in Clark County but habitat for these species does not occur within the project area. The last recorded observation of the Las Vegas catseye (*Cryptantha insolita*) was in 1942, at an undefined location in the Valley, and it is now presumed extinct (Mozingo and Williams 1980, Nevada Natural Heritage Program [NNHP] 2003). However, to confirm presence or absence of the species in the project area, all plants of the same genus as the Las Vegas catseye (i.e. *Cryptantha*) found during the botanical surveys, were identified to the species level. No Las Vegas catseye were found in the project area.

Table 3.2-1 Special Status Plant Species Evaluated for Potential Occurrence in the SCOP Project area.

Species		Protection Status			Suitable Habitat Present
Scientific Name	**Common Name**	**Federal [1]**	**State of Nevada [2]**	**MSHCP Covered [3]**	
Arctomecon californica	Las Vegas bearpoppy	SOC	Yes	Yes	Yes
Astragalus geyeri var. triquetrus	Threecorner milkvetch	SOC	Yes	Yes	No
Cryptantha insolita [4]	Las Vegas catseye	SOC	Yes	-	-
Eriogonum viscidulum	Sticky buckwheat	SOC	Yes	Yes	No
Penstemon bicolor ssp. Roseus	Rosy twotone beardtongue	SOC	-	-	Yes

Notes:

[1] Federal (USFWS) status for listing under the ESA: SOC (Species of Concern).

[2] State of Nevada special status species protected under Nevada Revised Statutes 527.

[3] Species covered by the Clark County MSHCP.

[4] Presumed extinct.

Source: Clark County 2000a, Nevada Natural Heritage Program (NNHP) 2002, and USFWS 2003.

A comprehensive list of plant species identified in the project area is included in Appendix E. Additionally, brief descriptions of the threecorner milkvetch, sticky buckwheat, and Las Vegas catseye are presented in Appendix E. However, based on the reasons previously stated, they will not be discussed in further detail in this section.

Las Vegas Bearpoppy. The Las Vegas bearpoppy is a federal species of concern and a Nevada state-protected species that occurs in Clark County, Nevada, and in Mohave County, Arizona near Lake Mead, at elevations ranging from 1,310 to 2,760 ft (399 to 841 m) above msl (Mozingo and Williams 1980). It is often found in highly gypsiferous soils on barren, gravelly desert flats, hummocks, and slopes. The Las Vegas bearpoppy is a perennial that produces several flower stalks bearing yellow flowers in April and May.

Potentially suitable bearpoppy habitat occurs in the project area along EI Reaches 1 and 2, and near the EI Terminus. However, a large portion of the habitat is highly degraded from frequent off-highway vehicle (OHV) use. One Las Vegas bearpoppy was observed in bloom outside of the study corridor about 1 mile (2 km) southeast of the CCWRD AWT as shown on Figure 3.2-1. About 200 ft (61 m) southeast of this individual plant, a cluster of dead bearpoppies was observed. Additionally, a population of bearpoppies is located outside of the project area west of the Magic Way access road. No bearpoppies were observed within the project area.

The BLM SMA, located north of the project area, includes designated areas for preservation and restoration of the Las Vegas bearpoppy and its habitat.

Rosy Twotone Beardtongue. The rosy twotone beardtongue, a federal species of concern, is typically associated with creosote bush habitats in Clark County, Nevada, and portions of

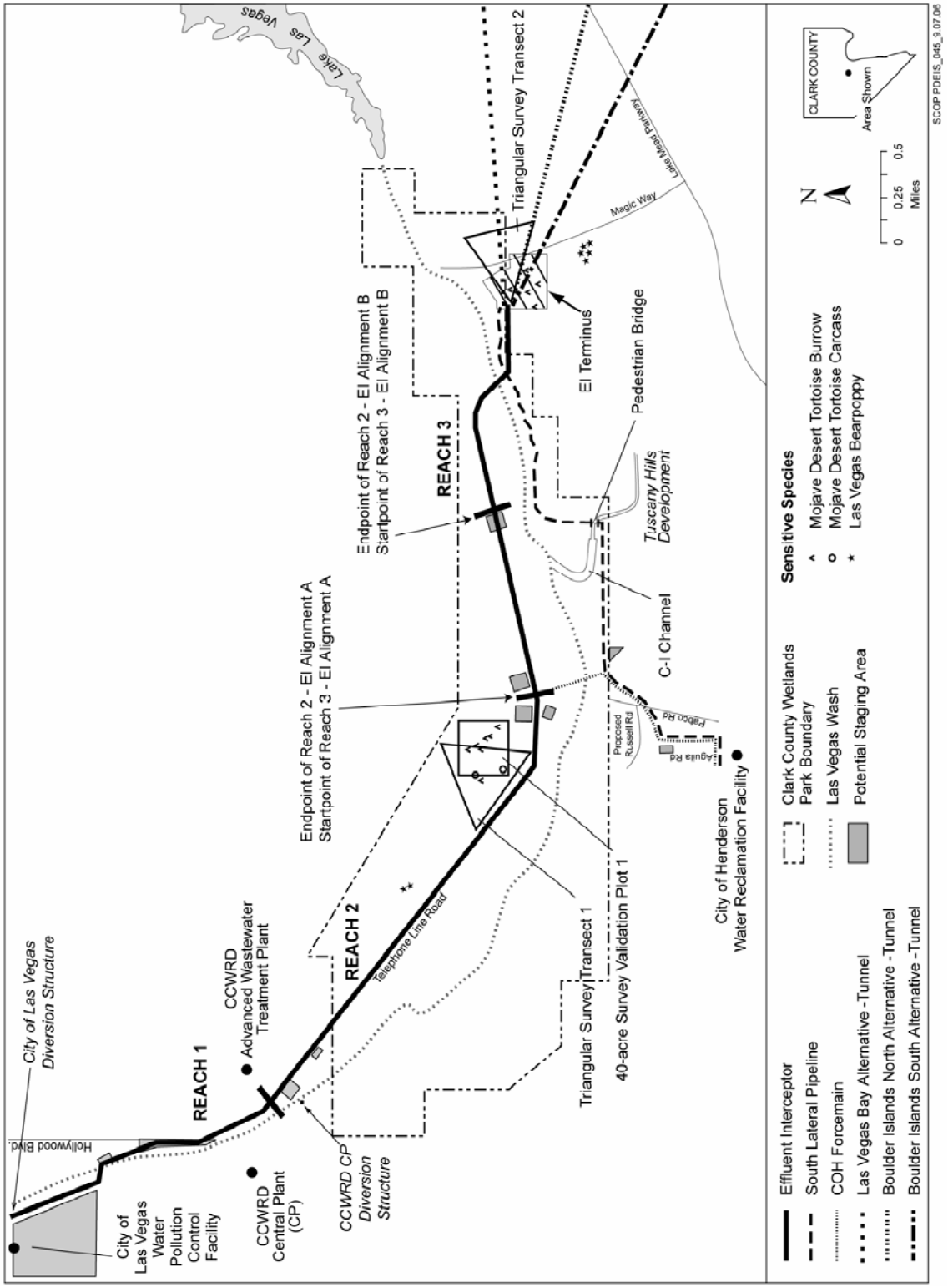


Figure 3.2-1 Sensitive Species – Effluent Interceptor Segment.

Arizona. It grows in shallow gravelly washes and on roadsides at elevations ranging from 1,970 to 5,480 ft (600 to 1,670 m) above msl. Ephemeral washes and roadsides in the project area provide potentially suitable habitat for the rosy twotone beardtongue. However, the species was not observed in the project area during the spring 2003, 2004, or 2005 field investigations.

Nevada State-protected Cacti, Yuccas, and Conifer Trees. During the botanical surveys, cacti were encountered infrequently. Approximately one to three individuals per acre of cottontop cactus (*Echinocactus polycephalus* var. *polycephalus*), barrel cactus (*Ferocactus cylindraceus*), pygmy barrel cactus (*Sclerocactus johnsonii*), fishhook cactus (*Mamillaria* sp.), beavertail cactus (*Opuntia basilaris* var. *basilaris*), pencil cholla (*O. ramosissima*), buckhorn cholla (*O. acanthocarpa*), and silver cholla (*O. echinocarpa*) were observed in the project area. No state-protected yucca or conifer species were noted during the field investigations.

3.2.1.3 Noxious Weeds

Federal agencies are directed by Invasive Species EO 13112 (1999) to expand and coordinate efforts to prevent the introduction and spread of invasive plant species (noxious weeds) and to minimize the economic, ecological, and human health impacts that invasive species may cause.

Weed management is an integral part of maintaining ecosystem health. A noxious weed is generally destructive and difficult to control or eradicate. A list of noxious weed species that are known to occur within the project area is included in Appendix E.

Two state-regulated noxious weeds, tamarisk and tall whitetop (*Lepidium latifolium*) are known to occur in the project area along the Las Vegas Wash. Current and ongoing efforts by Clark County and the LVWCC are underway to eradicate these invasive species from the Las Vegas Wash (LVWCC 2003b).

3.2.2 Wildlife

Wildlife species discussed in this section commonly occur in the Mojave Desert and have adapted to desert scrub habitats with little cover and xeric conditions. All wildlife species observed within the project area, or identified by indirect evidence such as tracks, burrows, carcasses, or scat, are listed in Appendix E.

Common reptiles in the Mojave Desert and the project area include the western whiptail lizard (*Cnemidophorous tigris*), zebra-tailed lizard (*Callisaurus draconoides*), desert iguana (*Dipsosaurus dorsalis*), side-blotched lizard (*Uta stansburiana*), desert spiny lizard (*Sceloporus magister*), and gopher snake (*Pituophis melanoleucus deserticola*).

Birds common to the Mojave Desert include common raven (*Corvus corax*), mourning dove (*Zenaida macroura*), black-throated sparrow (*Amphisizia bilineata*), house finch (*Carpodacus mexicanus*), cactus wren (*Campylorhynchus brunneicappillus*), Gambel's quail (*Callipepla gambelii*), and turkey vulture (*Cathartes aura*). A formal bird census was not conducted for the proposed project; however, several bird surveys have been conducted previously along the Las Vegas Wash and in portions of the project area. Approximately

150 migratory birds occur in the project area, with the highest diversity found along the Las Vegas Wash.

Common mammalian species in the project area include the pocket mouse (*Chaetodipus* spp.), whitetail antelope squirrel (*Ammospermophilus leucurus*), kangaroo rat (*Dipodomys* spp.), desert woodrat (*Neotoma lepida*), black-tailed jackrabbit (*Lepus californicus*), desert kit fox (*Vulpes macrotis arsipus*), and coyote (*Canis latrans*).

Thirty-one special status wildlife species were reported to potentially occur in the project area based on information obtained through the literature search and agency coordination. The scientific and common names, federal and state protection status, and indication of presence or absence of suitable habitat for special status wildlife species in the project area are included in Table 3.2-2. Five of these species are federally listed as threatened or endangered, one is a candidate for federal listing, and twenty-four are federal species of concern. Twenty-three of these species are also protected by the State of Nevada, due to rarity or other factors.

3.2.2.1 Federally Listed as Threatened or Endangered

Five federally listed wildlife species were evaluated for potential occurrence in the project area. The southwestern willow flycatcher, Yuma clapper rail, and least tern (*Sterna antillarum*) are federally listed as endangered. However, the least tern has federal protection status in a portion of its range that does not include Nevada. The bald eagle (*Haliaeetus leucocephalus*) and Mojave Desert tortoise are federally listed as threatened. Aquatic species are described in Section 3.2.3.

Mojave Desert Tortoise. The Mojave population of the desert tortoise, a federally listed as threatened and Nevada state-protected species, occurs throughout the Mojave Desert in California, Nevada, Arizona, and Utah. It is found most often on flats and bajadas characterized by sandy to sandy gravelly soils, but may also occur on slopes and in rocky soils, typically in association with desert creosote bush scrub communities. These communities are dominant below elevations of 5,000 ft (1,524 m) and are characterized by creosote bush, white bursage, yuccas, cacti, grasses, and a wide variety of other perennial and annual plants. Preferred desert tortoise habitat includes scattered shrubs and a sufficient herbaceous understory, which provide a source of food, complementary hydration, and shelter. No designated critical habitat for the tortoise occurs in the project area.

Approximately 531 acres (215 hectares) of Mojave creosote bush scrub, Mojave wash scrub, desert saltbush scrub, and ruderal vegetation were identified in the project area as potentially suitable desert tortoise habitat. A total of 13 tortoise burrows, 2 carcasses (disarticulated and scattered), and 5 sites with scat present were recorded during surveys. The approximate location of the tortoise burrows and carcasses are shown on Figure 3.2-1. The carcasses and the scat found near burrows were located in dry wash beds.

Based on results of these field surveys and previous surveys conducted in the area (PBS&J 2002, SWCA 2000a), the desert tortoise population density is estimated to be very low (0 to 10 animals per square mile). For further discussion and to review a summary of the tortoise data collected, refer to Appendix E.

Table 3.2-2 Special Status Wildlife Species Evaluated for Potential Occurrence in the SCOP Project area.

Species		Protection Status			Suitable Habitat Present
Scientific Name	**Common Name**	**Federal [1]**	**State of Nevada [2]**	**MSHCP Covered [3]**	
Reptiles					
Gopherus agassizii	Desert tortoise (Mojave Desert population)	LT	Yes	Yes	Yes
Heloderma suspectum cinctum	Banded Gila monster	SOC	Yes	-	Yes
Sauromalus obesus	Chuckwalla	SOC	-	Yes	Yes
Birds					
Athene cunicularia hypugea	Western burrowing owl	SOC	Yes	-	Yes
Chlidonias niger	Black tern	SOC	Yes	-	Yes
Coccyzus americanus occidentalis	Western yellow-billed cuckoo	C	Yes	Yes	Yes
Empidonax traillii extimus	Southwestern willow flycatcher	LE	Yes	Yes	Yes
Falco peregrinus anatum	American peregrine falcon	SOC	Yes	Yes	Yes
Guiraca caerulea	Blue grosbeak	SOC	Yes	Yes	Yes
Haliaeetus leucocephalus	Bald eagle	LT	Yes	-	Yes
Ixobrychus elixis hesperis	Western least bittern	SOC	Yes	-	Yes
Phainopepla nitens	Phainopepla	SOC	Yes	Yes	Yes
Piranga rubra	Summer tanager	SOC	Yes	Yes	Yes
Plegadis chihi	White-faced ibis	SOC	Yes	-	Yes
Pyrocephalus rubinus	Vermilion flycatcher	SOC	Yes	Yes	Yes
Rallus longirostris yumanensis	Yuma clapper rail	LE	Yes	-	Yes
Sterna antillarum	Least tern	LE(PS)	Yes	-	Yes
Vermivora luciae	Lucy's warbler	SOC	Yes	-	Yes
Vireo bellii arizonae	Arizona Bell's vireo	SOC	Yes	Yes	Yes
Mammals					
Corynorhinus townsendii pallescens	Pale Townsend's big-eared bat	SOC(PS)	-	-	Yes
Euderma maculatum	Spotted bat	SOC	Yes	-	Yes

Table 3.2-2 Special Status Wildlife Species Evaluated for Potential Occurrence in the SCOP Project area (continued).

Species		Protection Status			Suitable Habitat Present
Scientific Name	**Common Name**	**Federal[1]**	**State of Nevada [2]**	**MSHCP Covered [3]**	
Mammals					
Eumops perotis californicus	Greater western mastiff bat	SOC	-	-	Yes
Idionycteris phyllotis	Allen's big-eared bat	SOC	Yes	-	Yes
Macrotus californicus	California leaf-nosed bat	SOC	Yes	-	Yes
Myotis ciliolabrum	Small-footed myotis	SOC	-	-	Yes
Myotis thysanodes	Fringed myotis	SOC	Yes	-	Yes
Myotis velifer	Cave myotis	SOC	-	-	Yes
Myotis volans	Long-legged myotis	SOC	-	Yes	Yes
Myotis yumanensis	Yuma myotis	SOC	-	-	Yes
Nyctinomops macrotis	Big free-tailed bat	SOC	-	-	Yes
Ovis canadensis nelsoni	Desert bighorn sheep	-	Yes	-	Yes

Notes:

[1] Federal (USFWS) Status for listing under the ESA:
- LT Listed as Threatened
- LE Listed as Endangered
- C Candidate for listing
- PS Partial Status (a sub-species or part of a taxon's range has listed or candidate status but not in Nevada)
- SOC Species of Concern

[2] Nevada State protected species under NRS 501-503.

[3] Species covered by the Clark County MSHCP.

Source: Clark County 2000a, NNHP 2002, and USFWS 2003.

Southwestern Willow Flycatcher. The southwestern willow flycatcher is a federally listed as endangered and Nevada state-protected species. It is one of four subspecies of the willow flycatcher commonly recognized in North America (Hubbard 1987, Unitt 1987). Three of the these subspecies *E.t. extimus*, *E.t. adastus*, and *E.t. brewsteri* occur west of the Rocky Mountains, though the subspecies *E.t. extimus* is the only one listed under the ESA. *Empidonax* flycatchers are notoriously difficult to distinguish in the field, and separation of the four willow flycatcher subspecies is even more problematic. The willow flycatcher subspecies are distinguished primarily by subtle differences in color and morphology, including wing formula, bill length, wing to tail ratio (Unitt 1987 and 1997, Browning 1993), vocalization, and habitat use.

The historical breeding range of the southwestern willow flycatcher includes southern California, southern Nevada, southern Utah, Arizona, New Mexico, western Texas, southwestern Colorado, and extreme northwestern Mexico (Hubbard 1987, Unitt 1987, Browning 1993). The current breeding range for the southwestern willow flycatcher is similar to the historical range, but the quantity and quality of suitable habitat within this range has been reduced from historical levels.

Historically, the southwestern willow flycatcher nested in native vegetation such as willow (*Salix* sp.), box elder (*Acer negundo*), buttonbush (*Cephalanthus* sp.), and cottonwood (*Populus fremontii*) (Grinnell and Miller 1944, Sogge et.al. 1997, Unitt 1987). Following conversion of most riparian vegetation in the southwestern U.S. from native to non-native species, the flycatcher still nests in native vegetation where available, but also nests in thickets of non-native salt cedar and Russian olive, and in habitats with a mixture of native and non-native species (Hubbard 1987, Brown 1988, Sogge et al. 1997). Habitat characteristics such as plant species composition, size and shape of habitat patch, canopy structure, vegetation height, and vegetation density all vary throughout the species' range. However, vegetation in the interior of the patch is generally dense, particularly within the first 10 to 13 ft (3 to 4 m) above the ground, and in almost all cases, slow-moving or still surface water or saturated soil is present at or near breeding sites.

The southwestern willow flycatcher has been observed nesting in riparian habitats dominated by tamarisk along perennial waterways and reservoirs in southern Nevada and Arizona. McKernan and Braden (2000, 2001a) documented flycatchers during surveys conducted in the spring and summer of 2000 and 2001 along the Nevada portion of the Virgin River, including the Virgin River-Lake Mead delta. Most of the shorelines of Lake Mead lack suitable amounts of riparian vegetation and proper structural and hydrological characteristics required by the flycatcher (NPS 2002). Currently, suitable habitat is limited to inflow areas of the Colorado River and other tributaries and major washes. A small amount of marginal quality but potentially suitable nesting habitat for the flycatcher occurs along the Las Vegas Wash. Migrating or dispersing flycatchers may use areas less suitable for nesting, such as tamarisk-dominated riparian habitats, during spring and fall. No critical habitat has been designated or is proposed for southwestern willow flycatcher in the Las Vegas Wash.

Intensive systematic surveys conducted annually from 1998 through 2004 in the Las Vegas Wash within the Wetlands Park boundary, have detected flycatchers in most of the years, but breeding activity has not yet been observed (Marshall 2004; SWCA 1998, 1999, 2000a, 2000b, 2001, 2002, 2003). It is important to note that the flycatchers previously documented in the Las Vegas Wash by SWCA have not been identified down to subspecies using standardized survey protocols. For purposes of this report however, it is assumed that the documented flycatchers are the endangered subspecies *E.t. extimus*. This means the birds observed could be *E.t. extimus*, *E.t. adastus*, or *E.t. brewsteri*, or any combination of these. Therefore, it cannot be assumed that *E.t. extimus* occurs or has ever occurred in the Las Vegas Wash.

SWCA (2003) conducted a qualitative evaluation of habitat conditions along the Las Vegas Wash in spring of 2003 and reported that construction of ECSs in the interval between the 2002 and 2003 survey periods, and the vegetative cover lost to wildfire between 2001 and 2002, have substantially reduced the amount of potentially suitable flycatcher nesting habitat. Additional factors that affect habitat conditions for the flycatcher are lateral erosion of the Las Vegas Wash floodplain and the presence of a parasitic bird species, the brown-headed cowbird.

Bald Eagle. The bald eagle, federally listed as threatened (Bald Eagle Protection Act of 1940 as amended, 16 USC 668a-d PL 86-70, 87-884, 92-535, 95-161) and Nevada state-protected species, is found primarily along coasts, inland lakes, and large rivers throughout North America and Mexico, but may also be found along mountain ranges during migration. The species requires

open water habitats that support an adequate food base and provide appropriate roosting and nesting sites, such as cliffs and tall trees. Food base for the eagle primarily includes fish, small mammals, and waterfowl (Terres 1980). Bald eagles are generally present in the LMNRA from November to March. The NPS conducts annual surveys in January for wintering bald eagles. The bird surveys are conducted by boat along all shorelines of both Lake Mead and Lake Mohave. As many as 79 eagles have been recorded in the LMNRA in a single year. Eight bald eagles were observed wintering in 2003 and 2004 in the Boulder Basin (Boyles 2004). Five bald eagles were recorded in 2005 (Boyles 2005). Four bald eagles were recorded in 2006 (Boyles 2006).

Yuma Clapper Rail. The Yuma clapper rail, a federally listed as endangered and Nevada state-protected species, regularly inhabits freshwater marshes throughout the interior southwestern U.S. where moderately extensive emergent vegetation is persistent. The species is also known to occur in moderately dense cattail-bulrush marshes, and flooded tamarisk and willow stands (Eddleman 1989). The Yuma clapper rail is predominantly found in the lower Colorado River drainage system and the Salton Sea in Imperial County, California (Anderson and Ohmart 1985). However, occurrences of the species have been documented in extreme southern Nevada, along the Las Vegas Wash, dating back to 1959 (Alcorn 1988). Recent observations were made in 1998 just upstream of Pabco Road (SWCA 2000b), in 2005 just south of the Big Marsh observation point (SWCA 2006), and in 2006 in the C-1 Channel (SNWA 2006b). The Yuma clapper rail is largely migratory, generally wintering south of the U.S./Mexico border (Tomlinson and Todd 1973). Individuals detected in the Las Vegas Wash are likely temporary residents.

Least tern. The least tern is federally listed as endangered in a portion of its range that does not include Nevada. Federal protection is restricted to populations of least terns occurring in interior North America, which includes Arkansas, Colorado, Iowa, Illinois, Indiana, Kansas, Kentucky, Louisiana, Mississippi, Missouri, Montana, North Dakota, Nebraska, New Mexico, Oklahoma, South Dakota, Tennessee, and Texas. A recovery plan for the species has been established.

Premier nesting sites are salt flats, broad sandbars, and barren shores along wide, shallow rivers. Least terns arrive from late April to early June and spend 4 to 5 months at their breeding grounds. Important breeding habitat characteristics include presence of bare or nearly bare ground and alluvial islands or sandbars for nesting, availability of food (primarily small fish), and favorable water levels during the nesting season to ensure the nests remain above water. They usually nest on sites devoid of vegetation, but have been found on sites with small amounts of vegetative cover composed of grasses, shrubs, and trees and ranging from 39 to 95 centimeters (1 to 3 inches) in height (Whitman 1988). One least tern sighting along the Las Vegas Wash was reported in 1986 (NNHP 2003) and no sightings are known to have been reported since. The least tern is considered an incidental migrant to the area.

3.2.2.2 Federal Candidate Species and Species of Concern, Nevada State-protected Species, and Clark County MSHCP-covered Species

There is 1 species, the western yellow-billed cuckoo (Coccyzus americanus occidentalis), that is a candidate for federal listing, and 24 federal species of concern known to occur in the project area. Twenty three of these species are also protected by the State of Nevada due to rarity or other factors (Table 3.2-2).

The western yellow-billed cuckoo, a candidate for federal protection under the ESA and a Nevada state-protected species, is a migratory bird historically found in very limited patches of riparian habitat in California, Arizona, New Mexico, and Mexico. The western yellow-billed cuckoo is considered a rare species in Nevada. It breeds in the southwestern U.S. from June to mid-July and uses dense cottonwood and willow-dominated thickets along broad floodways of large river systems for nesting and foraging. Nests are located on branches in dense riparian foliage 5 to 46 ft (1 to 14 m) above ground. One observation of the western yellow-billed cuckoo was made in 1998 during systematic surveys conducted along the Las Vegas Wash (McKernan and Braden 2001b). No observations were made in years 1999 to 2001 (McKernan and Braden 1999, 2001a, 2001b; McKernan and Carter 2002). The SWCA conducted surveys along the Las Vegas Wash for the western yellow-billed cuckoo in 2003 and 2004. No detections were made as part of those surveys.

The desert bighorn sheep (Ovis canadensis nelsoni) is a Nevada state-protected species. A population of desert bighorn sheep occurs in the project area in the River Mountains. This sheep population, referred to as the River Mountains herd, is valued by the NPS, Nevada Department of Wildlife (NDOW), and the Arizona Game and Fish Department because the herd is highly productive. Individual sheep are translocated, as part of an interagency program, to enhance herds in other regions of the southwestern U.S, and are a popular subject of recreational wildlife viewing.

The boundaries of sheep habitat, lambing areas, and major movement corridors in the project area are shown on Figure 3.2-2. Desert bighorn sheep are relatively common in the rugged terrain of the River Mountains adjacent to the project area, but are rarely seen in the lower elevations near Lakeshore Drive. Additional information about the desert bighorn sheep and their habitat is provided in Appendix E.

The species of concern listed in Table 3.2-2 have the potential to occur in the project area. Descriptions of these species of concern and their specific habitat requirements are presented in Appendix E.

3.2.3 Aquatic Resources

Aquatic wildlife occupies suitable aquatic habitat throughout the proposed project area. These areas include the Las Vegas Wash and Lake Mead. A brief history of the riverine/reservoir environment of Lake Mead and its relation to the aquatic resources of the Lower Colorado River System is presented in Appendix E.

Amphibians known to occur in the Las Vegas Wash and the LMNRA include the southwestern toad (*Bufo microscaphus*), red-spotted toad (*Bufo punctatus*), pacific treefrog (*Pseudacris regilla*), North American spadefoot frogs (*Scaphiopus* spp.), and the candidate species the relict leopard frog (*Rana onca)*. The Woodhouse's toad (*Bufo woodhousii*) and the bullfrog (*Rana catesbeiana*), a non-native species, are the most common amphibians found within the Las Vegas Wash (LVWCC 2002).

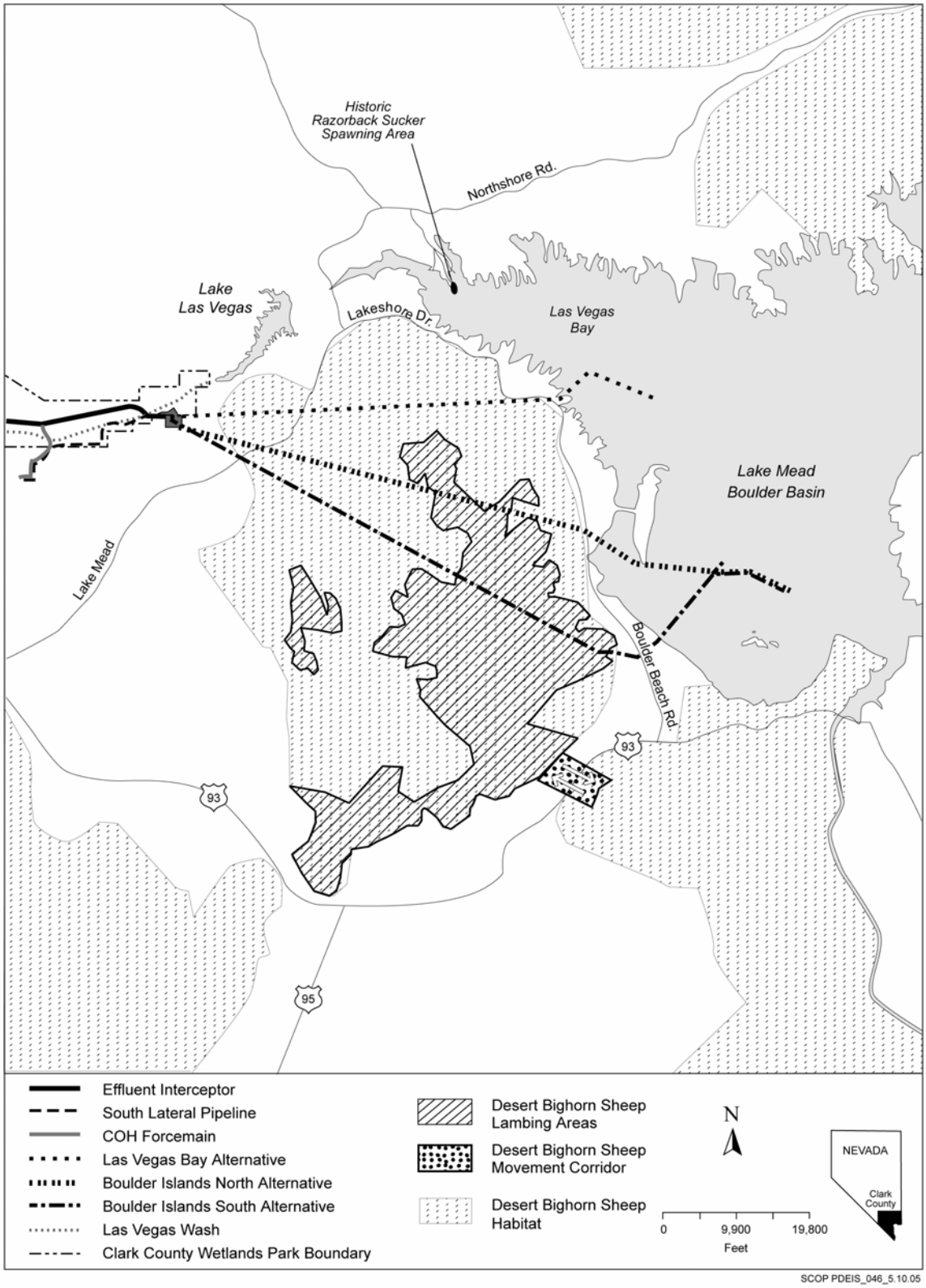


Figure 3.2-2 Sensitive Species – Lake Conveyance System Segment.

Table 3.2-3 Special Status Aquatic Species Evaluated for Potential Occurrence in the SCOP Project area.

Species		Protection Status			Suitable Habitat
Scientific Name	**Common Name**	**Federal [1]**	**State of Nevada [2]**	**MSHCP Covered [3]**	
Fish					
Xyrauchen texanus	Razorback sucker	LE	Yes	no	Yes
Gila elegans	Bonytail chub	LE	Yes	no	Yes
Catostomus latipinnis	Flannelmouth sucker	SOC	No	yes	No
Gila robusta	Roundtail chub	SOC	No	no	No
Amphibians					
Rana onca	Relict leopard frog	C	Yes	yes	Yes
Bufo microscaphus	Southwestern toad	SOC, N	No	yes	Yes

Notes:

[1] Federal (USFWS) Status for listing under the ESA:

- LE Listed as Endangered
- C Candidate for listing
- SOC Species of Concern
- N Nevada BLM Special Status Species-Sensitive

[2] Nevada State special status species protected under NRS 501.

[3] Species addressed in the Clark County MSHCP.

Source: Clark County 2000a, NNHP 2002, and USFWS 2003.

Seven non-native fish species are known to occur in the Las Vegas Wash system. These species include the black bullhead catfish (*Ameiurus melas*), common carp (*Cyprinus carpio*), green sunfish (*Lepomis cyanellus*), mosquitofish (*Gambusia afinnis*), fathead minnow (*Pimephales promelas*), red shiner (*Cyprinella lutrensis*), and the aquaria suckermouth catfish (*Hypostomus plecostomus*). Other aquatic species known to occur in the Las Vegas Wash include the red swamp crayfish (*Procambrus clarkii*), red eared slider (*Trachemys scripta*), and spiny softshell turtle (*Apalone spinifera*) (LVWCC 2002).

Several fish species inhabit Lake Mead and Lake Mohave, including game, non-game, and endemic fish species. Non-game species known to occur in both lakes is common carp. Game fish species inhabiting the lakes include bluegill (*Lepomis macrochirus*), channel catfish (*Ictalurus punctatus*), crappie (*Pomoxis* sp.), largemouth bass (*Micropterus salmoides*), striped bass (*Morone saxatilis*), and rainbow trout (*Onchorhynchus mykiss*). Species with the potential to occur in the Lower Colorado River, Lake Mead, or Lake Mohave are listed in Appendix E.

Six special status aquatic species were identified to potentially occur in the project area based on information obtained through a literature search and agency consultation. The scientific and common names, federal and state protection status, and indication of presence or absence of suitable habitat for special status aquatic species in the project area are provided in Table 3.2-3. Additionally, some of these special status species are addressed in the Clark County MSHCP. Of the fish species, only the razorback sucker is identified as occurring in Lake Mead, and Lake Mead is designated by the USFWS as critical habitat (*Federal Register* 1994).

3.2.3.1 Federally Listed as Threatened or Endangered

The razorback sucker and bonytail chub (*Gila elegans*) are federally listed as endangered. However, the bonytail chub has not been identified in Lake Mead since the early 1950s. Therefore, the bonytail chub is not discussed in this section. However, a detailed description of the bonytail chub is provided in Appendix E.

Razorback Sucker. Currently, the razorback sucker are endemic to the Colorado River Basin System. In the lower basin, isolated populations occur in Lake Mead, Lake Mohave, and in the Lower Colorado River below Parker Dam (USFWS 1998). Two known populations and spawning sites have been documented in Lake Mead in the vicinity of Las Vegas Bay and Echo Bay.

Historical records indicate that the razorback sucker was previously abundant throughout the Colorado River watershed. However, extensive dam building altered habitat, and introductions of non-native fish resulted in a decline in razorback sucker populations that resulted in them being formally listed as endangered on November 22, 1992. On March 24, 1994, a final rule for critical habitat was approved (*Federal Register* 1994) and a recovery plan was approved for the razorback sucker on December 23, 1998 (USFWS 1998).

In the 1950s and 1960s, razorback suckers were relatively common throughout Lake Mead (Minckley 1973, Minckley and Deacon 1991, Holden 1994, Sjoberg 1995). Approximately 40 years after the closure of the dam, razorback numbers declined until no razorbacks were collected during survey efforts from 1980 to 1989 (Sjoberg 1995). In the early 1990s, razorback suckers were found to still be in existence in Lake Mead at two locations, Las Vegas Bay and Echo Bay. Further study revealed young fish that had been produced in the lake environment, and another aggregation located at the Muddy and Virgin River inflow area (Albrecht and Holden 2005). The razorback spawning location in Las Vegas Bay is located in the proximity of Blackbird Point. Additionally, larval razorbacks were captured in the Colorado River inflow area in 2000 and 2001; however, no juvenile or adult fish have been captured (Holden and Welker 2003). Most razorback populations in reservoir habitats consist of aging adults with no evidence of recruitment of young suckers into the population. The razorback population in Lake Mead is unique in that juvenile and new adult fish have been captured indicating several natural recruitment events occurring within the Lake.

Razorback sucker captures and spawning locations seem to occur in areas of the Lake that receive inflow, i.e. Las Vegas Wash into Las Vegas Bay, Echo Wash, and the Muddy and Virgin Rivers into Overton Arm and Echo Bay area. Factors cited as potentially contributing to reproductive success of the razorback suckers at those locations in Lake Mead include relatively high

phytoplankton density and turbidity levels and lake level fluctuation with subsequent inundation of vegetation (Holden and Welker 2003).

Razorback suckers have been successful in utilizing reservoir habitat. This has been documented in the continuing presence of populations in Lake Mead, Lake Mohave, and Lake Havasu. However, these populations are located in waters that contain many species of introduced fish that prey on the young suckers. During low-water years, predators become more of a problem as less shoreline habitat is available to protect young native fish.

Population demographics of the razorback sucker can change yearly and are tied to the river conditions at the time of spawning (USFWS 2002). The razorback sucker has adapted to a range of habitat conditions and can spawn successively in a variety of habitats, including reservoirs such as Lake Mead.

Spawning in lakes and streams occurs over loosely packed gravel or cobble substrate, and always at velocities less than 4.9 fps (1 mps) (Bradford and Vlach 1995). In Lake Mead, spawning has been observed from mid-February until early May (Holden et al. 1997). In the current reservoir system, ideal water conditions for razorback suckers include temperatures ranging from 59°F to 79°F (15 to 26°C), DO levels ranging from 3.5 to 10.5 mg/L, and pH ranging from 7.5 to 8.5 (Benke and Bensen 1983).

Turbidity is based on the amount of dissolved matter and suspended particles including sediment and microscopic biota. Contributors to turbidity in Lake Mead are measured by Secchi depths (water clarity), TSS, and chlorophyll samples. Turbidity is identified as an important water quality characteristic for larval razorback sucker survival especially in the presence of predators with which razorbacks did not evolve. Johnson et al. (1993) determined predator avoidance was reduced in larval razorback sucker relative to a sucker species that had evolved with multiple predators present. Johnson and Hines (1999) determined suspended sediment decreased the incidence of predation on larval razorback suckers in a laboratory. Factors that impact turbidity in the Las Vegas Bay include nutrient inputs that allow for phytoplankton blooms, suspended sediment inputs from effluent and storm runoff water, and lake elevation fluctuation.

Nutrient inputs affect razorback suckers in the Las Vegas Bay through several processes including: 1) increased phytoplankton production; 2) increased aquatic vegetation production, which provides cover; and 3) increased ambient turbidity, the effects of which are discussed in the previous paragraph.

Holden and Welker (2003) suggest high phytoplankton density may contribute to the successful recruitment of razorback suckers in Las Vegas Bay, Echo Bay, and the Virgin/Muddy inflow area. Nutrients, including phosphorous, nitrogen, nitrate, and ammonia, provide for phytoplankton production (measured as chlorophyll). The factors that influence phytoplankton production in the Las Vegas Bay include nutrient inputs from effluent discharge, nutrient inputs from terrestrial vegetation inundation, and storm and ground water inputs. Black and Veatch (2004c) indicate in 2002 that the Las Vegas Wash and Las Vegas Bay had the highest level of chlorophyll production lakewide (Figure 3.1-11). Several studies suggest that productivity in Lake Mead is limited by the availability of phosphorus (LaBounty and Burns 2005), thus TP loading is used as a measure of the potential chlorophyll production and an estimate of turbidity.

Aquatic vegetation production in most lake systems is limited by phosphorus. Lake Mead is now over 70 years old and, as a result of reservoir aging processes, has very little aquatic vegetation except in areas of phosphorus input such as the Las Vegas Wash, natural inflow areas like the Colorado River inflow area and the Muddy and Virgin Rivers, and in the zones where established terrestrial vegetation is inundated as Lake levels increase. The source of TSS in the Las Vegas Bay are storm water runoff events that carry sediment from the Las Vegas Wash. Effluent discharge contains very little TSS (La Bounty and Burns 2005). Razorback sucker recruitment trends in Lake Mead (Holden and Welker 2003) indicate recruitment events are associated with rising Lake levels and the inundation of new vegetation in combination with the resultant increase in turbidity due to new nutrient availability. Effluent discharge into the Las Vegas Bay has provided a consistent source of turbidity, productivity, and aquatic vegetation despite fluctuating Lake elevations, though no consistent recruitment has been observed. The consistent quality of the Las Vegas Bay to the recruitment of razorback sucker is questionable due to data gaps in water quality monitoring and long-term comparable water quality sampling at other razorback aggregations. Potential recruitment of razorback suckers in the optimal conditions presented in the Las Vegas Bay may be undermined by elevated predator abundance caused by the same optimal conditions. Thus, the advantage larval and juvenile razorback suckers gained by elevated turbidity and cover availability to avoid predators may be offset by the frequency of predator encounters due to increased predator abundance. However, Albrecht and Holden (2005) documented annual growth rates of wild razorbacks in the Las Vegas Bay to be 23.1 millimeter (mm) as compared to 3.5 mm in Echo Bay fish. This suggests Las Vegas Bay provides a good quality environment for rapid razorback growth that may decrease the amount of time razorbacks are vulnerable to predators. A decrease in the components of turbidity will increase predator effectiveness (Johnson and Hines 1999). The cumulative advantage and limitations of these variables to razorback suckers is unknown. Further monitoring and comparison of turbidity components, cover availability, predator density, and predation rates among the known razorback aggregations in Lake Mead are necessary to assess the limiting factors to razorback recruitment and the importance of effluent discharge in Las Vegas Bay.

Currently, a small population of razorback suckers is present in Lake Mead in limited numbers. All of Lake Mead, to its full pool elevation (1221.4 ft [372 m] above msl), and downstream of the Hoover Dam through Lake Mohave, to Davis Dam is designated critical habitat for the species. Lake Mohave is significant for having the largest and most genetically diverse population of razorback suckers along the entire Colorado River. Lake Mead's population is very small, but it is significant because it is the only documented area to contain a successful group of sexually mature fish following creation of a reservoir.

3.2.3.2 Federal Candidate Species and Species of Concern, Nevada State-protected Species, and Clark County MSHCP-covered Species

One candidate species for federal listing as threatened and endangered, and three species of concern are known to occur in the vicinity of the proposed project as shown in Table 3.2-3.

Relict leopard frog. The relict leopard frog was assigned as a candidate species for federal listing as threatened or endangered in June 2002. It is a Clark County endemic, except for one relict leopard frog population near Littlefield, Arizona, thought to be this species (Clark County 2000a).

In Clark County, relict leopard frog populations remain within small areas on NPS lands, in the Rogers and Blue Point springs area south of Overton, and in springs in Black Canyon below Hoover Dam.

The relict leopard frog is found in desert riparian habitat along permanent streams, tributaries, springs, and other water impoundments up to 2,500-ft (762-m) elevation. Considered a habitat generalist, relict leopard frogs occupy a variety of habitats including springs, streams, and wetlands characterized by clean, clear, deep and shallow water, and cover/forage such as submerged, emergent, and perimeter vegetation. The frog utilizes water, root stock, and grassy banks as cover when disturbed (Stebbins 1985).

The project area is located adjacent to the known historic and current range of relict leopard frog. Small, isolated areas of potential habitat may exist within the project area, but it is unlikely that the relict leopard frog occupies these areas because of the distance from known populations.

The species of concern that have the potential to occur in the project area include the Flannelmouth sucker (*Catostomus latipinnis*), roundtail chub (*Gila robusta*), and southwestern toad. These species are described in Appendix E.

3.2.3.3 Sport Fishery

The quality of the sport fishery in Lake Mead is generally dependant on forage fish production (NDOW 2004). The primary forage fish species in Lake Mead is the threadfin shad. The NDOW (2004) conducts forage fish surveys throughout Lake Mead and determined Las Vegas Bay has the highest density of forage fish, upwards of five times that of the Overton Arm. This high production of forage fish supports what NDOW terms a 'world-class' fishery on Lake Mead, particularly in the Las Vegas Bay area. Boulder Basin, which includes Las Vegas Bay, sustained over 71 percent of the total fishing pressure expended on Lake Mead during 2004 (NDOW 2004). Lake Mead is the largest recreational fishery in Nevada, representing over 425,000 angler-use days and an economic gain of $95 million to Clark County annually (NDOW 2004).

The factors that drive threadfin shad production and the quality of the sport fishery in the Las Vegas Bay include nutrient inputs from effluent discharge into the Las Vegas Bay via the Las Vegas Wash, nutrient inputs from terrestrial vegetation inundation, and storm and ground water inputs. These nutrients, including phosphorus, nitrogen, nitrate, and ammonia, provide for phytoplankton production (measured as chlorophyll *a*). Phytoplankton is then consumed by zooplankton and the threadfin shad consume both. The condition of sport fish populations fluctuate with shad abundance, therefore, the quality sport fishery that is now established in Lake Mead is likely dependant upon the nutrient input from Las Vegas Wash.

3.3 Cultural Resources

Cultural resources are the tangible remains of past human activities. Cultural resources are prehistoric and historic archaeological sites, districts, structures, or locations considered significant to a culture, a subculture, or a community for scientific, traditional, religious, or other reasons. To be eligible for the National Register of Historic Places (NRHP), an archaeological

site or other property must satisfy at least one of the National Register criteria as set forth at 36 CFR 60.4. The site or property must:

a. be associated with events that have made a significant contribution to the broad patterns of our history; or
b. be associated with the lives of persons significant in our past; or
c. embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or
d. have yielded, or may likely to yield, information in prehistory or history.

Typical prehistoric archaeological resources in the project area include:

- Campsites,
- Tool procurement sites,
- Food-processing areas, and
- Rock-art locations.

Typical historic sites may include structures with features such as mine shafts or adits, transportation routes, and refuse deposits.

A TCP is "….[a property] that is eligible for inclusion in the National Register because of its association with cultural practices or beliefs of a living community that (a) are rooted in that community's history, and (b) are important in maintaining the continuing cultural identity of the community" (NPS 1998).

Cultural resource investigations were conducted between December 2002 and January 2003 for the proposed alignment of the EI pipeline. Between April and October 2004, archaeologists conducted a Class I inventory of approximately 12 miles (19 km) of proposed tunnels and a Class III inventory of approximately 186 acres (75 hectares) of land associated with tunnel shafts, construction areas, and access roads for the proposed LCS alignments. In January and March 2005 nautical archaeologists conducted an underwater remote-sensing survey of approximately 889 acres (360 hectares) within the LMNRA including the area containing the Hoover Dam Aggregate Plant facility. The investigations included a review of the existing data inventory for portions of the project area that had already been surveyed for cultural resources and Class III inventory of portions of the project area that had not been previously examined. This chapter summarizes the data collected, compiled, and reported in *Archaeological Inventory of the Effluent Interceptor Pipeline Clark County, Nevada* (HRA 2004) and *Archaeological Inventory for the Systems Conveyance and Operation Program, Lake Conveyance System Pipeline, Clark County, Nevada* (HRA 2005). The investigations were conducted in compliance with NEPA, NHPA, the ARPA, and their respective implementing regulations and guidelines. Under Section 106 of the NHPA, federal agencies are required to consider the effects of their undertakings on cultural resources found eligible for listing on the NRHP and provide the Advisory Council on Historic Preservation an opportunity to comment on the action if such a property will be adversely affected.

3.3.1 Cultural Overview

In the Valley most of the sites that have been excavated cover only a brief span of time or have been too heavily disturbed to provide much useful chronological information. However, there are indications from locations along the Las Vegas Wash, Duck Creek, and nearby River Mountains that the Wetlands Park area could have been used as early as 12,000 years ago, and during later Archaic times (Roberts and Ahlstrom 2000a). Information from archaeological sites in the Wetlands Park indicates the area was definitely inhabited from AD 600 through the historic period. The cultural history of southern Nevada can be discussed with reference to five major periods:

- Paleo–Archaic (10,000–5500 B.C.),
- Archaic (5500 B.C.–A.D. 300),
- Ceramic (A.D. 300–1800),
- Historic Paiute/Chemehuevi/Mojave (A.D. 1800–1905),
- Historic Euroamerican (A.D. 1500–1950).

The first three periods deal with Native American history and the fourth and fifth periods deal with both Native American and Euro–American history.

3.3.1.1 Paleo-Archaic Period (10,000 – 5500 B.C.)

Two artifact traditions are generally distinguished within the Paleo-Archaic period: the Fluted Point (Paleo-Indian) and the Stemmed Point (Lake Mohave) (Grayson 1993, Schroedl 1991). Fluted points have been identified at sites in the Mojave Desert of California. Stemmed points are rare in the Valley.

During the survey of the eastern half of the Wetlands Park (Roberts and Ahlstrom 2000a), a Clovis point base (the oldest type of fluted point) was found within the Wetlands Park boundary on the terrace north of the Las Vegas Wash. This point is the first confirmed evidence of the Clovis tradition reported in Clark County. Evidence of the Clovis tradition, primarily in the form of isolated projectile points, has been found elsewhere in southern Nevada, southwestern Utah, southeastern California, and northwestern Arizona. At this time, no sites have been located in the Valley that can be convincingly attributed to a late Paleo-Archaic period occupation (HRA 2004).

3.3.1.2 Archaic (5500 B.C. – A.D. 300)

The Archaic tradition is characterized by a broad-spectrum adaptation to the animal and plant resources of a Holocene environment that is more or less like the modern-day environment. Characteristic artifacts of the Middle (5000–3000 B.C.) and Late Archaic (3000 B.C.–A.D. 1) periods include large projectile points that would have been hafted to darts that were propelled with atlatls, (a wooden device used to throw long, stone-tipped darts). Late Archaic subperiod sites are more common than Middle Archaic sites in southern Nevada, and several have been investigated within a few miles of the Wetlands Park.

Several sites located along Duck Creek appear to contain Middle Archaic occupations (Ezzo and Majewski 1995), while two sites in the Wetlands Park may contain Middle Archaic components based on the presence of a large expanding stemmed projectile point on one (Ferraro 1975a) and a Gatecliff projectile point on the other (HRA 2004, Woodman et al. 2001). In the nearby River Mountains, excavation at the Basic Site led to the recovery of a Gypsum point (Brooks and Larson 1975) indicative of a Late Archaic occupation (HRA 2004).

3.3.1.3 Ceramic (A.D. 300 – 1800)

The introduction of the bow and arrow, and the adoption of pottery for cooking and storage, marks the beginning of the Ceramic period (A.D. 300–1800). The replacement of lightweight basketry with heavier ceramic containers is usually associated with a farming economy and greater sedentism. The Valley straddles the boundary between the Virgin Anasazi and Patayan culture areas. The ceramic assemblages from various sites in the Valley frequently contain equal numbers of Patayan and Virgin ceramics. Southern Paiute Brown Ware sherds are also well represented (Seymour 1997). The Ceramic period is delineated by three subperiods: Early (A.D. 300-100), Middle (A.D. 1000-1500) and Late (A.D. 1500-1800).

The earliest ceramics identified in the Valley are a handful of Virgin Anasazi sherds. The Middle Ceramic subperiod is possibly the best represented subperiod in the Valley. During the Middle Ceramic subperiod, Paiute ceramics first appeared in the Valley. The Wetlands Park contains one site that dates to this subperiod.

3.3.1.4 Historic Paiute/Chemehuevi/Mojave and Historic Euroamerican (A.D. 1800-1905)

The identity of the people who lived in and around the Valley just before the Historical period has been established by archaeological, linguistic, and Native American origin myth sources. Generally, there is agreement that Numic speaking peoples who occupied this region were engaged in hunting, gathering, and foraging practices that were supplemented by horticulture. Historic and archaeological evidence suggest that Southern Paiute and Patayan/Mojave people occupied the Las Vegas Wash area in the Historical and possibly Late Historic periods (Fowler 1999, Seymour and Hatzenbuehler 1995).

The Las Vegas Wash represented an important travel corridor, habitation/camping locale, and resource procurement area for the Mojave/Yumans. These people settled along the Las Vegas and Duck Creek washes, relying on the mesquite trees and farming for subsistence. Duck Creek begins in the southwestern end of the Valley and drains northeast until it flows into the Las Vegas Wash inside the current boundaries of the Wetlands Park. There are two occupation sites in or near the Las Vegas Wash, and the Southern Paiute and Mojave tribal members have identified the Las Vegas Wash as an area of cultural significance (Stoffle and Dobyns 1983, Roberts and Woodman 1999).

Intaglios are large designs created on the ground by scraping away the desert pavement, and are generally associated with Yuman groups. In 1990, an intaglio located less than a mile south of the Wetlands Park was recorded. Known today as the Las Vegas Wash Intaglio (26CK4509), it is one of the few known intaglios in southern Nevada. Soon after the feature was recorded, Reclamation fenced the area and took aerial photographs of the site.

The first documented European entry into the Valley was by Antonio Armijo in 1829 (Warren 1974). Other early explorers such as Jedediah Smith and James O. Pattie traveled near the Las Vegas Wash on their trapping expeditions down the Virgin and Colorado rivers. Blue glass and ceramic trade beads, which were recovered from two sites (26CK1138 and 1139) in the Wetlands Park, may date to this early period. Members of the Church of Jesus Christ of the Latter Day Saints, known as Mormons, made the first attempt to settle in Las Vegas in 1855. The Mormons built a small adobe fort along the Las Vegas Wash near what is now Las Vegas Boulevard and Washington Avenue, but the group was ordered to leave the mission after two years.

3.3.1.5 Historic (A.D. 1905 - 1960)

The Bishop family established the Glendale Ranch, a cattle and horse ranch, in the vicinity of the Las Vegas Wash in 1905 (Ritenour 1979). By 1912, the ranch was 800 acres (324 hectares) with a house and outbuildings. Two archaeological sites related to the Glendale Ranch were excavated during the Colorado River Salinity Project for Reclamation (Brooks and Larson 1975, Ferraro and Ellis 1982). Artifacts, maps, and other sources suggest that the Glendale Ranch buildings may continue to have been occupied until the main house burnt down after 1933.

The remains of the Three Kids Mine and its town site are located at the southeastern edge of the Wetlands Park. This mining operation ran sporadically from 1941 through 1961. Most of the mining sites recorded within the Wetlands Park boundary appear to post date 1940, and are associated with gypsum mining and prospecting.

On December 21, 1928, Congress passed the Boulder Canyon Project Act that authorized the building of the Boulder (later renamed Hoover) Dam on the Colorado River. From 1931 until completion in 1936, the construction of the Hoover Dam was the largest water project in the U.S. and one of the largest in the world. This construction project included the dam, four diversion tunnels, a hydroelectric power generation plant at the base of the dam, and the establishment of a construction community called Boulder City (ACRE 2003).

Construction of the dam could not begin until a transportation system was established. This system included a series of railroads and a highway to transport the thousands of workers and millions of tons of equipment and materials to the dam site. The use of the railroad and road system for dam construction was the most extensive at the time, and included three distinct railroads and a paved highway. Approximately 52 miles (84 km) of railroad comprised the overall Hoover Dam railway system (Myrick 1963). The three railroads were:

- The Boulder City Branch Railroad, which connected the Union Pacific Railroad near Las Vegas to Boulder City;
- The U.S. Construction Railroad (USCRR), which connected Boulder City to the dam site; and
- The Six Companies, Inc. Railroad (SCIRR), which was used to haul aggregate materials (sand and gravel) for dam construction (ACRE 2003).

An aggregate-classification plant (Aggregate Plant) was built in Hemenway Wash at the convergence of the three railroad systems (Stevens 1988). One fork of the rail system delivered raw material from Arizona, while the other two forks of the rail system delivered processed aggregates to the mixing plants (Stevens 1988, Park 1986). The Aggregate Plant was an

imposing complex consisting of an intricate system of bunkers, sieves, conveyers, tunnels, and towers that had the ability to process 9 million tons of aggregate over a 2.5 year period (Stevens 1988, Reclamation 1941). The Aggregate Plant was in operation from 1932 until 1935.

Following construction of Hoover Dam, a Civilian Conservation Corps (CCC) consisting of 500 men was established in Boulder City to support the NPS with lakeside developments and related issues. The CCC worked on projects around Lake Mead including visitor facilities, beach improvements, at least one boat ramp, campgrounds, cabins, water and sewage systems, and irrigation to vegetation in the Hemenway Wash area (ACRE 2003, Daron 1999). The CCC was disbanded in 1942.

3.3.2 Effluent Interceptor

A portion of the EI project area is located within the Wetlands Park, which accounts for much of the project area. A site-file search was conducted to identify known archaeological sites in the vicinity of the proposed EI. A 200-ft (61-m) wide corridor was surveyed for portions of the EI alignment that had not been previously surveyed for archaeological sites. The tunnel portals, which require approximately 300 x 300 ft (91 x 91 m) activity areas at the entrance shafts and approximately 240 x 240 ft (73 x 73 m) at the exit shafts, were also surveyed. Survey transects were spaced at intervals of no more than 65 ft (20 m). Ground visibility was good except in dense stands of tamarisk and salt bush where intensive survey was not possible. In addition, some areas were found to have been heavily disturbed through the removal or re-contouring of sediments, and these areas received minimal reconnaissance (HRA 2004).

3.3.2.1 Effluent Interceptor File Search

The site-file search was conducted at the Harry Reid Center for Environmental Studies, UNLV during April 2000.

In addition to referring to the results of the site-file search, the following files and curated artifacts relating to sites within the Wetlands Park were examined:

- Previous surveys within the Wetlands Park;
- Items that are held by Reclamation, Lower Colorado Regional Office in Boulder City, Nevada;
- General Land Office maps and mineral claim records at the BLM, Las Vegas Field Office; and
- Special Collections section of the Emily Dickenson Library at UNLV (examined by Reclamation staff).

There have been 74 archaeological sites recorded in the Wetlands Park or the immediate vicinity. The current project area includes linear ROWs through the Wetlands Park, which has been intensively inventoried. As the result of previous investigations within the Wetlands Park, a total of 49 sites have been recorded that are considered contributing elements to the Las Vegas Wash Archaeological District. In addition, 23 sites have been recorded that were found to be non-contributing elements to the district and not eligible for the NRHP though located within the district. Two additional sites are located within the Wetlands Park but are located outside the existing archaeological district boundaries.

As a result of previous surveys within and adjacent to the Wetlands Park, a total of six archaeological sites have been identified within the EI area (Table 3.3-1). Of these six sites, four have been determined to be eligible for nomination to the NRHP.

Table 3.3-1 Previously Identified Archaeological Sites within the Effluent Interceptor Project Area.

Site No.	Period	Site Type	Ownership	NRHP Eligibility	NRHP Criterion
26CK1300	Prehistoric	Rock Rings	Clark County	Eligible contributing element	D
26CK1301	Ceramic	Rock Shelter	Clark County	Eligible contributing element	D
26CK1303	Historic	Rock Alignment	Clark County	Eligible contributing element	D
26CK4877	Prehistoric	Rock Ring	Clark County	Not eligible	--
26CK6150	Historic	Power Line	Clark County/Private/ Reclamation	Eligible	A
26CK6150	Historic	Power Line Road	Clark County/Private/ Reclamation	Non-contributing element	--

Source: HRA 2004.

Site 26CK1300

In two surveys conducted in this area (Roberts and Ahlstrom 2000a, Woodman et al. 2002), HRA recorded 15 rock-ring features, three rock clusters, and a number of artifacts including a quartzite bifacial core, a battered cobble, a retouched flake, and a few flakes distributed over an area that measures approximately 320 m (1,050 ft) north/south by 250 m (820 ft) east/west. In addition to the bifacial core that was recorded at the site during HRA's earlier survey, other lithic materials identified near some of the features include:

- A white chalcedony flake,
- Two quartzite flakes,
- A retouched tan chert flake,
- A battered chert pebble, and
- Four pieces of debitage.

Site 26CK1301

This rock shelter was originally recorded in March 1975 by Bussard and Olson of the Nevada Archaeological Survey during the survey for the Colorado River Basin Salinity Control Project (Ferraro 1975a, 1975b). The site form describes the site in the following manner:

- This site contains a rock shelter formed by the erosion of unconsolidated Horse Springs sediments from beneath the Basal Muddy Creek conglomerate. The site dimensions are approximately 12 ft (4 m) from the drip line north to the rear, 20 ft (6 m) from east to west, and 3 ft (1 m) from floor to ceiling.
- Artifacts observed at this site included a knife/scraper, a projectile point base, and numerous waste flakes-all made of chert. Charcoal fragments were also noted. There is at least 2 ft (1 m) of midden depth as determined by the removal of a pollen core sample (Site Form, on file at the Harry Reid Center, UNLV).

In the final report for this survey, Ferraro described the site and noted that test excavations would be needed if the site were to be impacted. In 2000a, Ahlstrom and Roberts found that the site remained in excellent condition and has not been vandalized. This may be because the site is hidden from view by a thick stand of salt bush and tamarisk. The shelter is approximately 10-m (33-ft) long and 2-m (6-ft) deep. Cultural materials include:

- Stained ashy silt,
- Flaked stone,
- Ground stone,
- Sherds,
- Calcined bone, and
- Charcoal.

Most of the artifacts occur in the eroded, sloping deposits in front of the shelter, outside the dripline. Flaked stone artifacts included secondary and tertiary flakes of white, red, gray, mustard, and brown chert. A small grinding slab was also identified in the deposits in front of the shelter. Sherds identified included a Colorado Red-on-Buff sherd and a Plain Buffware sherd with fine temper, buff-colored paste, and a red wash. A small rock wall was identified west of the shelter at the top of a small rill. The level area located in front of the shelter, about 33 ft (10 m) from the dripline, has the potential to contain deeply buried cultural deposits.

Site 26CK1303

This historic camp was first recorded in 1975 by David Ferraro of the Nevada Archaeological Survey during the survey for the Colorado River Basin Salinity Control Project (Ferraro 1975a), and is described as:

Feature 1: A rectangular rock alignment that is approximately 12-ft (4-m) long and 8-ft (2-m) wide, with the remnants of two wooden pegs found projecting above the surface.

Feature 2: To the south of this feature there is a "U" shaped rock alignment, which is composed of mud-mortared rock fragments. No artifacts were found in association with this site (Site Form, on file at the Harry Reid Center, UNLV).

In their 2000a survey, Ahlstrom and Roberts recorded that the site was found to be essentially the same as it was when Ferraro first described it. The site is located on a low narrow ridge spur that projects into the floodplain from the base of the terrace north of the Las Vegas Wash. The site measures 40 ft (12 m) north-south by 60 ft (18 m) east-west and includes the two features described above.

Site 26CK4877

Dr. Kevin Rafferty originally recorded this site in 1992 during a survey for the Lake Las Vegas Sewer Pipeline (Rafferty 1992). Rafferty noted that the site was in poor condition and had been impacted by erosion, blading, and development. He recommended that the site not be considered significant because it lacked artifacts, depth of deposits, and integrity. In the 2000a survey, Ahlstrom and Roberts could not relocate the site, and it is presumed to have been destroyed during construction of the sewer line.

Site 26CK6150

The site consists of a power line running from the Hoover Dam/Lake Shore switchyard to Pioche, Nevada and a road that parallels much of the power line. The site passes through the Wetlands Park, crossing a series of alluvial fans and the shallow drainages that divide them. The soil consists of poorly developed, highly disturbed desert pavement.

A records search of *Reclamation's Master Title Plats* (HRA 2004) revealed that the ROW for the power line was issued on February 21, 1939. A map of the proposed ROW, dated 1934, indicates that it runs from Hoover (then Boulder) Dam to the Pioche Switch Station. The map shows the power line running in a straight line through the Wetlands Park. Currently, the power line curves where it diverges from the road, which could mean that the poles in the southeastern portion of the site were erected in a post-1939 realignment of the line.

3.3.2.2 Effluent Interceptor Survey Results

The project components include three Reaches 1, 2, and 3, the South Lateral Pipeline alignment, the COH Forcemain, two short connections to existing treatment plants (the CCWRD CP and AWP Connections), and the EI Terminus site. The areas investigated for the EI components are shown in Figure 3.3-1.

Reach 1 of the EI alignment would be located in an area that had not been previously subjected to intensive or recent archaeological investigations. Reaches 2 and 3 would be located within the Wetlands Park boundary. Substantial portions of Reaches 2 and 3 have previously been surveyed

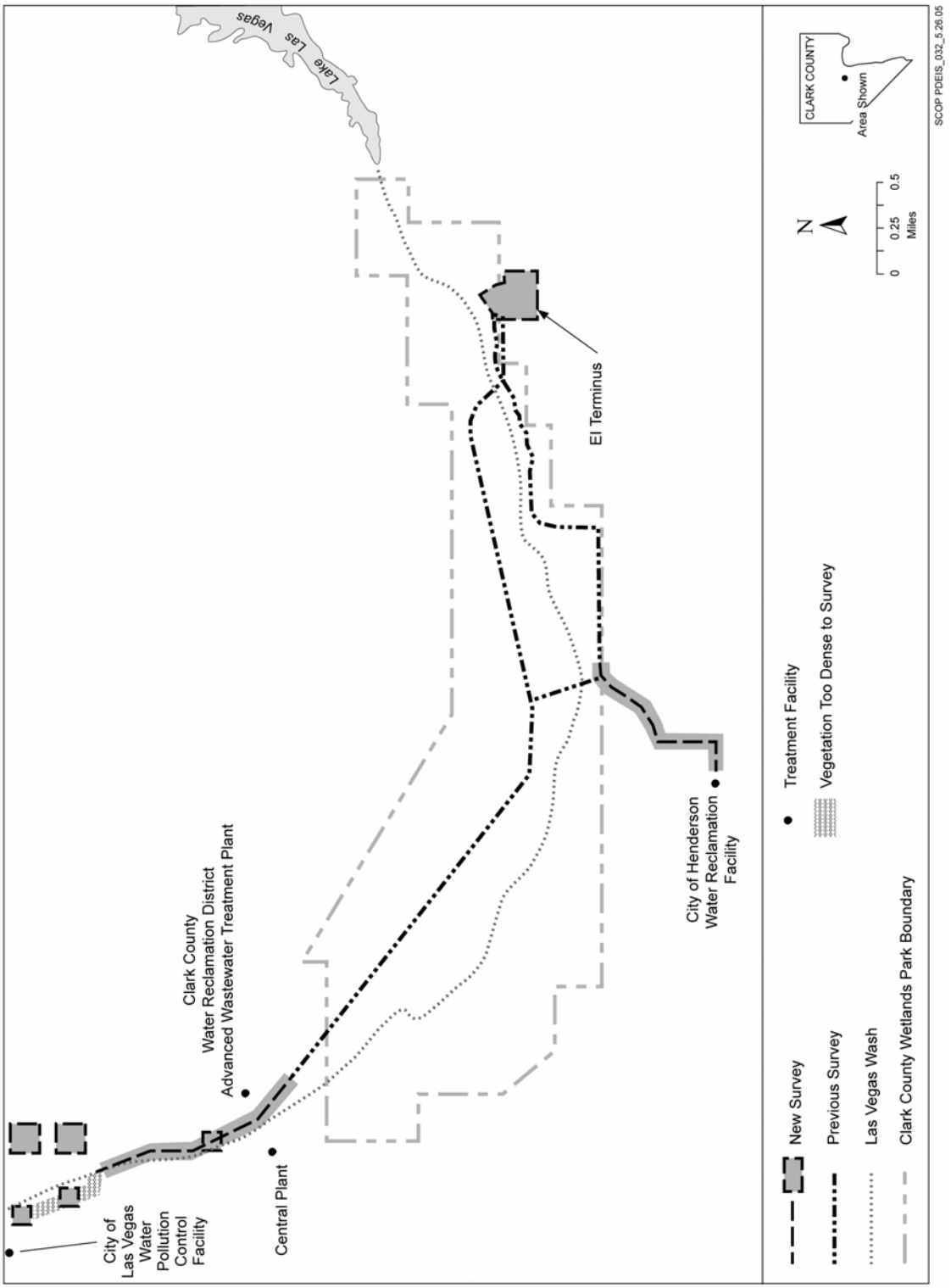


Figure 3.3-1 Areas Investigated for Cultural Resources in the Vicinity of the Effluent Interceptor.

extensively (Roberts and Ahlstrom 2000b, Woodman et al. 2001, Woodman et al. 2002, White 1996, Jones 1991).

No new archaeological sites or isolated occurrences were identified in the course of this survey. In addition, HRA considers it unlikely that the areas with dense stands of tamarisk and salt bush contain significant, undiscovered cultural remains, for two reasons. First, no sites or isolated objects were found in adjacent, less densely vegetated areas. Second, the densely vegetated areas are surrounded by areas of surface disturbance and have probably undergone considerable disturbance. Some areas were found to have been heavily disturbed through the removal or re-contouring of sediments, and these areas received minimal reconnaissance (HRA 2004).

3.3.3 Lake Conveyance System

There are three LCS alignments associated with the three action alternatives. A site-file search was conducted to identify known archaeological sites in the vicinity of the three LCS alignments. Field surveys were performed in areas not previously surveyed and areas that had been previously surveyed, but that warranted a resurvey.

A significant portion of the three LCS pipelines would be installed in a tunnel located more than 56-ft (17-m) below the ground surface. Therefore, no survey was conducted along the tunnel segments except in the areas where surface disturbance would occur including the working shaft locations, PRS locations, and access roads. The proposed locations of the working shaft and PRS locations were surveyed. The areas surveyed for the working shaft and PRS locations varied depending on the proposed size described in Sections 2.2, 2.3, and 2.4. A 165-ft (50-m) wide corridor was surveyed along each of the proposed access roads. The LCS above-water cut-and-cover segments were surveyed by HRA between April and October 2004 for the three alignments.

In March 2005, PBS&J nautical archaeologists surveyed the underwater segments of the Boulder Islands North and Boulder Islands South alignments. The survey consisted of 13 parallel transects, spaced 100-ft (30-m) apart. An Aggregate Plant (Site 26CK7285) that was used during the construction of Hoover Dam is located at the western base of the Boulder Islands. The Aggregate Plant is not located within the area of potential effect (APE) for any of the proposed LCS alignments, and will not be described further in this EIS. However, at the request of the NPS, PBS&J nautical archaeologists surveyed the Aggregate Plant, which is described in Section 3.3.1.5. The Aggregate Plant has been recommended eligible for listing on the NRHP.

3.3.3.1 Lake Conveyance System File Search

Seventeen sites were identified within the area of the LCS alignments during previous surveys. Of these 17 sites, 13 sites are located in areas that would not experience surface disturbance. They are located in areas where the LCS would be installed in a tunnel more than 56-ft (17-m) deep. Table 3.3-2 contains information regarding the 17 sites. There are four sites (26CK4046A, 26CK4046B, 26CK6247, and 26CK6249) located in areas where surface disturbance would occur. Portions of 26CK4046A and 26CK4046B, the USCRR and SCIRR, respectively, in the

Table 3.3-2 Previously Identified Prehistoric and Historic Sites in the Project Area.

Site Number	Period	Site Type	NRHP Eligibility	Surface Disturbance Would Occur (Yes or No)
26CK1118	Prehistoric	Lithic Scatter	Not-eligible	No
26CK1119	Prehistoric	Stone Circles, Lithic Scatter	Not-eligible	No
26CK1120	Prehistoric	Lithic Scatter	Eligible	No
26CK1124	Prehistoric	Cleared Circles, Rock Rings	Eligible	No
26CK1126	Prehistoric	Cleared Circles, Artifact Scatter	Not-eligible	No
26CK1134	Prehistoric	Cleared Circles, Lithic Scatter	Eligible	No
26CK1293	Prehistoric	Cleared Circles, Lithic Scatter	Not-eligible	No
26CK1294	Prehistoric	Lithic Scatter	Not-eligible	No
26CK1298	Prehistoric	Lithic Scatter	Not-Eligible	No
26CK4046A	Historic	U.S. Construction Railroad Grade	Non-contributing element	Yes
26CK4046B	Historic	Six Companies, Inc. Railroad Grade	Non-contributing element	Yes
26CK4509	Prehistoric	Lithic Scatter, Intaglio, Trail	Eligible	No
26CK4510	Prehistoric	Lithic Scatter	Not-eligible	No
26CK5383	Historic	Lakeshore Road	Eligible	No
26CK6247	Historic	Hemenway Road/Old Lake Highway	Not-eligible	Yes
26CK6249	Historic	Southern California Edison North Transmission Line	Eligible	Yes
26CK6756	Historic	Transmission Line	Not-eligible	No

Source: HRA 2005.

vicinity of the project are considered to be non-contributing segments of these eligible properties. Site 26CK6247 is a non-eligible site, and Site 26CK6249 is an eligible site. In addition to the previously recorded sites, one newly recorded site (26CK7115) was investigated by HRA.

Site 26CK4046A

This site is the remains of the USCRR, which was owned by the federal government and was built to transport materials and equipment from Boulder City to the Nevada Rim of the dam construction site (ACRE 2003). A portion of the railroad has been damaged by sheet wash action

of Hemenway Wash. This section of the railroad has been previously determined as a non-contributing element to the overall line because of damage from natural disturbances (HRA 2005).

Site 26CK4046B

This site is the remains of the SCIRR, which was used to transport aggregate for the construction of Hoover Dam. Three lines primarily comprised the SCIRR: a section of the main line that was used to transport mined aggregate from the Arizona gravel pit to the Aggregate Plant (Gravel Pit Line), an extension of the main line from the Aggregate Plant to a junction with the USCRR (USCRR Junction Line), and a branch line traveling through Black Canyon to the Hoover Dam construction site.

The total length of the SCIRR main line consisted of more than 19 miles (30 km), and approximately 3 miles (5 km) of railroad grade remain above the high-water level of Lake Mead (ACRE 2003). The rails, ties, and other connection hardware were removed prior to 1962. Portions of the railroad grade above the high-water level of Lake Mead were destroyed or altered by the construction of Lakeshore Road or pipelines. Approximately 164 ft [50 m] of the railroad grade was destroyed or altered for each crossing of Lakeshore Road and the railroad grade. In addition, the railroad grade has been severely eroded at several locations including in the central portion of Hemenway Wash, where an approximately 0.5 mi (1 km) segment no longer retains integrity (ACRE 2003).

Site 26CK6247

Site 26CK6247 is the remains of the Hemenway Wash Road (or Old Lake Highway), which was the main access to the Colorado River for the area prior to the construction of Hoover Dam. The road today consists of fragments of paved and washed out or eroded roadbed in various degrees of integrity. Overall, the road within the LMNRA has been cut, crossed, repaved, and neglected. Much of the site's integrity has been severely impacted by erosion. However, one section of the road has been well preserved, lacks any erosion damage, and contains intact and passable pavement. Schweigert, in 2001, recorded this site, and recommended that the site was not eligible for the NRHP because he did not believe that the road existed prior to the construction of Hoover Dam (Schweigert 2001A). The NPS concurs with Schweigert and recommended that site 26CK6247 is not eligible for the NRHP. The Nevada SHPO concurs with this recommendation.

Site 26CK6249

This site is the Southern California Edison North Transmission Line, or the Hoover to Chino No. 1. This high-voltage transmission line ran from the Southern California Edison switchyard located at Hoover Dam to Chino, California (Schweigert 2001b). This early transmission line is important for its direct association with the early operation of Hoover Dam, but it was also extremely important for providing the energy for war industries in California during World War II (Schweigert 2001b). Because of the direct association, this site has been recommended eligible for the NRHP under Criterion A.

3.3.3.2 Lake Conveyance System Survey Results

A Class III inventory of approximately 186 acres (75 hectares) of land associated with the proposed working shaft locations, PRS locations, and access roads was conducted by HRA between April and October 2004. Underwater remote-sensing surveys of approximately 889 acres (360 hectares) of the LMNRA were conducted by PBS&J between January and March 2005. The terrestrial areas investigated for the LCS components are shown in Figure 3.3-2.

The results of the terrestrial and underwater surveys are described in this section.

3.3.3.2.1 Terrestrial Surveys

One newly recorded archaeological site (26CK7115) and one previously recorded site (26CK6247) were investigated in the course of the LCS terrestrial archaeological surveys. Both sites are linear historic sites related to the construction of Hoover Dam and the resulting recreational use of Lake Mead (HRA 2005).

Site 26CK7115 consists of the above-ground features of a buried water line, portions of which were constructed by the CCC in the early 1940s. The site includes three loci (A, B, and C) that consist of a large earthen covered concrete cistern, two concrete vaults, and two small valve boxes with a buried tank (HRA 2005). The site has been recommended eligible for list on the NRHP under Criterion a, association with events or broad patterns important in history.

Site 26CK6247 is the remains of the Hemenway Wash Road (or Old Lake Highway) as described in Section 3.3.3.1. HRA investigated this site to determine the potential effects that the proposed LCS may have on Site 26CK6247. The potential impacts are described in Section 4.3.2.2.1.

Two isolated occurrences were noted during the 2004 surveys. Isolated Occurrence 1 is a survey marker consisting of a 4-inch (10-cm) interior diameter metal pipe set into the ground that was filled with mortar and a wire nail. This marker may have been for use with the gravel pit operation located to the west and up the Hemenway Wash. Isolated Occurrence 2 is a metal keg hoop with nails. The hoop is of the type typically seen on kegs that were used for bulk hardware shipments. Railroad connection hardware such as spikes, rail bolts, washers, and nuts typically were shipped in wooden kegs; as well as other bulk hardware such as nails, screws, and other fasteners (HRA 2005).

3.3.3.2.2 Underwater Surveys

Elements of Site 26CK4046B were investigated using remote-sensing equipment. The underwater portions of Site 26CK4046B located within the APE of the two Boulder Islands LCS alignments include the Gravel Pit Line and the USCRR Junction Line. All reusable railroad materials, including tracks and ties, were reportedly removed from this portion of the SCIRR route in 1934.

A relatively static environment on the Lake floor in the survey area has minimized the effects of erosion, siltation, and other destructive forces on bottom features. Railroad grades appear to be

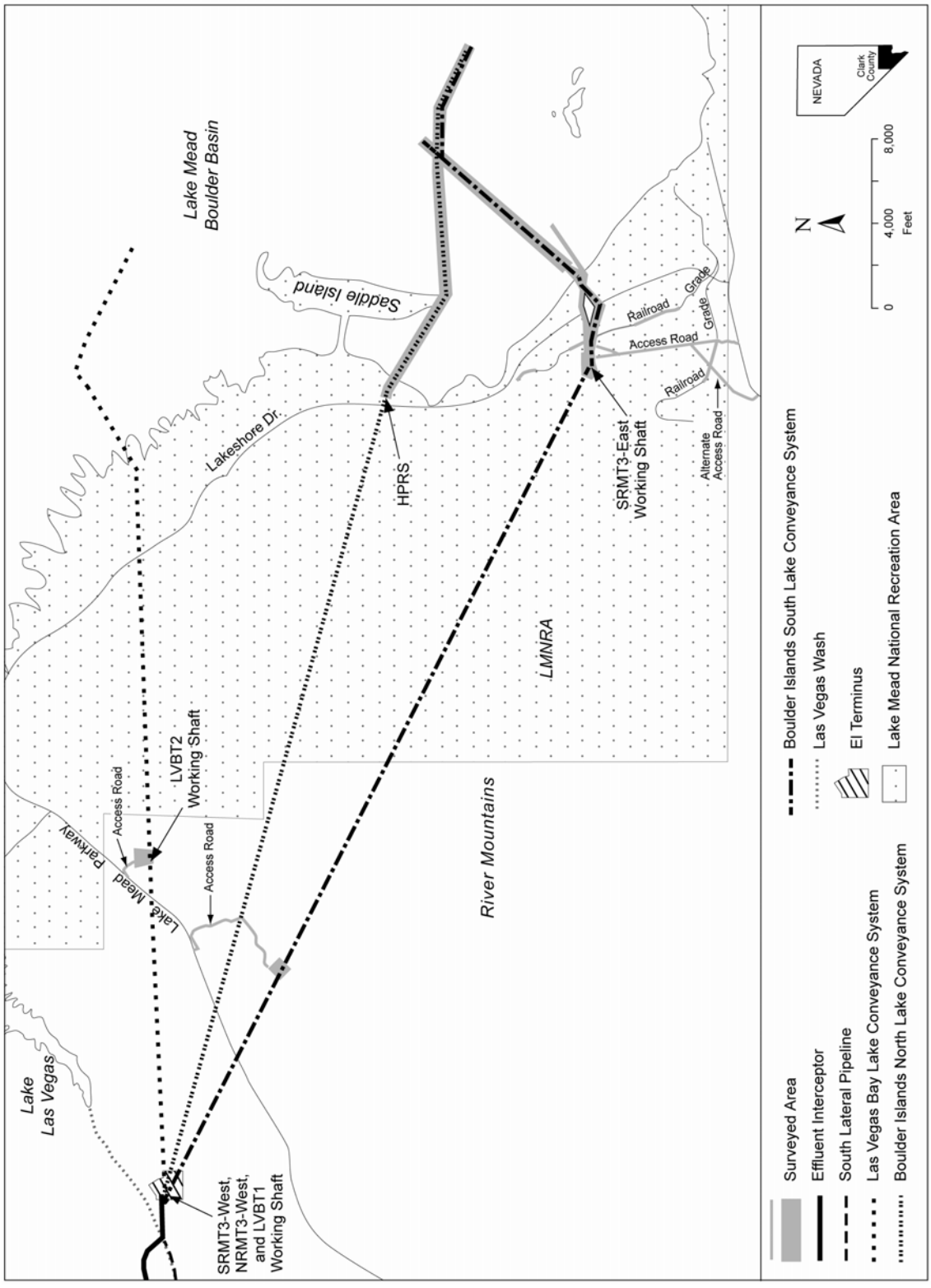


Figure 3.3-2 Terrestrial Areas Investigated for Cultural Resources in the Vicinity of the LCS Alignments.

well preserved. The Gravel Pit Line and USCRR Junction Line segments of the SCIRR are identifiable by a clearly defined and continuous linear pattern on the sonar record, signifying a uniform integrity of the grade across the survey area (HRA 2005).

In addition to the segments of the SCIRR, the underwater portions of Site 26CK4046B, features include a track siding (part of Site 26CK4046B), service road (Site 26CK7254), and raw aggregate storage pile (Site 26CK7285). The isolated track siding spans the full width of the APE. The track-siding grade is approximately 39-ft (12-m) wide throughout the APE. The aggregate storage pile was created as a reserve of raw material in case there was an interruption of aggregate delivery from the Arizona gravel pit. The aggregate pile spans the full width of the Boulder Islands South APE and extends into the southern half of the Boulder Islands North APE. An unpaved service road parallels the SCIRR within the survey area. The service road was likely the primary access road between the Aggregate Plant and the Arizona gravel pit. The road is approximately 1,608-ft (490-m) long within the survey area.

3.4 Recreation

The project area comprising the east-central portion of the Valley is used for multiple recreational activities. The surrounding mountain and desert ecosystems provide open space for OHV activities, mountain bicycling, sightseeing, rock collecting, hunting, hiking, nature observation, and horseback riding. The Colorado River and associated tributaries and reservoirs, including Lake Mead, support water-associated activities such as fishing and boating.

Local, county, state, and federal agencies manage the various public recreation areas. The NPS, BLM, Reclamation, and Clark County manage the largest recreational parcels that would be adjacent to or transected by the proposed alignments (Figures 3.4-1 and 3.4-2). Several small open-space parcels and general recreation opportunities occur within the project area. This section focuses on organized public recreational uses.

3.4.1 Lake Mead National Recreation Area

The NPS has administered the LMNRA since 1936, first under a cooperative agreement with Reclamation until 1964 when it was established by Congress as a unit of the National Park System. Lake Mead and Lake Mohave comprise the LMNRA encompassing approximately 1.5 million acres (607,028 hectares), and 110 miles (177 km) of the Colorado River (NPS 2003a). The LMNRA ranks as the fifth most visited unit of the National Park System with recreational visits totaling more than 8.2 million in 2003 (NPS 2003b). The majority of the LMNRA visitation occurs during the summer months between May and September, and primarily involves water-based recreation. However, visitation is increasing in the spring and fall as visitors discover the backcountry regions of the recreation area through hiking and travel on the approved road system (NPS 2003c).

The project area is located in the western portion of the LMNRA in the Boulder Basin Developed Area on Lake Mead (Figure 3.4-2). In the recently approved *Lake Management Plan*, the NPS

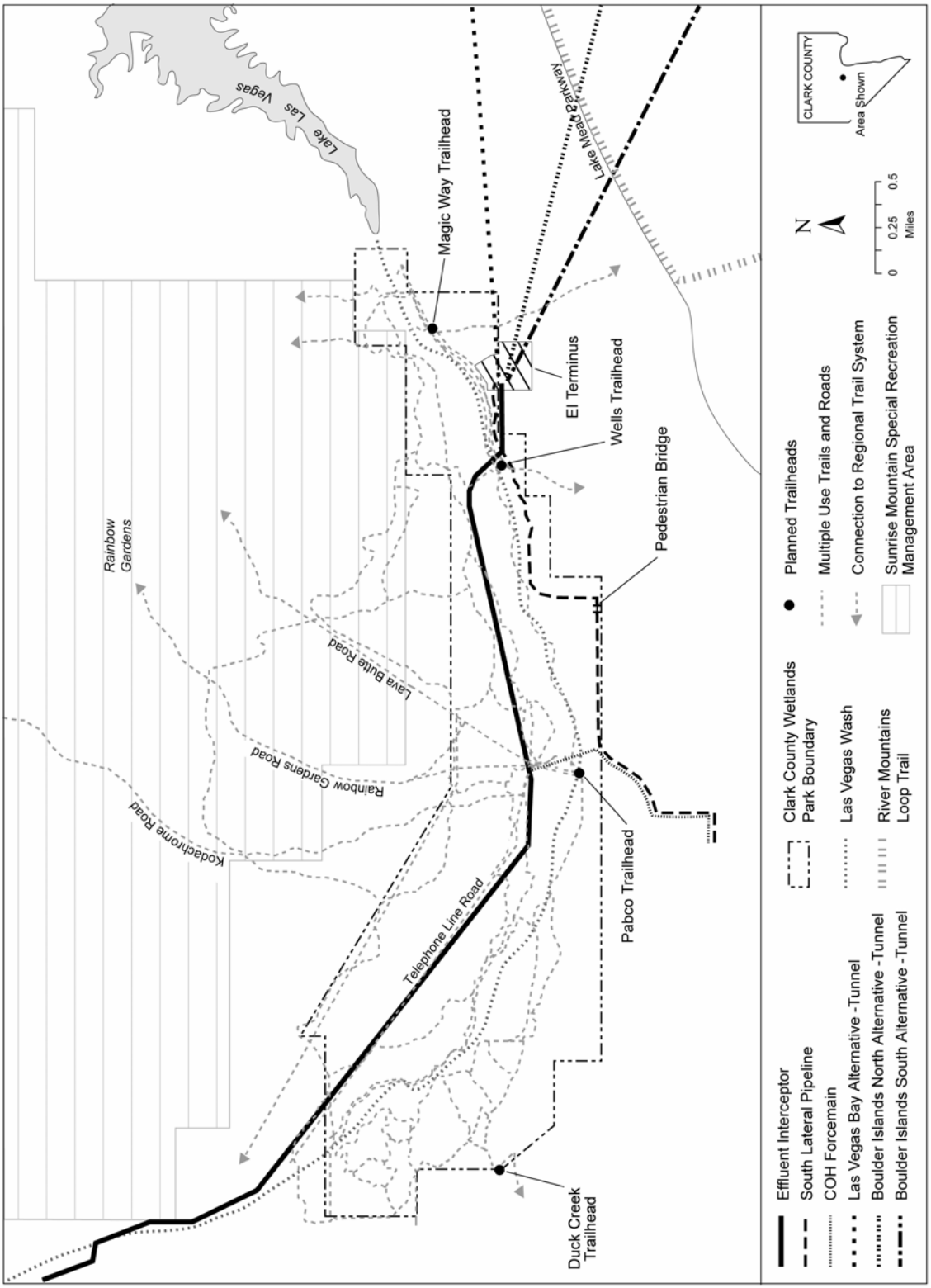


Figure 3.4-1 Recreation Areas in the Project Vicinity – Effluent Interceptor Segment.

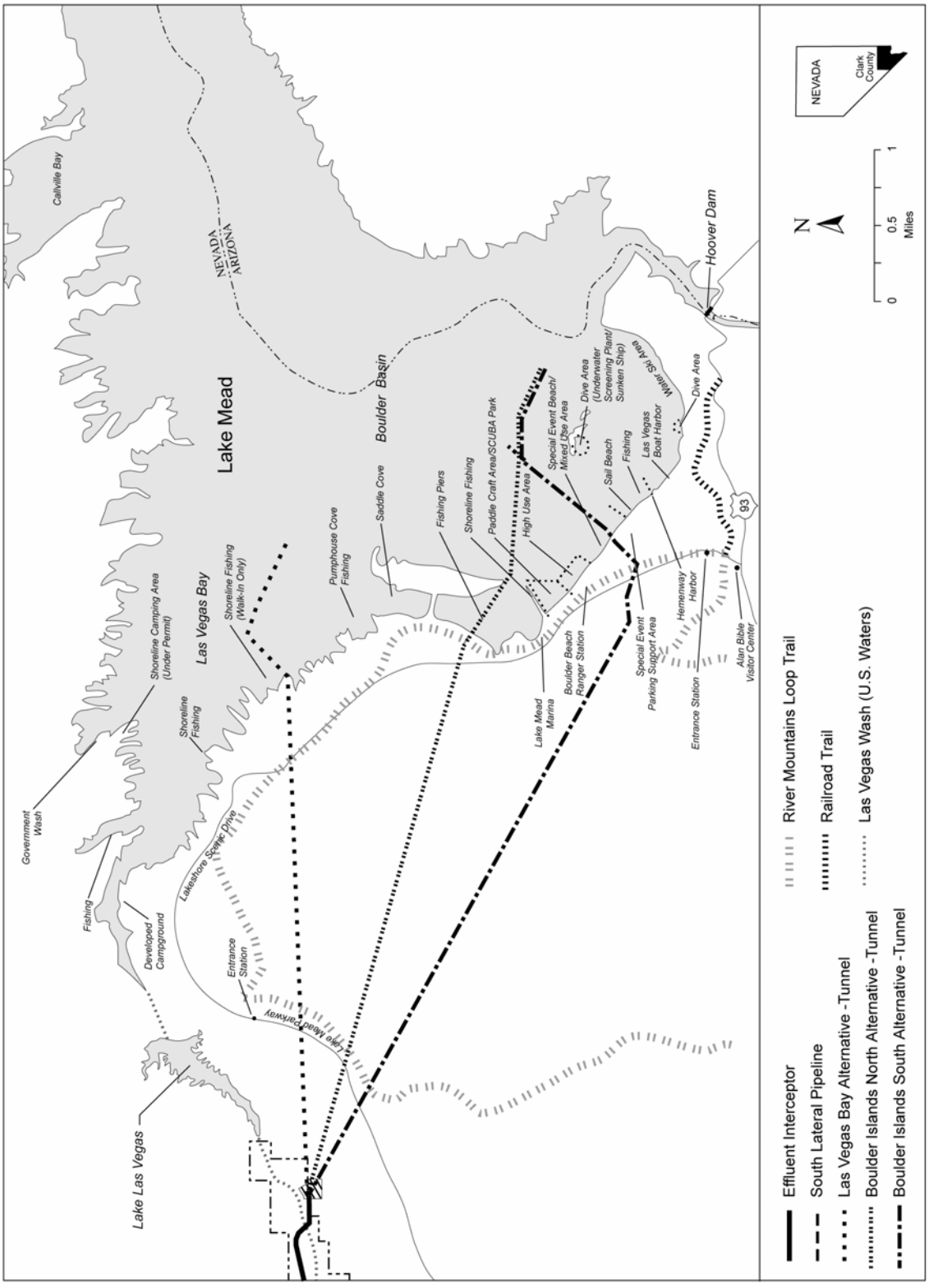


Figure 3.4-2 Recreation Areas in the Project Vicinity – Lake Conveyance System Segment.

designated the Boulder Basin as an Urban Park Zone a recreational management setting for areas that may experience intense visitor use (NPS 2002). The Boulder Basin is located within 30 minutes of most locations within the Valley as well as Henderson and Boulder City. It serves as the primary access point to the LMNRA. Approximately half of the visitors to LMNRA go to Boulder Basin.

Available facilities in the Boulder Basin area include four concession-operated marina and service facilities including: Callville Bay Resort, Lake Mead Resort, Lake Mead Cruises, and Las Vegas Boat Harbor. The marina facilities include restaurants, stores, trailer villages, and mooring services. Public launch ramps are located at Callville Bay, Government Wash, Las Vegas Bay, Boulder Harbor, and Hemenway Wash. Additional public facilities include Lakeshore Drive and Northshore Road scenic overlooks with parking and picnic facilities, and campgrounds. There are also employee housing areas, trailer villages, a state-operated fish hatchery, the SNWA AMSWTF, and the Alan Bible Visitor Center.

A wide variety of recreational opportunities are available including camping at Callville Bay, Las Vegas Bay, and Boulder Beach. Primitive camping opportunities are available along the north shore of Boulder Basin at Boxcar Cove, Crawdad Cove, Montana Agate Wash, and mile post 8.0 of Northshore Road. These shoreline areas are accessible by gravel roads. These areas are also popular for swimming, sun bathing, shoreline hiking, boating, and personal watercraft (PWC) use.

The Callville Bay Developed Area is the most popular boating location in the Boulder Basin. The marina includes 647 slips, a store, restaurant, trailer village, dry-boat storage, maintenance area, and lounge. Public facilities include a 160-ft (49-m) wide public launch ramp and improved parking, along with an 80-unit campground and picnic area. The area also supports an NPS and concession housing area.

The Government Wash area was developed in 1992 to improve Lake access. These facilities include a public launch ramp, restroom, and parking area. The shoreline below the public launch ramp is popular for shoreline camping and other water-based recreation activities. Additional improvements are proposed for the Government Wash area to support increasing visitor use.

The Las Vegas Bay Developed Area has been dramatically affected by lowering water levels on Lake Mead. The floating 635-slip marina complex has been temporarily relocated to Horsepower Cove. The area still supports the concession-operated dry-boat storage area and maintenance area. Public facilities include the 89-space campground, and picnic areas. The public launch ramp is closed.

The Las Vegas Wash, a tributary to Lake Mead, conveys surface-water runoff and treated municipal and industrial wastewater flows from the Valley to the Las Vegas Bay. The nutrient load in these flows encourages growth of algae, a food base for fish. This food source supports the local game fishery in the Las Vegas Bay and creates conditions ideal for sport fishing. The quality of the sport fishery in Lake Mead is generally dependant on forage fish production (NDOW 2004). The primary forage fish species in Lake Mead is the threadfin shad. The NDOW (2004) conducts forage fish surveys throughout Lake Mead and determined Las Vegas Bay has the highest density of forage fish, upwards of five times that of the Overton Arm. This high

production of forage fish supports what NDOW terms a 'world-class' fishery on Lake Mead, particularly in the Las Vegas Bay area. Boulder Basin, which includes Las Vegas Bay, sustained over 71 percent of the total fishing pressure expended on Lake Mead during 2004 (NDOW 2004). Lake Mead is the largest recreational fishery in Nevada, representing over 425,000 angler-use days and an economic gain of $95 million to Clark County annually (NDOW 2004).

The factors that drive threadfin shad production and the quality of the sport fishery in the Las Vegas Bay include nutrient inputs from effluent discharge into the Las Vegas Bay via the Las Vegas Wash, nutrient inputs from terrestrial vegetation inundation, and storm and ground water inputs. These nutrients, including phosphorus, nitrogen, nitrate, and ammonia, provide for phytoplankton production (measured as chlorophyll *a*). Phytoplankton is then consumed by zooplankton and the threadfin shad consume both. The condition of sport fish populations fluctuate with shad abundance, therefore, the quality sport fishery that is now established in Lake Mead is likely dependant upon the nutrient input from the Las Vegas Wash.

Underwater visibility in the Las Vegas Bay near the terminus of Las Vegas Wash is poor all year due to high silt content and algae growth (NPS 2004a). Therefore, conditions are not favorable for SCUBA diving in this area.

Within the 3-mile long Boulder Beach area there are two concession-operated marinas and Lake Mead Cruises. The slip capacity of these two marina operations is in excess of 1,200 slips and there are two public launch ramps, making this a high use area for boats. Each of the marinas includes floating restaurants and stores.

The Boulder Beach area is developed and zoned to support a wide variety of visitor activities. The northern end of Boulder Beach is designated as a dive park and includes the placement of sunken artifacts to support diving operations. The center portion of Boulder Beach is buoyed off to allow swimming and other shoreline activities. Additional SCUBA opportunities are provided at the Boulder Islands where two 45- to 50-ft (14- to 15-m) long boats (Tortuga and Cold Duck) have been placed on the lake floor to support exploring and training dives. The Special Events Beach provides for a variety of activities including areas for sailboat and PWC use. Accessible shoreline fishing facilities are provided at Fishing Point with other shoreline fishing improvements provided at other locations within the Boulder Basin.

In addition to the water-based development, the NPS has also developed a Boulder Beach Trail on the east side of Lakeshore Drive between the Alan Bible Visitor Center and the Lake Mead Marina. This trail will be incorporated into the 35-mile (56-km) River Mountains Loop Trail connecting the Boulder Basin with Boulder City, Henderson, and the Valley. While the trail today only measures approximately 3 ft (1 m) in width, as it is developed to be part of the larger trail, the width will increase to 10 ft (3 m) and the surface will be paved.

There are numerous backcountry roads that access the shoreline of Lake Mead in the Boulder Basin. These include four gravel roads along the north shore of the Boulder Basin. There are four additional access points in the Saddle Cove area of the Boulder Basin. There are two additional backcountry roads in the project area. One of these roads, AR-77, provides access to the Cholla Forest in the River Mountains. The other backcountry road, AR-76, provides access to NPS administrative facilities.

In addition to NPS managed recreation facilities, there are a number of tour operations that originate outside the LMNRA. These include scenic air tours that fly over portions of the Boulder Basin. It is estimated there may be as many as 400 such air tours daily.

3.4.2 Sunrise Management Area

The SMA is located approximately 5 miles (8 km) east of Las Vegas, and is managed by the BLM (Figure 3.4-1). The 37,620-acre (15,224-hectares) area includes the Sunrise Mountain Special Recreation Management Area and the Rainbow Gardens Area of Critical Environmental Concern (ACEC). The SMA management goals are to provide recreational opportunities and to protect biological, geological, hydrological, and cultural resource values (BLM 2000).

The SMA is dominated by Frenchman Mountain, with an elevation of 4,054 ft (1,236 hectares), and to a lesser extent by Sunrise Mountain. The Rainbow Gardens area of Frenchman Mountain was designated as an ACEC for its unique geologic features, which include wide sections of exposed rock strata, tilting and other formations influenced by fault activity, and large outcrops of gypsum-bearing soil. These geologic formations are one of many features that attract visitors to the area. The SMA also provides panoramic views of the surrounding desert, geologic features of Rainbow Gardens, Lake Mead, and Las Vegas.

Mountain bicycling and OHV use are the primary recreational activities in the area. Other recreational opportunities that attract visitors to the area include sightseeing, rock collecting, hunting, hiking, wildlife viewing, and horseback riding. Visitation occurs year-round, but the use and volume of visitors vary seasonally. No consistent visitor counts have been recorded and no visitation data exists for the SMA.

Primary access to the SMA from the south is via Telephone Line Road. Existing unpaved roads and trails in the SMA that connect to Telephone Line Road include Kodachrome Road, Rainbow Gardens Road, and Lava Butte Road. These roads and trails are designed for moderate to high use.

3.4.3 River Mountains Loop Trail

The River Mountains Trail Partnership was formally organized in 1998 and is an association of public agencies, community groups, businesses, and individuals committed to the development of a 35-mile (56-km) trail around the River Mountains. The River Mountains Loop Trail would encircle the River Mountains and connect the LMNRA to Hoover Dam, Boulder City, Henderson, and the rest of the Valley (Figure 3.4-2).

The trail portion within the LMNRA would be about 16-miles (26-km) long and would extend from the Lake Mead Parkway entrance station, near the LMNRA boundary with the COH and the Lake Las Vegas community, and continue in close proximity to Lakeshore Drive, primarily following disturbed corridors and existing trails, to the LMNRA boundary with Boulder City (NPS 2003c). The River Mountains Loop Trail system is under construction and completion is anticipated for fall 2005 (Holland 2004).

3.4.4 Clark County Wetlands Park

The 2,800-acre (1,133-hectares) Wetlands Park, managed by Clark County and Reclamation, is an extensive special-use regional park located along the Las Vegas Wash (Figure 3.4-1). The *Wetlands Park Master Plan* (Clark County 1995) includes a system of hiking, equestrian, and bicycle trails, and a nature center. Wildlife viewing areas will be constructed in phases over the next 10 to 15 years. The trails will eventually connect the Wetlands Park to the River Mountains Loop Trail and to the overall trail system for the Valley. Visitation occurs year-round but varies seasonally. Visitation to the Wetlands Park in 2003 was 6,637 visitors, based on numbers derived from individuals that signed in at the visitor center and from groups registered for guided and unguided tours of the park (Clark County 2004a).

3.4.5 Las Vegas Valley Primary Trails System

The Southern Nevada Regional Planning Coalition (SNRPC), created in 1999, consists of participants from, but not limited to, the cities of Las Vegas, North Las Vegas, Henderson, Mesquite, and Boulder City; Clark County; BLM; and Nellis Air Force Base. The goal of this cooperative planning effort is to recognize and support the continued development of an interconnected regional trail system that provides an alternative mode of transportation. The trail system would be designed to create convenient, non-motorized, access routes between neighborhoods, major commuter destinations, schools, parks, libraries, and other similar public spaces. The trail system would also include access to open-space features on federal lands in the deserts, mountains, foothills, lakes, and riparian areas that surround the Valley. The Las Vegas Valley Primary Trail System Map was created and is periodically updated by the SNRPC to reflect the existing and planned trail systems on lands managed by federal, state, and local entities (SNRPC 2003).

3.5 Hazardous Materials and Items of Special Concern

This section provides a description of the existing hazardous materials and items of special concern that may be encountered during implementation of the proposed project. The section is based on a *Phase I Hazardous Materials Environmental Site Assessment* prepared in April 2004 (Ninyo & Moore 2004). The Phase I analysis for the proposed project included review of topographical maps and aerial photographs to identify historic or current features that may be of concern. A description of adjacent and historic land uses within the proposed project area is described in the *Phase I Environmental Assessment Systems Conveyance and Operations Program* (Ninyo and Moore 2004), which is available upon request.

3.5.1 Environmental Databases Reviewed

A review of state and federal regulatory agency databases was conducted for reported release locations of hazardous substances to soils and/or groundwater in the project area. The purpose of this review is to ascertain the location of existing hazardous materials and the impact those materials have had on the environment.

The summary of environmental databases was searched on March 19, 2004, and listed sites are presented in Table 3.5-1. No sites listed in federal and state databases were found to exist within the linear search distances from the proposed alignment. There are 13 sites from the environmental database search that were located within 1 mile (2 km) on either side of the center line of the proposed alignment. The sites have been identified as having significant unauthorized releases of hazardous substances or other events with potentially adverse environmental effects.

Table 3.5-1 Summary of Environmental Database Search.

Database Name	Agency	Search Radius [1] (miles)	Sites Listed
National Priority List (NPL)	EPA	1.00	0
Sites currently or formerly under review by EPA (Comprehensive Environmental Response, Compensation, and Liability Information System)	EPA	0.50	1
No Further Remedial Activities Planned	EPA	0.125	0
Resource Conservation and Recovery Act (RCRA) Treatment, Storage, and Disposal (TSD) Facilities	EPA	0.50	0
RCRA Corrective Action with out TSD	EPA	1.00	0
RCRA Generators List	EPA	0.25	0
Emergency Response Notification System List	EPA	0.12	2
State Sites	NDEP	1.00	8
Permitted as solid waste landfills, incinerators, or transfer stations	NDEP	0.50	0
Registered Underground Storage Tanks (UST) and Aboveground Storage Tanks (AST) Lists	NDEP	0.25	1
Leaking UST Lists	NDEP	0.50	1

Note:

[1] Search radius along the proposed alignment was 1 mile from the centerline on both sides of the alignment.

A description of each site is presented in Section 5.0 of the *Phase I Environmental Site Assessment*. Three sites were identified as having recognizable environmental conditions (RECs) and are described in Section 3.5.3. All other sites were considered to have a low likelihood of presenting an environmental concern to the proposed project.

3.5.2 Site Reconnaissance

A site reconnaissance was conducted 1 mile (2 km) on either side of the alignment centerline on March 24, 2004. No stored hazardous substances or petroleum products; unidentified containers; or evidence of ASTs, USTs, and chemical releases (e.g., odors, stressed vegetation, stains, leaks, pools of liquids, and spills) were observed during the site reconnaissance. No pole- or pad-mounted transformers that may contain polychlorinated biphenyls (PCBs) were observed

during the site investigation along the proposed alignment. No evidence of pits, sumps, or drywells were observed during the site investigation.

Visible evidence of prior agriculture or landscaping activity that may indicate historic use of pesticides or herbicides within the project area was not present. There were numerous piles of waste rock and miscellaneous household debris in the vicinity. Solid waste observed in the proposed project area included construction waste, automobile parts, and domestic debris, but not to the extent of being an environmental concern.

3.5.3 Recognizable Environmental Conditions

The conclusion of the *Phase I Hazardous Materials Environmental Site Assessment* states that there was no evidence of hazardous materials or past spills in the proposed project area. However, the following RECs were noted:

- Portions of the SRMT3 would pass through the Three Kids Mine Site, an area with known metal (e.g., manganese, lead, and arsenic) and petroleum contamination from historical mining operations. The facility, located in the River Mountains west of Lake Mead and south of Lake Mead Parkway, mined manganese from 1917 to 1961. Part of the mining process entailed using diesel fuel flotation tanks. The waste liquid from the flotation tanks was pumped to evaporation ponds. Site investigation activities have occurred at the site, but no remedial actions have been performed. Groundwater does not appear to have been impacted.
- The Henderson Landfill has known metal contamination as a result of its use as a landfill. The facility located west of Calico Hills and north of Lake Mead Parkway, was operated as a municipal landfill until 1975. Site investigation activities are currently ongoing. Land use in the area is deed-restricted, with no residential development or water supply well construction allowed. Portions of the South Lateral Pipeline would be located near the facility.
- A known perchlorate groundwater plume, originating from the BMI Complex located to the southwest of the EI, COH Forcemain, and South Lateral Pipeline, exists in the project area. The plume migrated off the BMI site in a northeasterly direction and enters the Las Vegas Wash in the vicinity of the Pabco Road ECS. The source of the perchlorate has been traced to Kerr McGee Chemical Corporation and American Pacific Corporation facilities located in Clark County, Nevada. A groundwater interception system, overseen by NDEP, has been installed to intercept and treat the contaminated groundwater. Treated groundwater is returned to the Las Vegas Wash.

Portions of the COH Forcemain, South Lateral Pipeline, and EI pipeline alignment near the EI Terminus would be located in areas of known perchlorate groundwater contamination. Based on data received from SNWA, concentrations of perchlorate in the area of the Pabco ECS on the Las Vegas Wash range from 4.8 to 83.2 ppb, and perchlorate concentrations in the Las Vegas Wash near the EI Terminus range from 190 to 200 ppb. Concentrations of perchlorate in the groundwater obtained from soil borings located west of the EI Terminus on the south bank of the Las Vegas Wash ranged from 2,600 to 3,900 ppb (Ninyo and Moore 2004).

3.6 Noise and Vibration

Noise is defined as any unwanted sound that interferes with normal activities or otherwise diminishes the quality of the environment. It may be intermittent or continuous, steady or impulsive, stationary, or transient. The region of influence for noise includes those areas associated with construction and maintenance of the proposed project and those areas (e.g., neighborhoods, parks, wildlife) that could be adversely impacted from exposure to related activities.

The physical characteristics of noise, or sound, include its intensity, frequency, and duration. Various "weighting" factors are applied to noise measurements to produce measured values that correspond to human response because noise events have a range of characteristics, and the human ear does not respond to sounds of varying frequency and intensity in a linear fashion. The commonly used weighting scales are the "A" and "C" scales.

The normal human ear can usually detect sounds that range in frequency from about 20 hertz (Hz) to 20,000 Hz. However, all sounds throughout this range are not heard equally well. Therefore, some sound meters are calibrated to emphasize frequencies in the 1,000- to 4,000-Hz range. The human ear is most sensitive to these frequencies, and sounds measured with these instruments are termed "A-weighted." The A-weighted scale emphasizes sounds in the middle frequencies and de-emphasizes sounds in the low and high frequencies. The "A-weighted" scale is normally used to describe noise from transportation and other human activities. The "C-weighted" scale is normally used to describe large amplitude, impulsive sounds such as explosions and weapons noise. Values of A-weighted and C-weighted noise are described in terms of A-weighted decibels (dBA) and C-weighted decibels (dBC), respectively. Table 3.6-1 provides a range of noise conditions.

Noise conditions in the vicinity of the proposed project area are generated by residential activities, outdoor recreational activities, aircraft, vehicle traffic, and construction-related disturbances. Ambient noise conditions were not measured along the alignment for this proposed project. However, a noise assessment for the EI construction was conducted in November 2003 and is provided in Appendix F. Estimated noise emissions associated with construction of the proposed EI portion of the alignment were used to determine potential impacts to nearby residential and public-use areas.

3.6.1 Applicable Regulations and Policies

The project area is located in the cities of Las Vegas and Henderson in Clark County, Nevada, and is subject to local regulations regarding noise emissions. The CLV noise regulations are in *Title 9, Health and Safety*, of the municipal code (CLV Municipal Code Title 9). The COH noise regulations are in *Title 8, Public Peace and Safety*, of the municipal code (COH Municipal Code Title 8). The COH noise ordinance requires that no noise disturbance, due to alteration or repair of building or streets, occur in residential areas between the hours of 6 p.m. and 6 a.m. except in case of urgent necessity (COH 1988, 1989). Excessive noise that unreasonably interferes with the workings or sessions of nearby schools, hospitals, churches, or other sensitive receptors are considered violations. Likewise, a noise disturbance across residential boundaries from loading

Table 3.6-1 Typical Sound Pressure Levels Associated with Common Noise Sources.

Sound Pressure Level (dBA)	Subjective Evaluation	Outdoor Environment	Indoor Environment
140	Deafening	Jet aircraft at 75 ft	
130	Threshold of pain	Jet aircraft during takeoff at a distance of 300 ft	
120	Threshold of feeling	Elevated train	Hard rock band
110		Jet flyover at 1,000 ft	Inside propeller plane
100	Very loud	Power mower, motorcycle at 25 ft, auto horn at 10 ft, crowd noise at football game	
90		Propeller plane flyover at 1,000 ft, noisy urban street	Full symphony or band, food blender, noisy factory
80	Moderately loud	Diesel truck (40 miles per hour) or heavy construction equipment at 50 ft	Inside auto at high speed, garbage disposal, dishwasher
70	Loud	B-757 cabin during flight	Close conversation, vacuum cleaner, electric typewriter
60	Moderate	Air-conditioner condenser at 15 ft, near highway traffic	General office
50	Quiet		Private office
40		Farm field with light breeze, birdcalls	Soft stereo music in residence
30	Very quiet	Quiet residential neighborhood	Bedroom, average residence (without T.V. and stereo)
20		Rustling leaves	Quiet theater, whisper
10	Just audible		Human breathing
0	Threshold of hearing		

Source: Black & Veatch 2003.

and unloading building materials or similar objects between the hours of 11 p.m. and 7 a.m. is a violation (COH 1989). No exemptions for construction activities are provided in the municipal code. The COH municipal code contains a vibration performance standard. The standard states that no operation shall produce vibration, which is perceptible without the use of instruments for more than 3 minutes during any 1-hour period between the hours of 7 a.m. and 10 p.m. or for more than 30 seconds during any 1-hour period between the hours of 10 p.m. and 7 a.m. (COH 1989).

Clark County noise regulations are included in the *Site Environmental Standards*, *Title 30 of the Clark County Unified Development Code* (Part 68.20). However, the requirements of the County noise code do not apply to construction or demolition activities when conducted during daytime

hours (generally, 6:00 am to 6:00 pm.). Table 3.6-2 shows the maximum permitted sound levels from the County noise code.

The NPS states that activities causing excessive or unnecessary unnatural sounds in or adjacent to the LMNRA would be monitored, and action would be taken to prevent or minimize unnatural sounds that adversely affect LMNRA resources, values, or visitors' enjoyment.

Sound-pressure levels produced by any noise source must comply with the values shown in Table 3.6-2. Enforcement of the noise ordinance is initiated upon receipt of public complaints. The County determines the severity of the violation using a subjective assessment. The magnitude of the violation is also dependent upon the number of complaints filed each day.

Table 3.6-2 Maximum Permitted Sound Levels in Clark County.

Octave Band Center Frequency, Hz	Within Residential Districts, dB		Within Business and Industrial Districts, dB	
	Daytime	Nighttime	Daytime	Nighttime
31.5	72	65	76	65
63	65	58	69	62
125	58	50	62	54
250	53	44	58	49
500	50	40	55	45
1000	47	37	52	42
2000	43	33	49	38
4000	40	30	46	35
8000	37	27	43	32

Source: Clark County 2003.

3.6.2 Sensitive Receptors

Residences, motels and hotels, schools, libraries, religious institutions, hospitals, nursing homes, auditoriums, parks, and outdoor recreation areas are generally more affected by noise than commercial and industrial areas.

Residential properties located along the proposed project are considered to be sensitive receptor sites. The habitats of listed threatened and endangered animals and fowl are to be considered sensitive receptor sites when located at or near construction activities. Sensitive receptor sites within the project area are discussed in the following subsections.

3.6.2.1 Parks

Parks within the vicinity of the proposed project include the Wetlands Park and the LMNRA. Portions of the EI alignment, COH Forcemain, and South Lateral Pipeline would be located within the Wetlands Park as shown on Figure 3.6-1. The environment of the Wetlands Park is generally quiet, characterized by open marshland and desert accessed by local or unpaved roads (Reclamation and Clark County Parks and Recreation 1998). However, ongoing construction of ECSs and bank stabilization within the Wetlands Park adds to background noise levels. Also, construction outside the Wetlands Park at golf course and residential developments (Tuscany Hills and Weston Hills), and overflights of commercial aircraft contribute to the existing noise conditions within the Wetlands Park.

The area on the west shore of Lake Mead's Boulder Basin is a major tourist area, and includes the Lake Mead Marina and Boulder Beach campground and lodges. Noises in the LMNRA include naturally occurring sounds, such as wind, birds calling, rocks falling, and waves on the Lake. Human-caused sounds at LMNRA include watercraft, automobiles, horns, trucks, aircraft, generators, and electronic devices such as music players. Noise levels emitted from PWC vary from vessel to vessel depending upon many factors. Literature states that recently manufactured watercraft emit fewer than 80 decibels at 50 ft (15 m) from the vessel; however, other sources claim levels as high as 102 decibels may be reached (NPS 2002). Additionally, residences and campgrounds located along Lakeshore Drive and Boulder Beach contribute to the abovementioned background noise levels at the LMNRA.

3.6.2.2 Residential Properties

Rose Garden Estates, South Valley Ranch, Calico Ridge, John Laing Homes, Tuscany Hills, Weston Hills, and Lake Las Vegas are residential developments in the vicinity of the EI as shown on Figure 3.6-1. Currently, the nearest residences are located approximately 4,000 ft (1,219 m) southwest of the transition point between Reach 1 and Reach 2 of the EI. Future development plans in the project area indicate residences to be located adjacent to tunnel shafts in Reach 1 and a 1,390-ft (424-m) portion of the Reach 1 alignment. Also, residences are planned adjacent to approximately 3,400 ft (1,036 m) of the proposed South Lateral Pipeline alignment.

Noise conditions at existing and planned residential areas near the proposed EI were not collected. However, it is assumed that background noise levels in these areas are typical of residential communities. Typical background levels for residential properties range from 31 to 35 dBA in very quiet rural areas to 56 to 60 dBA for very noisy urban residential communities (EPA 1971).

3.6.2.3 Other Sensitive Receptors

Other sensitive receptors to noise in the project area include wildlife species, which are discussed in Section 3.2. The study of animal responses to noise is a function of many variables including characteristics of the noise, duration of the noise, life history characteristics of the species, habitat type, season and current activity of the animal, sex, age, and previous exposure (Manci et al. 1988). Existing sources of noise that may affect wildlife in the proposed project

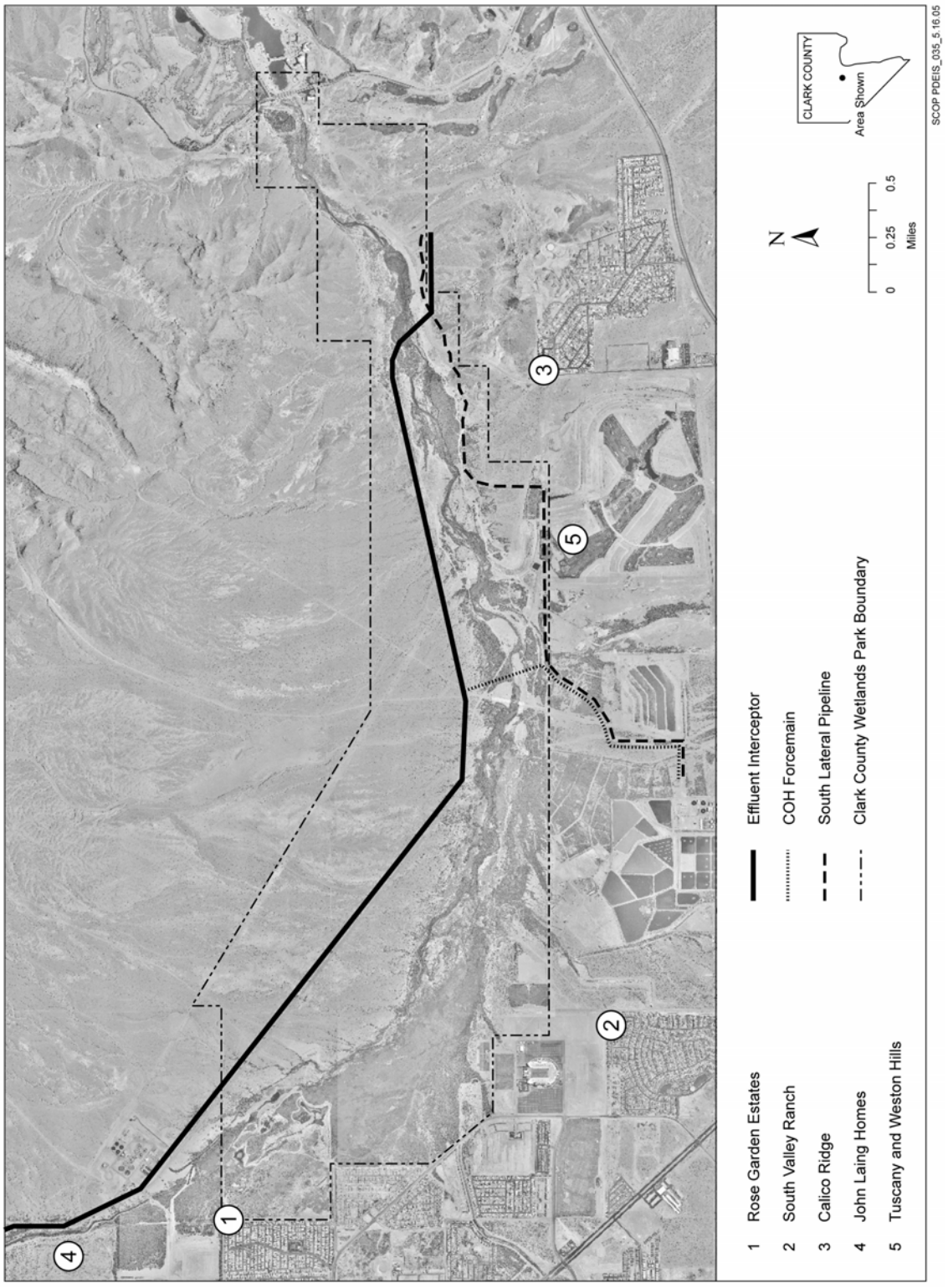


Figure 3.6-1 Sensitive Noise Receptor Locations.

area include recreational activities such as OHV use and motor craft within LMNRA, automobile traffic, heavy machinery, and construction equipment.

3.7 Air Quality

The project area is located in the southwestern desert region of Nevada and the northeastern portion of the Mojave Desert. Climate in the Mojave Desert is usually characterized by high temperatures and low precipitation throughout the year, with warm, dry winters, and hot summers, with occasional thunderstorms. Surface evaporation rates are extremely high, even in wet years. Temperatures and amounts of precipitation are dependent on elevation, with lower elevations generally experiencing the warmest temperatures and receiving the least rainfall. Temperatures vary significantly along elevation gradients and may decrease approximately 5.3°F (15°C) for every 1,000-ft (305-m) increase in elevation. Daily and seasonal temperatures can vary greatly. Daytime to nighttime temperatures may vary by 20º to 30°F (-7°C to -1°C) in the winter and 30° to 40°F (-1° to 4°C) in the summer. Maximum temperatures in the summer exceed 100°F (38°C) at the lower elevations. Minimum winter temperatures drop below freezing at the higher elevations.

The proposed project would be constructed in the most populous and developed airshed of Clark County, and consequently, in the region of Clark County with existing air quality concerns. For air quality purposes, Clark County has been divided into 13 different airsheds (Clark County Health District [CCHD] 1996), as shown in Figure 3.7-1. Airshed regions within the County are roughly based on hydrographic areas determined by the State Engineers' Office. The first two segments of the EI are located within the Las Vegas Valley airshed, which roughly encompasses all of hydrographic region 212. The EI Terminus and the LCS for the action alternatives traverse the Las Vegas Valley airshed and enter the Black Mountains Area airshed. The Las Vegas Valley airshed and Black Mountains Area airshed are shown on Figure 3.7-1 and designated as LV and BA, respectively.

3.7.1 Regulatory Background

The air quality of an airshed is classified by the concentrations of criteria pollutants (carbon monoxide [CO], nitrogen oxides [NO_x], sulfur dioxide [SO_2], lead [Pb], particulate matter [PM], and O_3 in the ambient air. Two different sizes of PM are regulated: PM_{10}, which denotes particulate matter with an aerodynamic diameter less than 10 microns, and $PM_{2.5}$, for particulate matter with an aerodynamic diameter less than 2.5 microns. The EPA has set acceptable concentrations of criteria pollutants in the ambient air (the outside air that we breathe), called the NAAQS. The NAAQS are concentrations of the pollutant in the ambient air presumed to be protective of human health and the environment. The NAAQS have been set for CO, NO_x, SO_2, PM_{10}, $PM_{2.5}$, Pb, and O_3. Of these pollutants, only O_3 is not emitted directly from sources, but is formed in the atmosphere by the reaction of nitrogen oxides and volatile organic compounds (VOCs) in the presence of sunlight.

The EPA established the NAAQS in order to specify acceptable pollutant concentrations that may be equaled continuously and, in the case of short-term standards, exceeded a specific number of

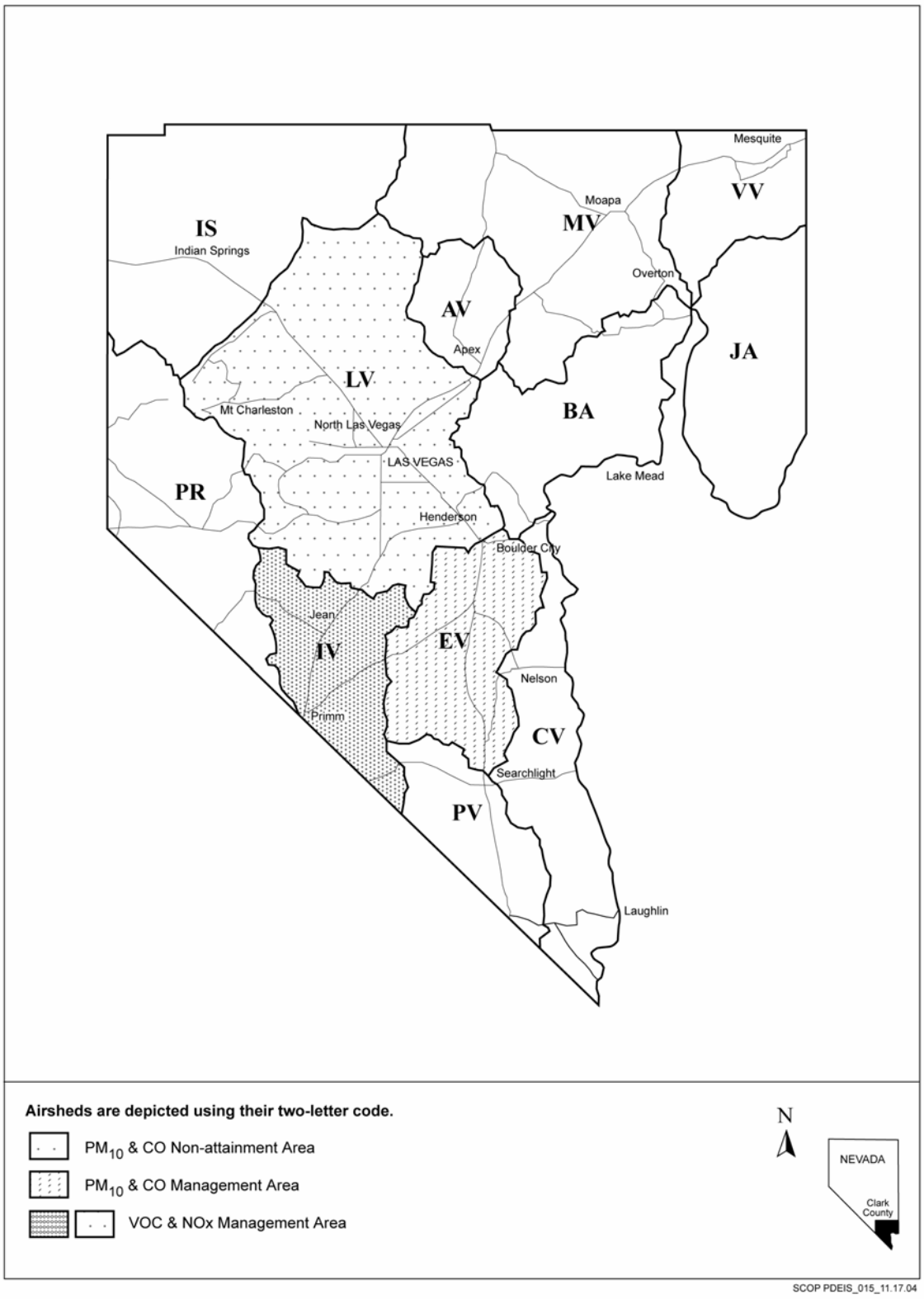


Figure 3.7-1 Clark County Airsheds.

times per year (EPA 2004a). Typically, each pollutant has two ambient air quality standards: the primary standard, which is protective of public health; and the secondary standard, which is protective of public welfare.

Public welfare includes quality of life issues such as visibility (clearness of air, visual distance), and damage to vegetation, crops, and buildings. The State of Nevada and the Clark County Department of Air Quality and Environmental Management (DAQEM) have established primary standards for ambient air quality (NDEP 2002, Clark County 2003a).

The CAA requires the classification of geographic areas based on their air quality. An area is classified as "attainment" for a pollutant if the concentration of the pollutant measured at official monitoring stations is equal to or below the NAAQS set for that pollutant. Areas that attain the NAAQS are subject to the Prevention of Significant Deterioration (PSD) program. The PSD program is designed to prevent the air quality in attainment areas from further degrading to the point where pollutant concentrations increase to levels close to the NAAQS. The PSD program defines two types of attainment areas.

A Class I designation is given to areas where only a minimal increase in air pollutant concentrations is allowed and is mandatory for international parks, and certain national wilderness areas, national parks, and national monuments, as specified in the CAA. A Class II designation is given to areas whose criteria pollutant concentrations are below the NAAQS, and can sustain a moderate increase in air pollutant concentrations without significant deterioration of air quality. The LMNRA is designated as a Class II air quality area under the CAA. However, park management laws and policies require the NPS to maintain the best possible air quality in order to “preserve natural resources and systems, preserve cultural resources; and sustain visitor enjoyment, human health, and scenic vistas” (NPS 2001a).

In a non-attainment area, the measured concentration of a pollutant has exceeded the NAAQS on one or more occasions. Once an area is classified as non-attainment for a pollutant, several steps must be implemented to bring the area back into attainment. One step is to develop a written plan for improving the air quality in that area. These plans are called SIPs. In the SIPs, states outline the steps that will be implemented to reduce the levels of the non-attainment pollutant and bring the non-attainment area back into attainment. A non-attainment classification also triggers the conformity regulations, which apply to federal projects and transportation projects in those areas.

The conformity regulations prohibit a federal agency from supporting a federal action that does not conform to a SIP. A federal action is any activity engaged in by a department, agency, or instrumentality of the federal government, or any activity that the federal government supports in any way, provides financial assistance for, licenses, permits, or takes approval action.

Clark County has one additional air quality classification. The term “management area” is given to certain airsheds in Clark County whose monitored pollutant concentrations are below the NAAQS. However, the difference between the NAAQS and the concentration of the monitored pollutant may not be large. New emission sources that locate in these areas may be required to reduce emissions and obtain emission offsets so that any area-wide increases in air pollutant concentrations do not result in or contribute to an exceedance of the NAAQS.

Some Nevada ambient air quality standards and Clark County air quality standards are more stringent than the NAAQS. Federal, state, and local ambient air quality standards are provided in Table 3.7-1.

Table 3.7-1 Local, State, and National Ambient Air Quality Standards.

Pollutant	Averaging Time	Clark County Standards	Nevada Standards	NAAQS Primary/ Secondary
O_3	8-hour	0.08 ppm	NA [1]	0.08 ppm
O_3 (Statewide except Lake Tahoe Basin)	1-hour	0.12 ppm	0.12 ppm	0.12 ppm/ 0.12 ppm
O_3 (Lake Tahoe Basin)	1-hour	--	0.10 ppm	0.12 ppm/ 0.012 ppm
NO_2	Annual Mean	0.053 ppm	0.053 ppm	0.053 ppm/ 0.053 ppm
CO (any elevation)	1-hour	35 ppm	35 ppm	35 ppm/None
CO (elevation < 5,000 ft)	8-hour	9 ppm	9 ppm	9 ppm/None
CO (elevation > 5,000 ft)	8-hour	--	6 ppm	9 ppm/None
SO_2	3-hour	0.50 ppm	0.50 ppm	None/0.5 ppm
SO_2	24-hour	0.10 ppm	0.14 ppm	0.14 ppm/None
SO_2	Annual Mean	0.03 ppm	0.03 ppm	0.03 ppm/None
PM_{10}	24-hour	150 µg/m ^{3}	150 µg/m ^{3}	150/150 µg/m ^{3}
PM_{10}	Annual Mean	50 µg/m ^{3}	50 µg/m ^{3}	50/50 µg/m ^{3}
$PM_{2.5}$	24-hour [1]	65 µg/m ^{3}	NA	65/65 µg/m ^{3}
$PM_{2.5}$	Annual Mean [1]	15 µg/m ^{3}	NA	15/15 µg/m ^{3}
Lead	Calendar Quarter	1.5 µg/m ^{3}	1.5 µg/m ^{3}	1.5 µg/m ^{3}
Hydrogen Sulfide	1-hour	--	112 µg/m ^{3}	None
Visibility	Observation	--	In sufficient amount to reduce the prevailing visibility to less than 30 miles when humidity is less than 70%	None

Note:

[1] NA = not available.

Sources: EPA 2004a, NDEP 2002, Clark County 2003a.

Portions of the project would traverse the LMNRA, which is managed by the NPS. The NPS is charged with protecting elements of a park environment that are sensitive to air pollution. These elements are called air quality related values (AQRVs) and consist of visibility, water quality, wildlife, historic structures and objects, cultural landscapes, and vegetation. The AQRVs can be adversely impacted at pollutant levels that are lower than the NAAQS, or by pollutants for which no federal, state, or local standard exists.

3.7.2 Existing Air Quality Conditions

Construction of this project would occur in two different airsheds, the Las Vegas Valley airshed and the Black Mountains Area airshed. The existing air quality in the Las Vegas Valley airshed does not meet air quality standards set for PM_{10}, CO, or O_3 (EPA 2004a). Further, the CCHD has designated the region as a management area for NO_x and VOCs, pollutants that are precursors to O_3 formation (CCHD 1996). The region is designated as in attainment for SO_2 and Pb (EPA 2004a). The EPA is expected to assign a classification with respect to $PM_{2.5}$ in 2005. Based on available monitoring information, the Las Vegas Valley airshed is likely to be designated as an attainment area for $PM_{2.5}$. The Black Mountains Area airshed and LMNRA are classified as attainment/unclassified for all criteria pollutants (EPA 2004a). There are no air-quality monitoring stations located in the Black Mountains Area airshed or the LMNRA. The majority of the land in the Black Mountains Area airshed is under control of the federal government.

The past 5 years of data from air quality monitoring stations located within a 25-mile (40-km) radius of the proposed project were used to characterize the background air quality (EPA 2004b, Clark County 2004b). The air quality is good, with concentrations of SO_2, NO_2, $PM_{2.5}$, and O_3 measured within this radius generally falling well below the NAAQS, Nevada standards, and Clark County standards. Recent monitoring data from one monitoring station located in the Valley indicates that the 8-hour O_3 standard was exceeded. As a result, the Valley has been classified as "basic non-attainment" for the ozone 8-hour standard.

The last exceedance of the 8-hour CO standard occurred in 1998 at the East Charleston monitoring station. The 24-hour CO concentrations measured at all of the monitoring stations are well below the NAAQS, Nevada standards, and Clark County standards. The CO SIP states that air pollution collects at lower elevations, under certain weather patterns, due to topography of the Valley. The East Charleston station is located at one of the lowest elevations in Clark County. Since 1998, the CO standard has not been exceeded at any of the air quality monitors within a 25-mile (40-km) radius of the project.

Two criteria must be satisfied to be in attainment with the PM_{10} ambient air quality standard – the 24-hour average concentration and the annual arithmetic mean. The PM_{10} concentrations exceeded the 24-hour federal, state, and local standards in 5 out of the past 5 years of available data. The highest concentrations occurred when wind speeds exceeded 25 miles per hour (mph) (40 km per hour). The annual arithmetic mean for PM_{10} was below the NAAQS at all monitoring stations within a 25-mile (40-km) radius of the project during calendar years 1999, 2000, 2001, and 2003. During calendar year 2002, the annual arithmetic mean PM_{10} at one monitoring station exceeded the standard.

These exceedances, as well as other exceedances of the PM_{10} standard in Clark County, have all occurred within an area known as the BLM land disposal area. The BLM land disposal area is the name given to that area of Clark County where growth and development may occur and the lands are eligible for public auction. The *Southern Nevada Public Land Management Act of 1998* established a boundary between public lands that could be developed from those that would remain in their native state (Figure 3.7-2) (PL 105-263). Portions of the EI and LCS would be located in both the BLM land disposal area and on public lands that cannot be developed.

The land-use surrounding the proposed pipeline routes varies from undisturbed, vacant land, to recently constructed housing developments. The BLM land disposal area is classified as non-attainment for PM_{10} and O_3. The public land areas are classified as attainment for all pollutants.

The PM_{10} SIP was prepared to address how the Valley will attain compliance with the PM_{10} standard. The significant sources of PM emissions identified in the SIP are wind-blown dust, re-entrained road dust, and construction activities (Clark County 2001). Wind-blown dust is difficult to control or reduce because of the lack of protective vegetation in this arid region. The emissions inventory prepared to support the SIP estimated that nearly 40 percent of the PM_{10} emissions in the non-attainment area were due to emissions from disturbed vacant lands. However, in the Valley, over 60 percent of the PM_{10} emissions are estimated to arise from construction and road dust emissions. The EPA approved the PM_{10} SIP for the Valley on May 3, 2004.

3.8 Earth Resources

The topography, geology, and soil conditions in the vicinity of the EI alignment and LCS are discussed in this section. Additional detailed geotechnical information is presented in the *Effluent Interceptor Preliminary Design Report* (Black & Veatch 2004a) and the *Draft Lake Conveyance System Conceptual Engineering Report* (Black & Veatch 2004d).

3.8.1 Topography

The project area is located within the physiographic feature known as the Las Vegas Valley, which is located in the southern part of the Basin and Range Physiographic Province. Linear valleys and mountains with a northwest trend characterize this Valley. The Valley is bordered on the north by the Las Vegas Range, on the east by the Frenchman, Sunrise, and River mountains, on the west by the Spring Mountains, and on the southeast by the McCullough Range (Figure 3.1-1). The River Mountains and the Rainbow Gardens area of Frenchman Mountain separate the Valley from Lake Mead to the east. Topography in the area is the result of repeated episodes of deposition, uplift, igneous activity, and erosion (Bedinger et al. 1989).

The existing topography along most of the proposed EI alignment generally slopes from the northwest to the southeast at an average gradient of less than 1 percent (Converse Consultants 2002). Ground-surface elevations along the alignment range from about 1,690 ft (515 m) above msl at Desert Inn Road to about 1,490 ft (454 m) above msl near the EI Terminus. The topography in the vicinity of Reach 3 includes moderate slopes.

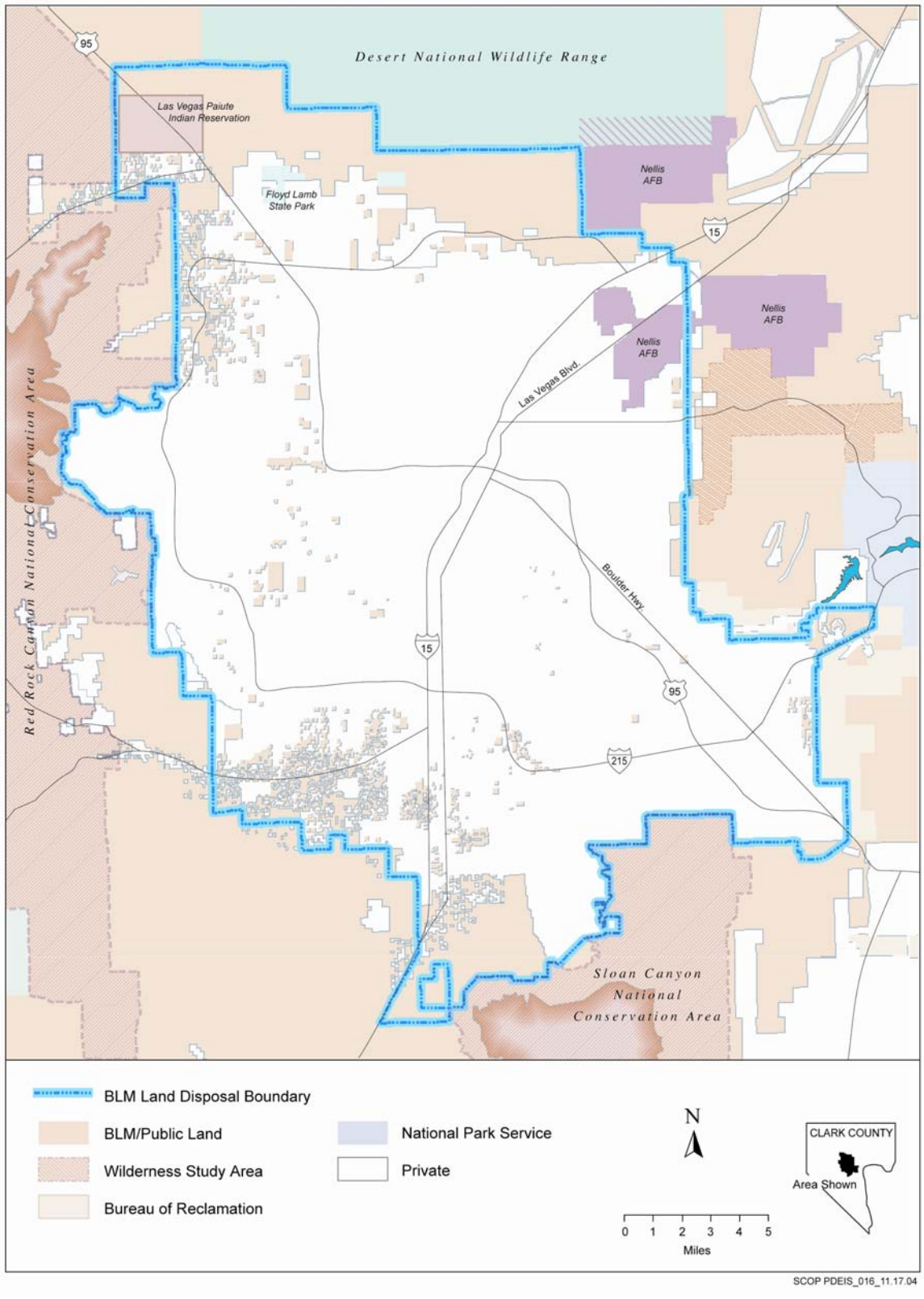


Figure 3.7-2 BLM Land Disposal Boundary.

The existing topography along the proposed LCS alignments is generally characterized by gentle slopes with an average gradient of less than one percent.

The principle drainage channel in the Valley is the Las Vegas Wash. It drains from north to south near the eastern edge of the valley floor and continues southeast out of the basin to Lake Mead. Several major natural drainage channels that are tributaries to the Las Vegas Wash dissect the Valley and have locally eroded channels up to 30-ft (9-m) deep (Reclamation and Clark County Parks and Recreation 1998).

3.8.2 Geology

The Valley is a structural basin that contains Miocene to Recent unconsolidated sediments overlying bedrock of Paleozoic age. The Valley is bounded by several mountain ranges that have developed through offset of faults present in the region. The mountain ranges expose rocks from Precambrian to Tertiary age. Precambrian gneiss crops out at the base of Frenchman Mountain to the east of Las Vegas, and on Saddle Island in Lake Mead. Thick sequences of Paleozoic, Mesozoic, and Tertiary sedimentary rocks overlie the Precambrian gneiss higher on Frenchman Mountain. Tertiary volcanics overlie the Saddle Island Precambrian rocks.

Structurally, the Frenchman Mountain-Rainbow Gardens area is tilted eastward and is separated from the Valley by a major northwest-trending lateral shear zone. Right-lateral movement along this zone ceased during the late Cenozoic era, but was followed by normal faulting with the downthrown block to the west (Converse Consultants 2002). The southeast end of the zone near the Las Vegas Wash appears to spread into several strands. There is no clear evidence that this zone extends across the Las Vegas Wash toward the River Mountains to the south. Nevertheless, numerous northwest-trending faults traverse the River Mountains to the south. In addition, some evidence indicates that a fault zone may parallel the Las Vegas Wash (Bell and Smith 1980).

3.8.2.1 Stratigraphy

Bedrock and Valley-fill sediments are the two main geologic units that characterize the proposed EI project area. The mountain ranges to the west, east, and north consist primarily of Paleozoic and Mesozoic sedimentary rocks including sandstone, limestone, siltstone, and conglomerates. The mountain ranges to the south and southeast consist primarily of Tertiary volcanic rocks including basalts, andesites, rhyolites, and associated intrusive rocks that overlie Precambrian metamorphic and granitic rocks. The Valley-fill sediments predominantly consist of Miocene to Holocene age fine to coarse grained deposits (Longwell et al. 1965).

The western portion of the EI project area has underlying Quaternary deposits while the eastern portion is underlain by Tertiary sedimentary rocks. Miocene basin deposits including the Thumb, Horse Spring, and Muddy Creek formations occur on the lower slopes of the north, south, and east sides of Frenchman Mountain and at the base of the River Mountains (Longwell et al. 1965). The Thumb and Horse Spring formations occur under the Valley and are comprised of siltstone, sandstone, conglomerate, freshwater limestone, gypsum beds, and lava flows. The Miocene and Pliocene Muddy Creek Formation and overlying younger deposits are generally thought to comprise the Valley-fill sediments.

The Muddy Creek Formation is overlain by up to 1,000 ft (305 m) of Tertiary and Quaternary basin fill deposits in the Valley. These fill deposits of gravel, sand, silt, clay, and conglomerates contain abundant carbonate clasts, and consist of coarse-grained deposits, fine-grained deposits, and thin interbedded coarse- and fine-grained deposits. Coarse-grained deposits generally occur on alluvial fans and pediments near the Valley margins and along the Las Vegas Wash (Longwell et al. 1965).

3.8.2.2 Faults and Seismicity

The current level of seismicity in southern Nevada is relatively low compared to more active parts of the Basin and Range Province (Rogers et al. 1991, Harmsen 1991). There have been no major earthquakes (greater than 6.0 magnitude) in the vicinity of Las Vegas since at least 1852. The record of seismicity in southern Nevada is dominated by small earthquakes (less than 4.0 magnitude) that generally occur in two areas: in the vicinity of the Nevada Test Site, which suggests the seismographs were recording nuclear explosions; and in the Lake Mead area, which may be related to strain release in the crust after the Lake was filled (Rogers et al. 1991, Rogers and Lee 1976).

Active faults in the Basin and Range physiographic province are categorized as follows:

- Holocene Active Fault, a fault that has moved within the last 10,000 years;
- Late Quaternary Active Fault, a fault that has moved within the last 130,000 years; and
- Quaternary Active Fault, a fault that has moved within the last 1,600,000 years (Nevada Earthquake Safety Council 1998).

The proposed EI alignment crosses several Late Quaternary Active Faults (Figure 3.8-1). A large fault zone (Sunrise-Frenchman-River Mountain) is located on the west side of the Frenchman Mountain in the Rainbow Gardens area (Longwell, et al. 1965, Bell and Smith 1980). This fault zone begins to split and form splays (divergent smaller faults) as it nears the Las Vegas Wash (Converse Consultants 2002). One such southeast trending splay was observed near the Las Vegas Wash crossing (Converse Consultants 2002). A second fault (Las Vegas Wash Fault) runs east/west perpendicular to the Sunrise-Frenchman-River Mountain Fault near the south bank of the Las Vegas Wash. The Las Vegas Shear Zone Fault is a strike slip fault located parallel to and west of the Sunrise-Frenchman-River Mountain Fault (Bell and Smith 1980). A strike slip fault is a type of fault that moves parallel to the alignment of the fault surface and the fault blocks move sideways or past each other. The Cashman-Whitney Mesa Fault is located parallel to the proposed EI alignment along Hollywood Boulevard.

Figure 3.8-2 shows the faults in the vicinity of the LCS portion of the project area. A major fault zone (Lake Mead Fault Zone) runs in a northeast/southwest direction in the Boulder Basin (Black & Veatch 2004a). Other smaller unnamed faults are located along the west side of the Boulder Basin (USGS 1978).

The project site is located within Seismic Zone 2B as defined in the *Uniform Building Code* (International Conference of Building Officials 1997). Zone 2B represents a low to moderately active seismic area and is defined as an area with moderate damage potential. The potential for

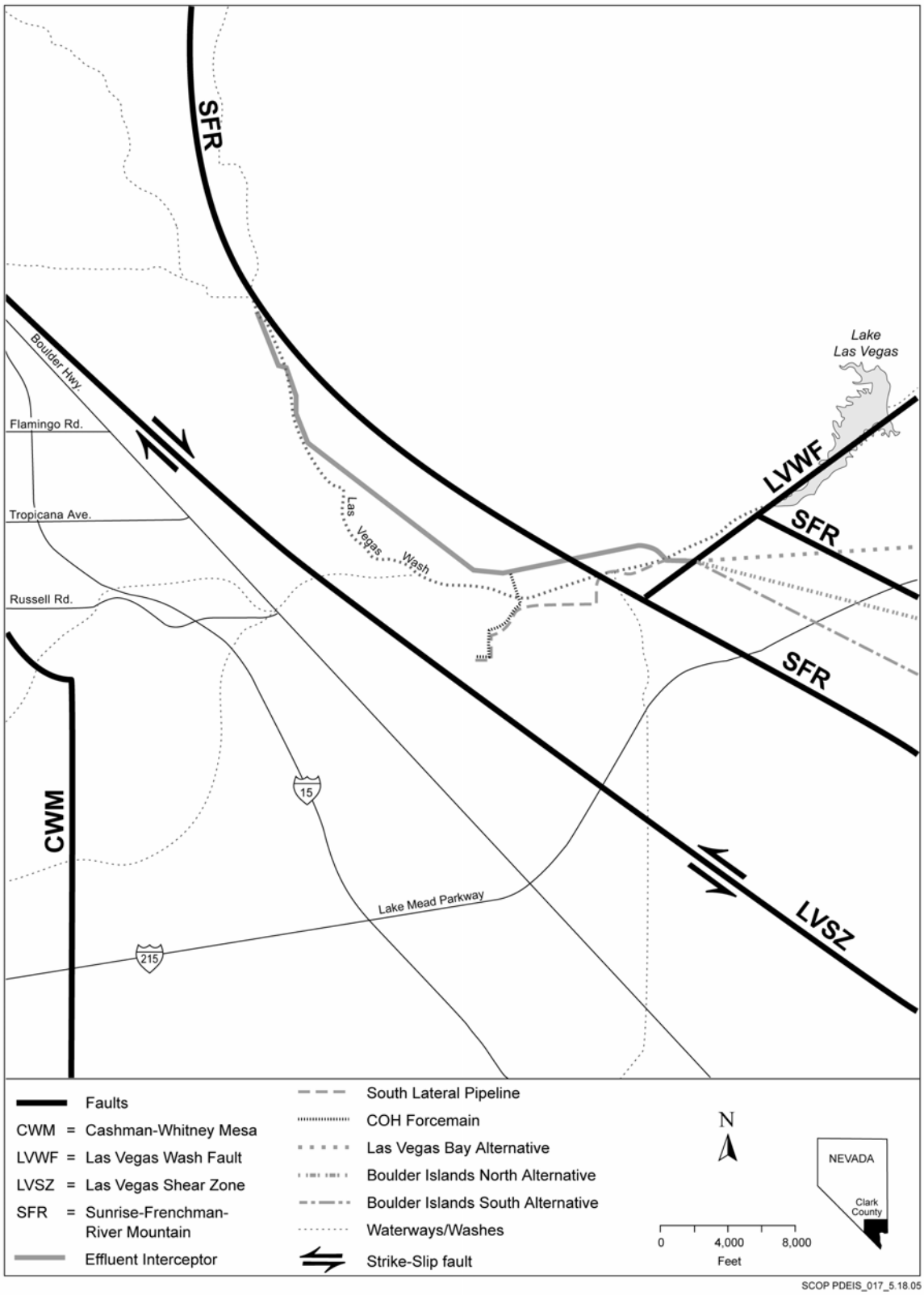


Figure 3.8-1 Faults in the Vicinity of the Effluent Interceptor.

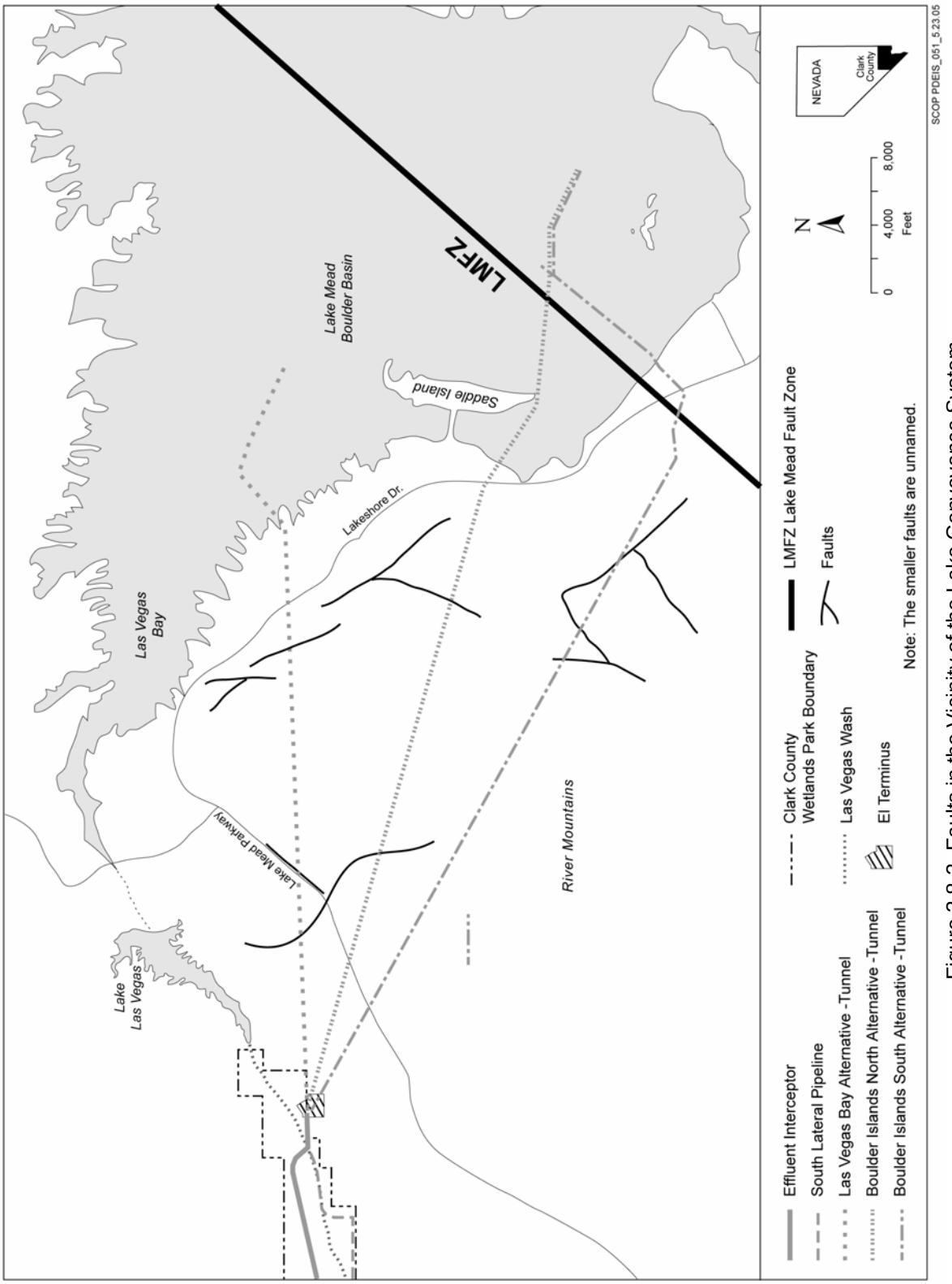


Figure 3.8-2 Faults in the Vicinity of the Lake Conveyance System.

damage from seismic activity becomes more severe in Zones 3 and 4. Current design practices require all proposed facilities in southern Nevada to be built to Seismic Zone 4 standards.

3.8.2.3 Minerals

Potential mineral resources within the Valley include sand, gravel, gypsum, copper, gas/oil, and manganese. The primary mineral resources along the EI alignment are sand and gravel. These materials are used as construction and building materials in southern Nevada and southern California. There are two gravel pits within the Wetlands Park boundary (Reclamation et al. 1998). A small pit is located on the east side of the Las Vegas Wash across from the eastern extension of Flamingo Road. A second, larger gravel pit is located east of the Henderson rapid infiltration basins.

Gypsum deposits are abundant in the Valley, and several have been mined. However, no gypsum deposits are currently being mined in the project area.

The project area is classified by the BLM (1998) as having a moderate potential for development of oil and gas. Numerous oil and gas wells were drilled in the Valley, but none have become producers and most wells are now abandoned (Longwell et al. 1965, Garside et al. 1988). There are no active leases on federal lands in the project area listed in the DOI's land status database.

Southern Nevada contains no known favorable locations for development of geothermal energy (BLM 1998). A water temperature of 145°F (63°C) (the hottest water in Clark County) occurs at Black Canyon Springs near Hoover Dam. Commercial development requires temperatures of at least 194°F (90°C). Higher temperatures of not less than 350°F (177°C) are needed for direct application uses (such as power generation). The low temperatures of waters in southern Nevada preclude their use as a geothermal energy source, except for small-scale uses (BLM 1998).

Within the project area there are no active mining claims filed under the Mining Act of 1872 listed in the DOI's land status database.

3.8.3 Subsidence

Land subsidence is caused by the compaction of aquifer systems that are subject to overdraft conditions. Overdraft occurs when more water is pumped from an aquifer than is recharged. Subsidence results when the water-bearing layers no longer contain groundwater and compress downward, resulting in a lowered ground level elevation at the area subsidence has occurred. Subsidence has occurred to a degree at various locations in the Valley as groundwater overdraft has occurred (Amelung et al. 1999).

Subsidence has been limited in the project vicinity because of its location at the lower end of the regional drainage basin. Groundwater levels are relatively high in this area.

3.8.4 Soils

The U.S. Department of Agriculture Soil Conservation Service (1985) has mapped the soils in the EI project area but not in the LCS project area. Quaternary deposits in the area consist of poorly sorted, unconsolidated to cemented gravel and sandy gravel on alluvial fans, and fine sand along the Las Vegas Wash. Sand along the Las Vegas Wash is less than 10-ft (3-m) thick, and coarse-grained deposits on alluvial fans and pediments are generally less than 30-ft (9-m) thick. The Muddy Creek Formation includes clayey silt and silty clay; interbedded gravel, sand, silt, and clay; fanglomerates; and fine sandstone, siltstone, and clay (Longwell et al. 1965). Most of the soils in the project area can be generally described as having a permeability ranging from moderately slow to moderately rapid, low to moderate shrink-swell potential, a slight to moderate potential for water erosion, and a moderate to high potential for wind erosion.

3.9 Land Use

This section details land ownership, existing land-use, land use plans, and planned land-use within the proposed project area and vicinity. The project area for land-use includes the land traversed by the proposed alignment alternatives and the lands adjacent to the proposed alignments (Figure 1.1-2).

Land use in the project area was analyzed using data and information from field surveys, planning documents, and communication with relevant planning departments. Information considered includes land ownership, existing land use, land use plans, and mining claims. There are no prime or unique farmlands within the project area.

3.9.1 Land Ownership

The proposed pipeline alignments would traverse lands owned by Reclamation, BLM, NPS, Clark County, CLV, COH, and private entities (Figure 1.1-2). Portions of the EI alignment would be located within the Wetlands Park boundary. Clark County Parks and Community Services own some of the land within the Wetlands Park and leases a portion of the land from Reclamation. The CLV WPCF is located on land owned by the CLV. The CCWRD CP and AWT are located on lands owned by Clark County and lands patented under the Recreation and Public Purposes Act from the BLM. The COH WRF is located on land owned by the COH.

The majority of the proposed LCS alignments are located within the LMNRA, which is managed by the NPS. The western portion of the LCS traverses land managed by Reclamation, BLM, and land owned by the COH and private entities (Figure 1.1-2).

3.9.2 Existing Land Use

The information about existing land use is separated into two subsections, the EI and the LCS.

3.9.2.1 Effluent Interceptor and Ancillary Facilities

No commercial or agriculture land uses currently exist in the vicinity of the proposed EI alignment. A portion of the EI alignment traverses the 2,900-acre (1,174-hectare) Wetlands Park. Existing land uses within the Wetlands Park include undeveloped land and recreation. The Wetlands Park currently has a 130-acre (52-hectare) Nature Preserve, a Visitor and Education Center, and pedestrian and equestrian trail systems.

Residential communities in the vicinity of the EI alignment include Rose Garden Estates, South Valley Ranch, Calico Ridge, John Laing Homes, Tuscany Hills, Weston Hills, and Lake Las Vegas. The location of these residential communities is shown on Figure 3.6-1.

Public facilities within the project area include the CLV WPCF, the CCWRD CP and AWT, and the COH WRF (Figure 1.1-2). The CLV WPCF is located at the north end of the EI alignment. The CCWRD CP and AWT is located to the east and west of the Las Vegas Wash near Flamingo Road and Hollywood Boulevard. The COH WRF is located to the south of the Wetlands Park.

Major road ROWs in the vicinity of the proposed EI alignment include Desert Inn Road, Flamingo Road, Vegas Valley Drive, Hollywood Boulevard, Pabco Road, Lake Mead Parkway, Lake Las Vegas Parkway, and Northshore Road (Figure 2.2-4). Additional information regarding roads is presented in Section 3.13.

Utilities within the proposed EI alignment area include drinking-water main and distribution lines, natural-gas distribution lines, electric-power distribution lines, and sewer lines (Figure 3.9-1).

Several flood control facilities exist along the Las Vegas Wash within the project area. The majority of these facilities are SNWA erosion control and bank protection structures, which are described further in Section 3.1.1.

There are no active mining claims along the EI alignment or within the EI Terminus site (Kennedy/Jenks et al. 2003).

3.9.2.2 Lake Conveyance System

The eastern segment of the LCS would be located on lands owned or managed by Reclamation or BLM. The majority of the LCS would be located within the LMNRA, which is managed by the NPS.

No industrial or agriculture land uses currently exist in the vicinity of the proposed LCS alignment. Existing land uses within the LCS project area include:

- Undeveloped land,
- Recreation,
- Tourist/Commercial,
- Public facility,

- Public ROW, and
- Utilities (Figure 3.9-1).

Recreational uses include, but are not limited to, water activities, hiking, camping, and auto touring. Tourist/commercial areas include concessions such as food service, general stores, and boat/auto fuel at the Lake Mead Marina and Las Vegas Bay Marina. Lodging is offered at the Lake Mead Resort and campgrounds at Las Vegas Bay and Boulder Beach. Recreational vehicle campgrounds with hook-ups, laundry, and showers are located at the Lakeshore Trailer Village. Section 3.4 discusses recreational areas in further detail.

Boulder Beach is open to motor vehicles from 6:00 a.m. to 10:00 p.m. from Memorial Day weekend through Labor Day weekend, and from 6:00 a.m. to dusk from Labor Day weekend to Memorial Day weekend. It is open to pedestrian use 24 hours a day.

Hoover Dam is located to the east and southeast of the LCS project area. The dam was constructed for the purposes of flood control, improvement of navigation and regulation of the Colorado River, storage and delivery of Colorado River waters for public use, and hydroelectric power production. Hoover Dam is a regional tourist attraction, which provides tours, a visitor center, educational presentations/exhibits, and concessions.

Public facilities in the vicinity of the LCS project area include the SNWA AMSWTF and the drinking-supply intake structures located at Saddle Island (Figure 3.9-2). Utilities within the project area include water distribution lines, natural-gas distribution lines, electric-power distribution lines, and sewer lines (Figure 3.9-2).

Major roads in the vicinity of the proposed LCS alignment include Lake Mead Parkway, Lake Las Vegas Parkway, Northshore Road, and Lakeshore Drive. Additional information regarding roads is presented in Section 3.13.

The proposed project area is in the Gold Butte or St. Thomas mining district. The BLM has declared that certain lands in this district are not available for appropriation under the Mining Law of 1872 (30 USC 22-24, 26-30, 29-30, 33-35, 37, 39-42, 47). Lands within the proposed project area are designated for mineral segregation (Figure 3.9-3) (Kennedy/Jenks Consultants et al. 2003).

The CCWRD AWT Plant is located on land that has recently been patented (Patent No 27-80-001) to Clark County. The BLM withheld mineral rights from that patent.

The Three Kids mining area consists of patented mining claims. According to the Nevada Division of Minerals, this property is not being actively mined, and the land is for sale (Lombardo 2004).

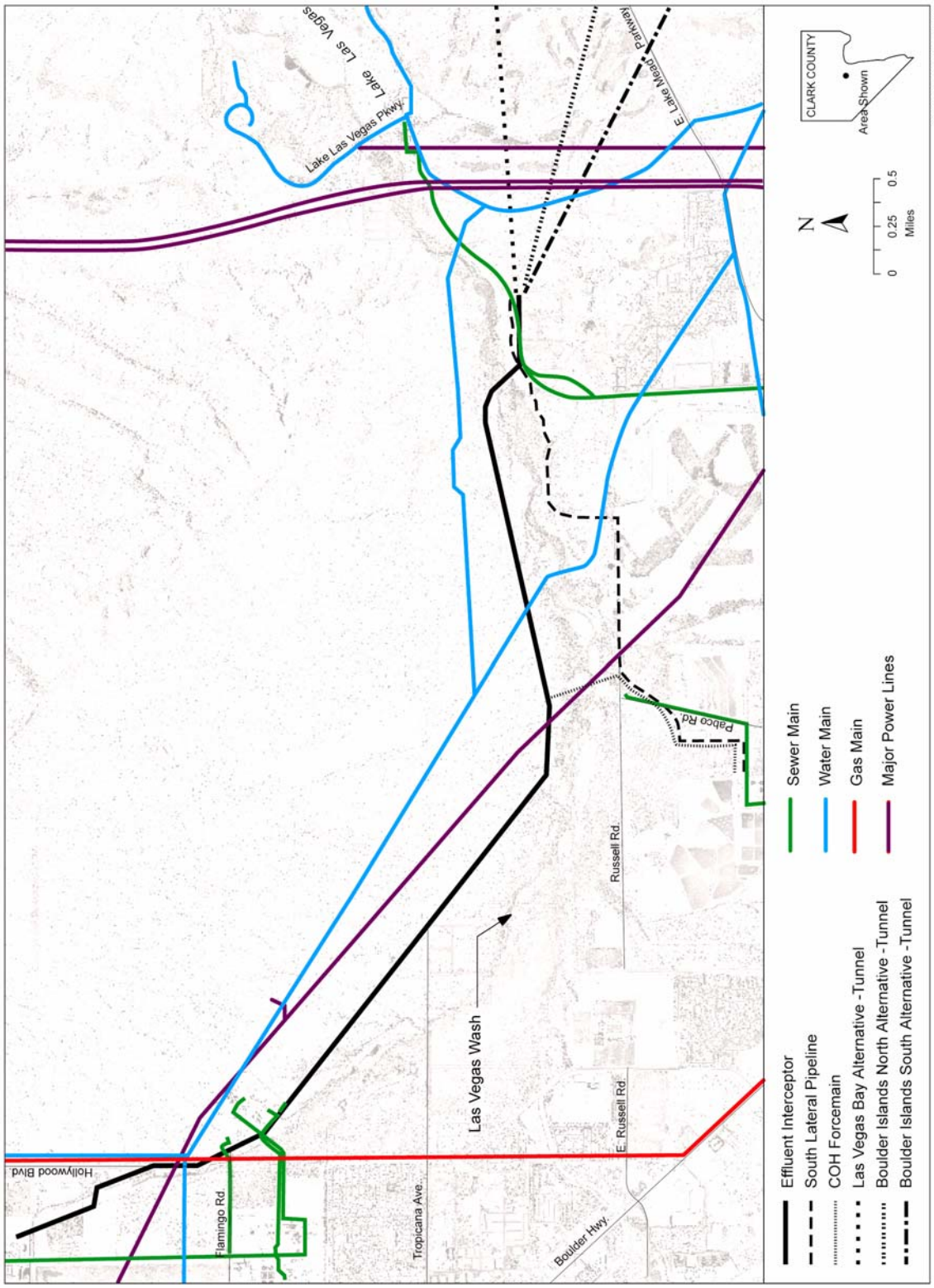


Figure 3.9-1 Effluent Interceptor, Utilities, and Rights-of-way.

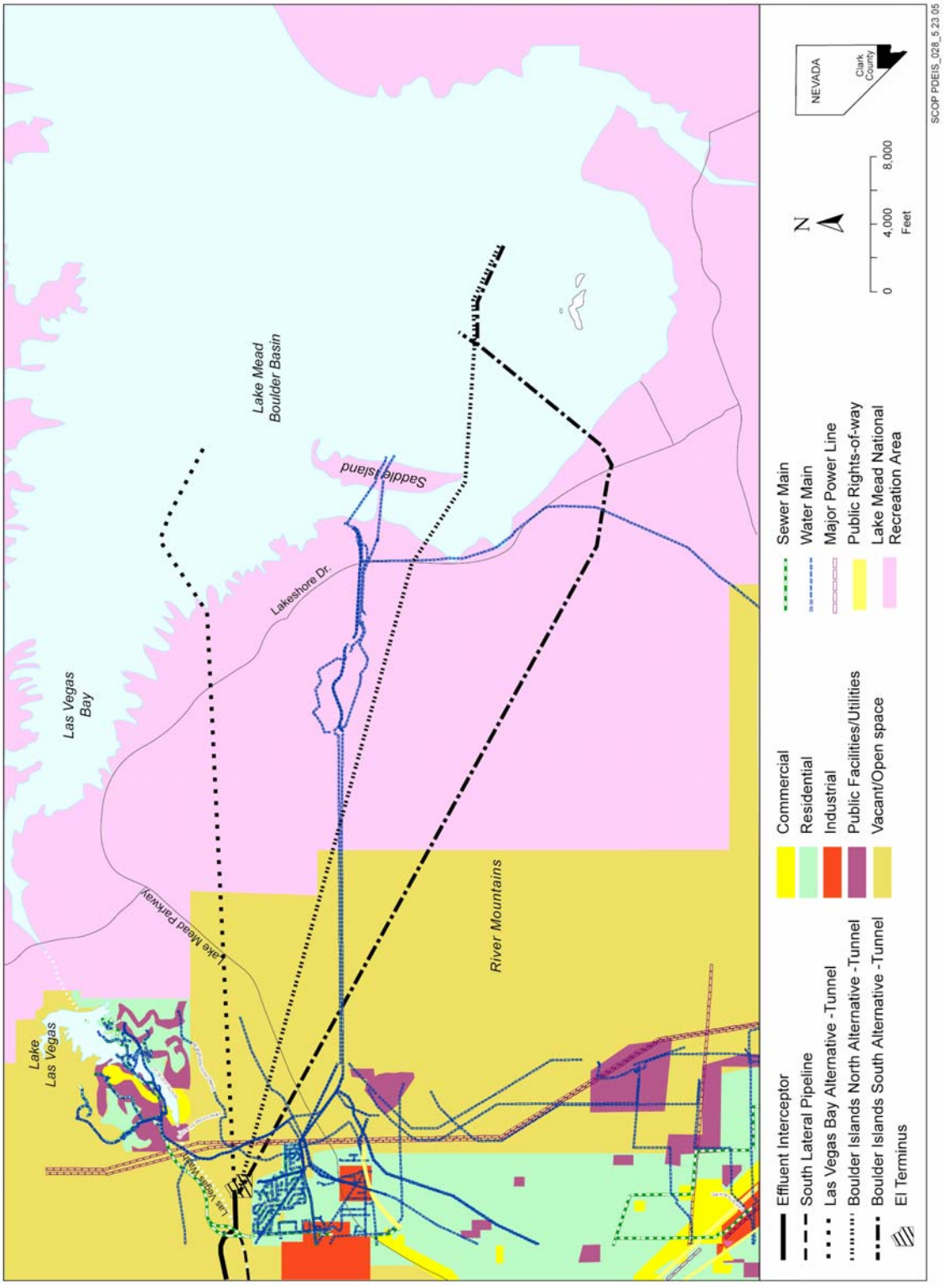


Figure 3.9-2 Existing Land Use, Utilities, and Rights-of-way in the vicinity of the Proposed Lake Conveyance System Alignments.

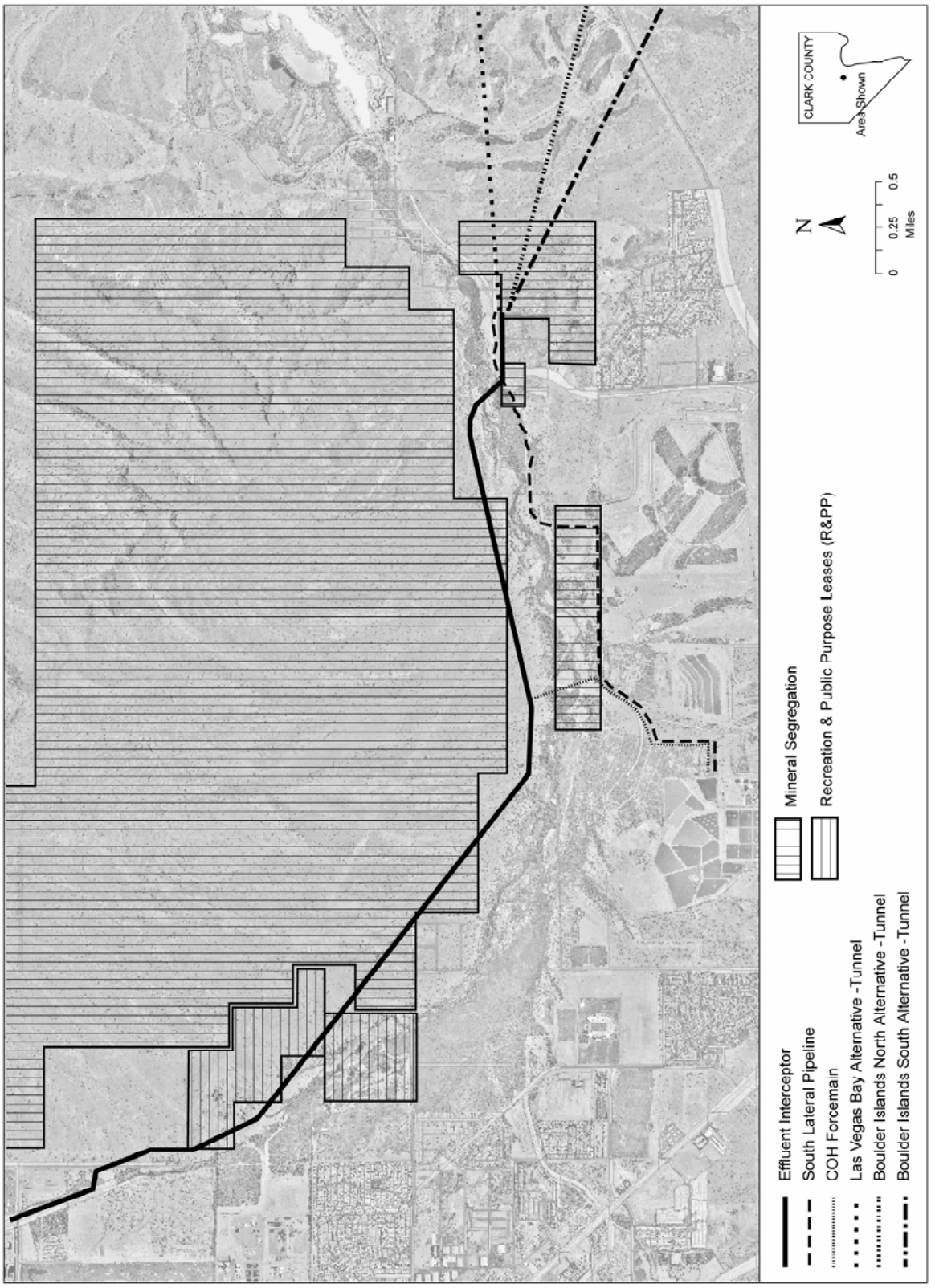


Figure 3.9-3 Lands Designated for Mineral Segregation and R&PP Leases.

3.9.3 Land Use Planning

Land-use Plans relevant to the project include the:

- *Clark County Comprehensive Master Plan,*
- *Sunrise Manor Land Use Plan,*
- *Whitney Land Use Plan,*
- *City of Henderson Comprehensive Plan,*
- *Las Vegas Resource Management Plan and Final Environmental Impact Statement, and*
- *Lake Mead National Recreation Area General Management Plan 1986 and 2002 Lake Management Plan and Final Environmental Impact Statement*.

Clark County Comprehensive Master Plan. The *Clark County Comprehensive Plan* (Clark County 1983) applies to Clark County. However, individual plans for planning communities such as unincorporated towns and incorporated cities within Clark County were created as guidance for land-use planning and decision making specific to those areas (Sunrise Manor and Whitney).

Sunrise Manor Land Use Plan. The *Sunrise Manor Land Use Plan* (Clark County 1999) covers a planning area of 40 square miles (104 square km) (25,600 acres [10,360 hectares]) in the eastern part of the Valley. However, only the extreme northern portion of the EI (north of Desert Inn Road including the CLV WPCF connection) is located within this planning area. Planned land use within the Sunrise Manor planning area in the vicinity of the project is business park/industrial. This land-use plan is contained within the *Clark County Comprehensive Master Plan*.

Whitney Land Use Plan. The *Whitney Land Use Plan* (Clark County 2000b) covers a planning area of 36 square miles (93 square km) (23,240 acres [9,405 hectares]) in the southeastern part of the Valley. This area includes the BLM SMA, the lower Las Vegas Wash, and the Wetlands Park. The majority of the EI project is within this planning area. Planned land use within the EI project area includes open land, rural estates, parks/public facilities, and public lands management areas.

City of Henderson Comprehensive Plan. A section within the *City of Henderson Comprehensive Plan* addresses land use. The *City of Henderson Comprehensive Plan* covers 96 square miles (249 square km) (61,440 acres [24,864 hectares]) of land in the southeast portion of the Valley. The South Lateral Pipeline alignment is located within the COH Pittman Neighborhood Planning Area (COH 2002b). The planned Tuscany Hills residential/golf course development is depicted as the Tuscany Hills Redevelopment Area in the *City of Henderson Future Development Plan*, which is located to the south of the project area (COH 2002c). Another master planned community in Henderson within the EI project area is Calico Ridge (COH 2002d). Planned land use within the project area includes business/industry, public/semi-public, and low and medium residential.

Lake Mead National Recreation Area General Management Plan 1986 and 2002 *Lake Management Plan and Final Environmental Impact Statement* (NPS 1986, 2002). The 1986 General Management Plan established a development zone within the Boulder Basin Zone, which includes the Las Vegas Bay and Boulder Beach areas. The 2002 *Lake Management Plan* designated the Boulder Basin Zone as an urban park setting, which is characterized by paved roads, campgrounds with hookups, commercial facilities, a high level of boating and water activity, intense visitor use, artificial lighting, motorized vessels and automobile traffic, highly modified landscape, and full emergency services.

3.9.4 Zoning

Zoning classifications within the project area are designated by Clark County, the COH, and the NPS depending on the jurisdiction. Zoning designations are intended to implement the policies of a land use plan within a specific planning area such as those discussed in Section 3.9.3. Zoning classifications define the use or development standards of a parcel of land to be compatible with the surrounding and planned land use.

Clark County zoning within the EI project area is characterized by low and very low density residential and public facility use designations (Clark County 2002). Land within the LCS project area is primarily zoned for very low density residential and other appropriate uses of the vast areas of rural land.

The COH zoning designations in the vicinity of the project include low and medium density residential, public/semipublic use, and a small portion of mixed commercial (COH 2002d). A portion of the project area within the COH maintains a base, or original zoning classification called general industrial. This classification serves to protect existing industrial sites and allow for continued operation of existing general industry, manufacturing, extraction, salvage, and related activities. However, these land-use areas are subject to requirements that minimize potential environmental impacts.

The NPS-planned land-use designations for the LMNRA are described in the 1986 *General Management Plan* and 2002 *Lake Mead National Recreation Area Lake Management Plan and Final Environmental Impact Statement* and discussed in Section 3.9.3.

3.10 Visual Resources

The visual resources evaluation for this project is being conducted in accordance with the objectives and methods described in the BLM *Visual Resource Management (VRM) Guidelines* (BLM 1986a) and the BLM *Manual Handbook - Visual Resource Contrast Rating* (BLM 1986b). The objective of the VRM Guidelines is to manage federal lands in a manner that would protect the quality of the scenic or visual values of those lands.

The BLM VRM guidelines were used for visual resource assessment because Reclamation and the NPS do not have any formalized guidance procedures for assessing visual resources. The

visual resource inventory process provides Reclamation and NPS managers with a means for determining visual values.

The baseline inventory consists of the evaluation of the scenic quality, sensitivity level, and delineation of distance zones. Based on these three factors, federally administered lands are placed into one of four visual resource inventory classes. Classes I and II are the most valued, Class III represents a moderate value, and Class IV is of least value. Appendix H, Visual Resources, provides a description of the evaluation factors and visual resource inventory classes. A discussion of the methodology used to classify the existing visual resources in the area of the proposed project and the results of the classification are also presented in Appendix H.

A total of 12 key observation points (KOPs) were established throughout the project area (Figure 3.10-1). These KOPs were selected based on three factors:

(1) the major, potentially sensitive, viewer groups that may be affected by the action under study; (2) the types of planned improvements that would have varied visual impact consequences; and (3) the orientation of the viewers toward the project areas.

The visual characteristics in the vicinity of the proposed EI alignment are different than those in the vicinity of the LCS. Therefore, the existing visual resources for the EI and the LCS are discussed in separate subsections.

3.10.1 Effluent Interceptor

An analysis of the scenic quality, sensitivity level, and distance zone delineations was completed for each segment of each EI alignment that has not been previously assigned a VRM classification by the BLM. The scenic quality rating for the EI and EI Terminus is category C, low scenic quality. Generally, the sensitivity level in the areas of the EI and ancillary facilities is low. However, the Wetlands Park and Rainbow Garden/Lava Butte Roads have a medium sensitivity. The viewing areas along the EI are mostly within the foreground-middleground (F/M) distance zones from travel routes or observation points. Based on the analysis of the scenic quality, sensitivity level, and distance zones, all of the EI segments and ancillary facilities' settings were designated as Class IV.

The area is generally characterized by a flat basin with rugged mountain ranges to the east and north of the Las Vegas Wash. Ground surface elevations along the EI alignment range from about 1,690 ft (515 m) above msl at Desert Inn Road to about 1,490 ft (454 m) above msl near the EI Terminus. The Las Vegas Wash, which runs north to south, turns to the southeast at approximately the middle of the Reach 2 alignment, and eventually flows into Lake Mead.

3.10.1.1 Reach 1

The terrain along Reach 1 of the EI is scarred with unpaved maintenance roads and construction activities for residential housing on both sides of the Las Vegas Wash. Reach 1 has been cleared of most vegetation and is being developed for John Laing Homes and Woodside Homes

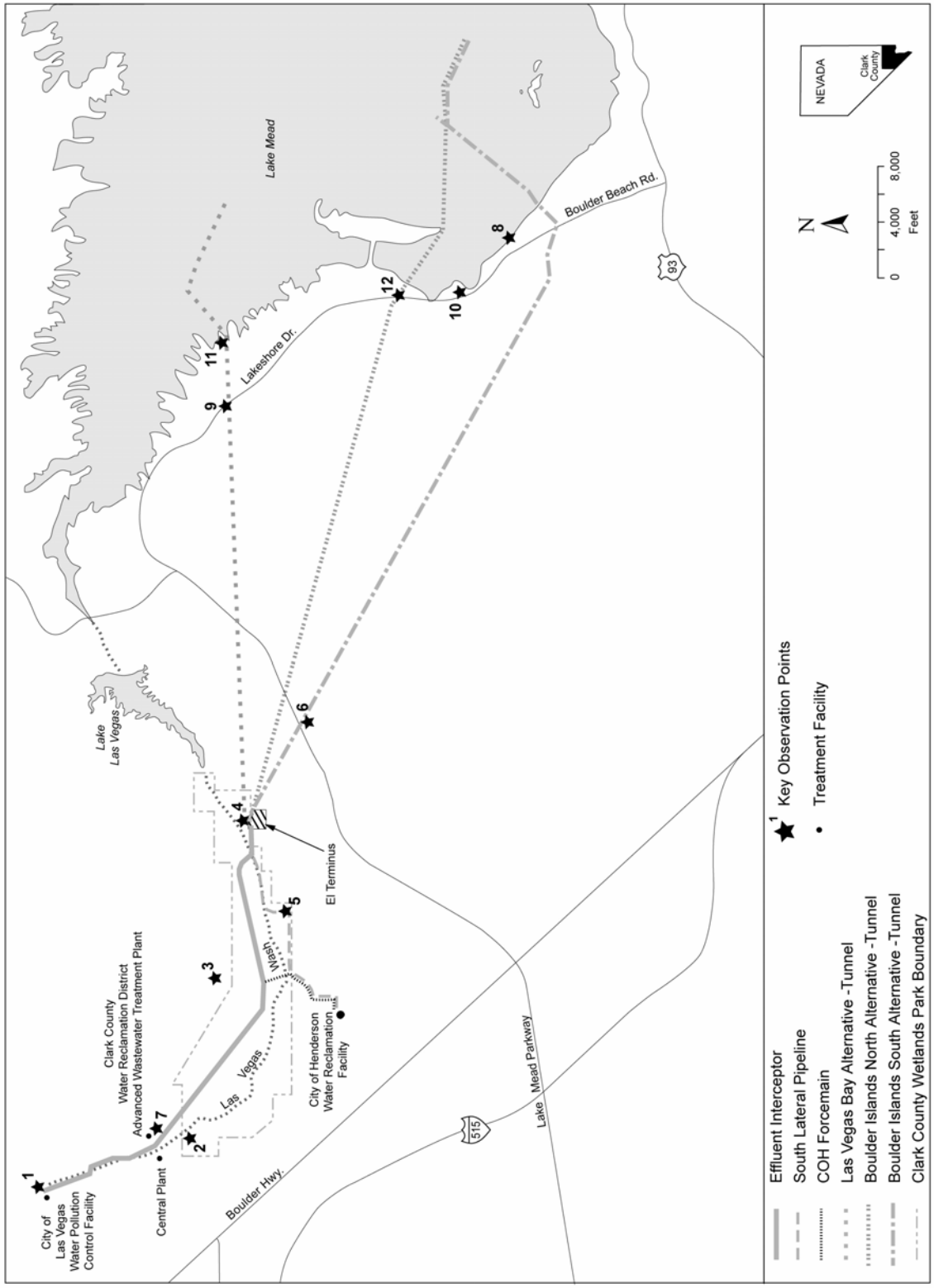


Figure 3.10-1 Key Observation Points.

residential housing. Remaining vegetation exists sporadically between existing unpaved roads and disturbed areas, and is dominated by tamarisk. The Las Vegas Wash has a constant flow of water that meanders in a southeast direction. Visually, this area appears drab, limited in contrast with a minimal variety of vegetative shades of green, gray, and brown.

The adjacent scenery consists of WWTPs, development, poorly maintained and unpaved roads, and illegally dumped trash and debris. The horizon to the north is overshadowed by the relatively undisturbed Frenchman Mountain, which moderately enhances the overall visual experience of the area.

3.10.1.2 Reach 2

Reach 2 is scarred with unpaved maintenance roads on both sides of the Las Vegas Wash. Reach 2 of the alignment is within the ROW of Telephone Line Road, which is a two-lane paved access road north of the Las Vegas Wash that is in poor condition. An historic utility line that runs in a southeastern direction is located along the northern side of Telephone Line Road. The area includes unpaved roads and illegally dumped trash and debris. The topography along the cross-country portion of EI-Alignment B Reach 2 consists of rolling hills with sparse vegetation containing several species of Mojave Desert scrub including creosote bush, four-wing saltbush, desert holly (*Atriplex hymenelytra*), and shadscale (*Atriplex confertifolia*). The vegetation is brownish grey, blends in with the soil, and does not distinctly stand out against the mountain range in the background.

The Las Vegas Wash is located south of the EI alignments in Reach 2. The Las Vegas Wash is lined with a variety of vegetation, including but not limited to, cattail, cottonwood, mesquite, tamarisk, and the common reed. The vegetation of the Las Vegas Wash adds the only line of color variety to the surrounding Mojave Desert scrub landscape.

3.10.1.3 Reach 3

The terrain along Reach 3 is very similar to the southern portion of Reach 2. The area includes unpaved roads and illegally dumped trash and debris. The topography in this area consists of rolling hills with sparse vegetation located throughout the landscape. The Las Vegas Wash in the vicinity of Reach 3 is approximately 300-ft (91-m) wide and 50- to 60-ft (15- to 18-m) deep. The stream banks of the Las Vegas Wash in this area are heavily eroded due to the velocity of runoff during storm events. High flows during storm events have created islands of vegetation and patches of reeds within the Las Vegas Wash. The thicker vegetation adds a variety of different heights and shades of green and brown to the banks of the Las Vegas Wash and is conspicuous against the surrounding brownish-gray landscape. The upland vegetation is brownish grey, blends in with the soil, and does not distinctly stand out against Rainbow Gardens, which is located in the background to the north of the Reach 3 alignment.

3.10.1.4 South Lateral Pipeline and COH Forcemain

The majority of the South Lateral Pipeline and COH Forcemain follow existing paved and unpaved roads and ROW. Surrounding vegetation is dispersed in clumps along the side of the

road. Chain-link property boundary fences meander through the vegetation on both sides of the road. In addition, trash and debris is scattered throughout this area.

The Las Vegas Wash and Wetlands Park are located to the north and west of the South Lateral Pipeline. A small portion of the pipeline would follow a proposed walking trail within the Wetlands Park. Vegetation along this portion of the proposed alignment consists mainly of cattails, tamarisk, and common reed. The vegetation provides variety in green colors to the surrounding brownish-gray terrain. The surrounding landscape consists of small rolling hills and washes. Visually, the majority of this area appears drab and limited in contrast, with a minimal variety of vegetative shades of green, gray, and brown.

Much of the area proposed for the South Lateral Pipeline and COH Forcemain is on previously disturbed land. The color variety is minimal and consists mainly of shades of brown. In the area where the C-1 Channel converges with the Las Vegas Wash, the brown shades are divided by a meandering line of gray-green vegetation. The C-1 Channel area is basically a concrete channel. The calico colored hills to the east provide a colorful panoramic view and add texture to the overall sparsely vegetated area.

3.10.1.5 Effluent Interceptor Terminus

This area is highly disturbed from both vegetation removal and numerous dirt roads. These roads are used mainly by maintenance/construction crews for access to the Las Vegas Wash and flood control facilities. Visually, this area appears drab and limited in contrast, with a minimal variety of vegetative shades of green, gray, and brown. Large rocks from previous earth-moving activities and adjacent man-made slopes characterize the area, and vegetation is sparse. Man-made slopes are prominent to the west, south, and east. The Las Vegas Wash is located to the north, where tamarisk is the dominant species. Small portions of the Lake Las Vegas development can be seen from the EI Terminus site. Large power lines influence the line of vision to the east. The area is surrounded by steep slopes, which add variety to the overall line of sight; however, disturbed land dominates the panoramic view.

3.10.2 Lake Conveyance System

The NPS is congressionally directed to not allow LMNRA resources and values to be impaired. Actions that create impacts to LMNRA may be allowed when necessary and consistent with NPS policy, applicable regulations, and resource objectives.

The proposed LCS alignment includes three alignment alternatives, with discharge in the vicinity of the Boulder Islands or the Las Vegas Bay. Each of the alternatives has a unique location, shape, and function. The visual quality of the three alternatives is described in general terms. For the purposes of the visual analysis, the sites of the proposed alternatives are defined as separate areas to potentially be affected by construction and operation of the LCS and the ancillary facilities (Figure 3.10-1).

Generally, except for the area along Lake Mead Parkway, the LCS alternatives are of a high scenic quality. There is a high degree of sensitivity in the vicinity of the three proposed alternatives with the exception of the Lake Mead Parkway thoroughfare. Views from the

designated KOPs are within the F/M distance zones from travel routes or observation points. Based on the analysis of the scenic quality, sensitivity level, and distance zones, the LCS area, except for KOP #6 – Lake Mead Parkway, was designated as Class II.

3.10.2.1 Boulder Islands North Alternative

The terrain along the Boulder Islands North alternative varies from rolling hills to mountains to bajadas to washes, ending at the Lake Mead shoreline. Vegetation exists sporadically and is typical of a Mojave desert scrub environment. The vegetation is dominated by several species including creosote bush, four-wing saltbush, desert holly, and shadscale.

The area from the EI Terminus to Lake Mead Parkway provides views of rolling hills and a background of the River Mountains to the east. This portion of the Boulder Islands North Alternative offers limited distance views because of the closeness of the River Mountains. The dominant color scheme is gray-green and is typical of the Mojave desert scrub environment.

The area where the NRMT3-East working shaft would be located near Lakeshore Drive provides views of rolling hills and a background of the River Mountains to the east. This portion of the Boulder Islands North Alternative offers panoramic views of the River Mountains to the east and Lake Mead to the west and south from Lakeshore Drive. The AMSWTF dominates the view to the northeast. The dominant color scheme is gray-green broken by the blue-green of Lake Mead.

The area as seen from Lake Mead, provides panoramic views of the east side of the River Mountains. The dominant color scheme is gray-green and is typical of the Mojave desert scrub environment. The adjacent scenery consists of rolling hills and washes, sloping toward Lake Mead. The horizon to the north is dominated by views of Lake Mead, which provides a focal point in the area. The Boulder Islands are to the east of Boulder Beach, and are visually dominated by gray rock. The high-water mark surrounding Lake Mead provides a focal point of a white horizontal line around the Lake.

3.10.2.2 Boulder Islands South Alternative

The scenic quality and conditions in the vicinity of the Boulder Islands South Alternative are the same as those described for the Boulder Islands North Alternative as described in Section 3.10.2.1, except for the view at Lakeshore Drive. This alternative would not include the NRMT3-East working shaft at Lakeshore Drive.

3.10.2.3 Las Vegas Bay Alternative

The terrain along the Las Vegas Bay alignment includes rolling hills and washes, ending at the Las Vegas Bay and delta. Vegetation exists sporadically and is dominated by several species of Mojave Desert scrub.

The area from the EI Terminus to Lake Mead Parkway provides views of rolling hills and a background of the River Mountains to the east. This portion of the Las Vegas Bay Alternative offers limited distance views because of the closeness of the River Mountains. The dominant color scheme is gray-green and is typical of the Mojave desert scrub environment.

The area as seen from the Las Vegas Bay overlook at Lake Mead, provides panoramic views of distant mountains. The foreground scenery consists of rolling hills and washes sloping toward Lake Mead. The horizon to the north and east is dominated by views of Lake Mead, which provides a focal point and adds a blue gray color to the otherwise brown/gray background. Las Vegas Wash and delta are to the west of Las Vegas Bay, and are visually dominated by sediment deposits. The dominant colors are gray and brown. Generally, the line of sight from the overlook is flat with background mountain views.

3.11 Socioeconomics

Socioeconomic data and information are provided at two geographic levels for the purposes of this analysis: the Project Region and the Study Area. Each is defined differently in this section than in other sections of this document.

The Project Region includes the Las Vegas Metropolitan Statistical Area (MSA) (which includes all of Clark County, Nevada, and Mohave County, Arizona) as well as the CLV, COH, City of Boulder City, and the unincorporated Town of Whitney (all located in Clark County, Nevada). The Project Region provides a broad perspective for the region within which the proposed project occurs.

The Study Area covers 64 square miles (166 square km) or approximately 40,960 acres (16,576 hectares) and comprises the area within a 1-mile (2-km) buffer that surrounds the perimeter of the proposed project alternatives. It is located mostly within unincorporated areas of Clark County southeast of the CLV, and west and northwest of Lake Mead, and includes portions of the unincorporated Town of Whitney, the COH, and a small portion of Boulder City. Also, portions of the Study Area occur within the LMNRA, where there is little permanent population. Mohave County, Arizona makes up a very small portion of the Study Area at its extreme southeastern edge. Therefore, very little analysis, if any, is dedicated to Mohave County, Arizona in this section. The Study Area boundary is shown in Figure 3.11-1, along with the year 2000 U.S. Census Bureau (USBOC) census tracts that overlap the Study Area either partially or fully.

Socioeconomic data was collected primarily through government resources, information available through the Internet, and telephone interviews with government personnel.

3.11.1 Employment and Economy

The employment, industry, and earnings data presented in this section were obtained from the U.S. Bureau of Economic Analysis (BEA): *Form CA25, CA25N Total full-time and part-time employment* and *Form CA05 and CA05N Personal income by major source and earnings by industry* (BEA 2004). Forms CA25N and CA05N use the North American Industry Classification (NAICS), and forms CA25 and CA05 use the Standard Industrial Classification (SIC) system. The SIC classification system is an organizational system that identifies business establishments by the principal activity in which they are engaged. The NAICS system, like the SIC system, uses a coding system that classifies industries by the principal activity in which they are engaged and is used in the U.S., Canada, and Mexico. Because the industry categories used in

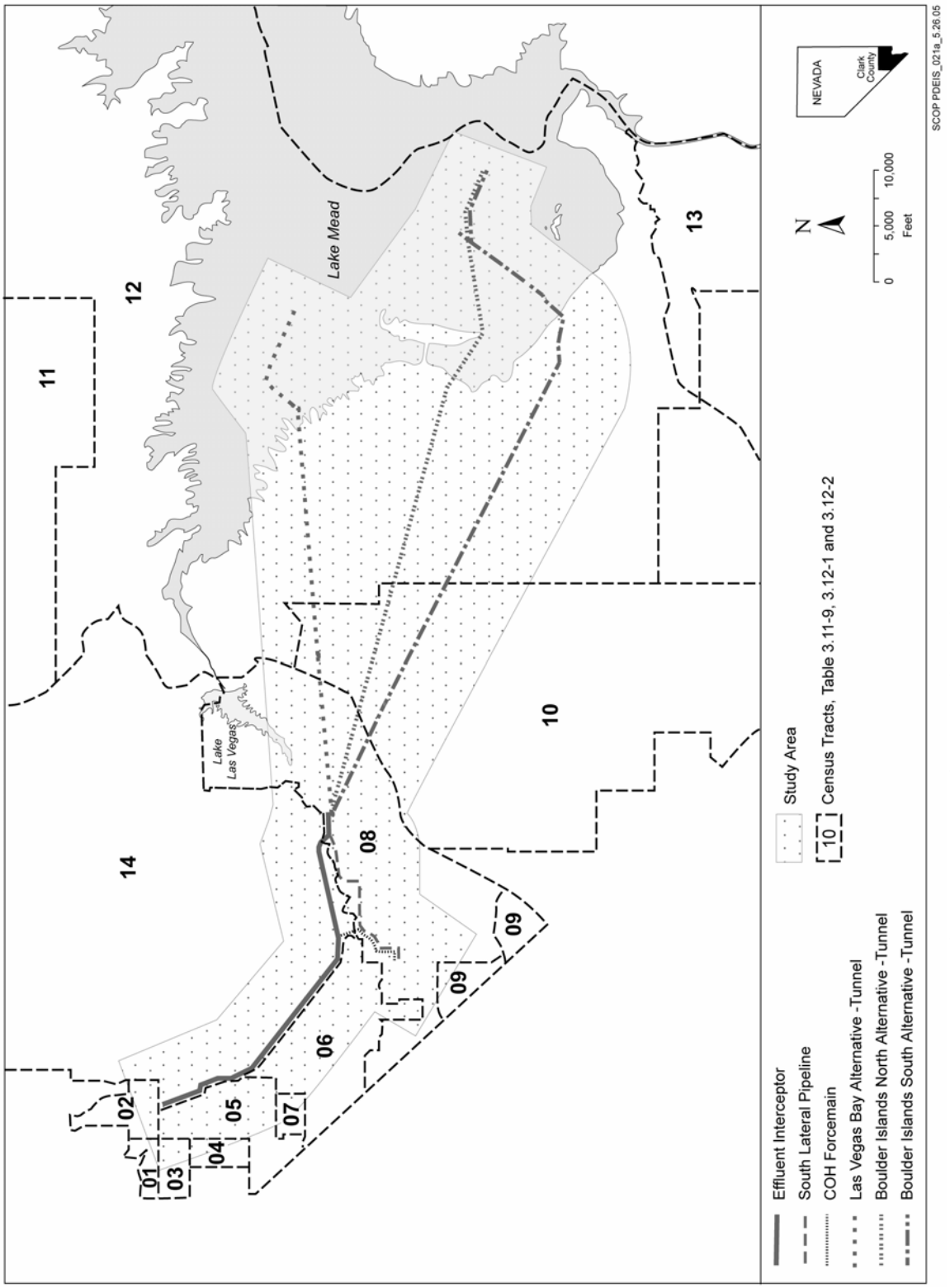


Figure 3.11-1 Socioeconomic Study Area and Census Tracts.

the NAICS and SIC systems are slightly different, it is difficult to make direct comparisons concerning industry changes overtime in terms of the number of employees, the number of establishments, and earnings.

Table 3.11-1 provides the Economic Census data by industrial sector for Clark County from 1990 to 2002. The data show the number of employees and the annual payroll by industry for Clark County. Appendix I provides information on per industry number of employees, establishments, and annual payroll for 1993, 1997, and 2000.

The service industry (which includes hotels, gaming, and food services) had the greatest number of employees and was highest in earnings in 2002. The Las Vegas service industry is dominated by the gaming/hotel industry, which is the single-largest attraction for tourists to the Las Vegas metropolitan area. There were approximately 35 million visitors to the Las Vegas metropolitan area in 2002, and there was approximately $7.6 billion in gross gaming revenue generated (UNLV 2003a).

The Lake Mead recreational industry (which includes boating, food services, boat storage, marina services, and other recreational activities) generates approximately $500 million annually with an additional $45 million in gross revenues generated by Lake Mead concessionaires (Turner 2004).

Starting in 2001, the NAICS system added the information industry to its employment categories. This has been incorporated into the finance, insurance, and real estate category for purposes of this report. As stated earlier, the industry categories used in the NAICS and SIC systems are slightly different, and this difference partially accounts for the large increase in the finance category.

New job growth within the Las Vegas MSA was relatively steady from 1990 to 2003, adding an average of 29,500 new jobs per year, or an average annual growth rate of 6.3 percent. Growth in Clark County was also relatively steady from 1990 to 2003, adding an average of 26,800 new jobs per year, or an average annual increase of 6.5 percent. In the State of Nevada, during the same 13-year period, the labor force increased from approximately 667,000 employees to 1,113,200 employees, or a 66.9 percent increase. New job growth in Nevada was also relatively steady from 1990 to 2003, adding an average of 31,900 new jobs per year, or an average annual increase of 4.8 percent (UNLV 2003b).

Table 3.11-2 provides labor force and unemployment data for the Las Vegas MSA, Clark County, the State of Nevada, and the U.S. as a whole, from 1990 to 2003. As defined by the USBOC, employment and unemployment are identified as all civilians 16 years old and over who are currently employed or actively looking for work. Excluded from the employed are people whose only activity consisted of work around the house or unpaid volunteer work for religious, charitable, and similar organizations. Labor force, as defined by the USBOC, includes all people

Table 3.11-1 Employment and Earnings by Industry in Clark County, Nevada, 1990 – 2002.

Industry Sector	1990 Number of Employees	2002 Number of Employees	Percent of Change	1990 Earnings by Industry (in $1,000)	2002 Earnings by Industry (in $1,000)	Percent of Change
Agricultural, forestry and other	3,915	289	-93	$65,163	$4,131	-94
Mining	832	1,256	51	$11,726	$46,174	294
Construction	40,525	79,061	95	$1,401,817	$4,038,243	188
Manufacturing	11,711	22,695	94	$357,842	$1,101,393	208
Transportation/Public Utilities	21,095	31,873	51	$713,699	$1,366,685	91
Wholesale trade	14,360	23,376	63	$469,277	$1,283,363	173
Retail trade	72,492	95,243	31	$1,222,319	$2,750,867	125
Finance, insurance and real estate	32,451	106,239	227	$509,672	$3,965,281	678
Services	210,796	444,509	111	$5,434,079	$15,857,134	192
Government	50,783	85,978	69	$1,831,088	$4,713,624	157
Total	458,960	890,519	94	$12,016,682	$35,126,895	192

Source: BEA 2004.

classified in the civilian labor force, plus members of the U.S. Armed Forces that are on active duty. The labor force consists of people classified as either unemployed or employed.

The Las Vegas MSA and Clark County had very similar rates of unemployment from 1990 to 2003 (Table 3.11-2), with the Las Vegas MSA recording slightly higher rates than Clark County in 8 of the 13 years. The highest unemployment rate in the Las Vegas MSA during the 13-year period occurred in 1993 when unemployment reached 7.2 percent, and the lowest unemployment rate occurred in 1997 when it was 4.1 percent. Generally, unemployment in the Las Vegas MSA was equal to or higher than that of the State of Nevada (11 out of 13 years), but no clear trend emerged when compared to the national average unemployment rate.

Table 3.11-2 Labor Force and Unemployment Las Vegas MSA, Clark County, and State of Nevada, 1990 – 2003.

Year	Las Vegas MSA		Clark County, NV		State of Nevada		United States
	Total Labor Force (In 1,000s)	Un-employment Rate (Percent)	Total Labor Force (In 1,000s)	Un-employment Rate (Percent)	Total Labor Force (In 1,000s)	Un-employment Rate (Percent)	Un-employment Rate (Percent)
1990	468.7	4.7	414.7	4.7	667.0	4.9	5.6
1991	491.4	5.7	437.1	5.6	693.0	5.5	6.8
1992	507.3	6.8	450.7	6.6	715.0	6.6	7.5
1993	530.3	7.2	470.1	7.1	739.0	7.2	6.9
1994	572.4	6.4	507.3	6.1	779.5	6.2	6.1
1995	597.1	5.5	525.2	5.4	802.3	5.4	5.6
1996	630.9	5.5	557.4	5.3	839.9	5.4	5.4
1997	665.3	4.1	593.3	4.0	882.5	4.1	4.9
1998	697.6	4.2	624.2	4.2	919.9	4.3	4.5
1999	727.3	4.4	650.0	4.4	941.6	4.4	4.2
2000	767.7	4.2	688.5	4.1	986.1	4.1	4.0
2001	803.1	5.5	719.9	5.5	1023.5	5.3	4.8
2002	886.1	5.7	794.5	5.7	1121.7	5.5	5.8
2003	882.1	5.3	789.5	5.3	1113.2	5.2	5.7

Source: State of Nevada 2003, Bureau of Labor Statistics 2004.

Unemployment in Clark County was highest in 1993, at 7.1 percent, and it reached its low point in 2000, when it was 4.1 percent. Generally, unemployment rates in Clark County were either lower than or equal to the State of Nevada rates (10 out of 13 years), and were usually lower than or equal to the national average unemployment rates (10 out of 13 years).

Table 3.11-3 lists the 20 largest employers in Clark County in 2003. The largest single employer in Clark County is the Clark County School District with more than 20,000 employees. But, by far, the largest group of employers in Clark County was gaming/hotel companies along the Las Vegas Strip. In 2003, 13 of the top 20 employers in Clark County were hotel and casino companies, employing a combined total of between 55,000 and 63,988 workers, which represented approximately 10.4 percent of the total Clark County workforce.

Table 3.11-3 Twenty Largest Employers, Clark County, Nevada, 2003.

Ranking	Employer Name	Number of Employees
1	Clark County School District	20,000 +
2	Clark County	8,000-8,899
3	Bellagio Hotel and Casino	7,000-7,999
4	MGM Grand Hotel	7,000-7,999
5	Mandalay Bay Resort & Casino	6,000-6,999
6	Mirage Hotel & Casino	5,000-5,999
7	State of Nevada	4,000-4,999
8	Caesar's Palace Hotel & Casino	4,000-4,999
9	Las Vegas Metropolitan Police Department	4,000-4,999
10	UNLV	4,000-4,999
11	Rio Suite Hotel & Casino	4,000-4,499
12	Luxor Hotel & Casino	3,000-3,999
13	University Medical Center	3,000-3,999
14	Bally's & Paris Casino Hotels	3,000-3,999
15	Treasure Island	3,000-3,999
16	Excalibur Hotel & Casino	3,000-3,999
17	Flamingo Hilton Corporation	3,000-3,999
18	Circus Circus Hotel & Casino	3,000-3,999
19	City of Las Vegas	3,000-3,999
20	Harrah's Las Vegas	3,000-3,999

Source: Clark County 2003e.

3.11.2 Population

Table 3.11-4 shows population trends for the region's cities, the Las Vegas MSA, Clark County, and the State of Nevada. Clark County, NV was the fastest growing county in the U.S. during the 1990s. The Las Vegas MSA includes all of Clark County and the westernmost portion of

Mohave County, Arizona. The three most populous cities in Clark County -- Las Vegas, North Las Vegas, and Henderson -- have grown tremendously from 1990 to 2003.

Table 3.11-4 Project Region Historic Population Trends, 1990 – 2003.

Place	Population			Percent Change	
	1990	2000	2003	1990-00	2000-2003
Boulder City, NV	12,760	14,906	14,394	17%	0.2%
City of Henderson, NV	69,390	179,144	217,448	158%	21%
Town of Whitney,[1] NV	N/A	15,683	20,640	N/A	32%
City of North Las Vegas, NV	50,030	117,650	146,005	135%	24%
City of Las Vegas, NV	268,330	482,389	528,617	80%	10%
Las Vegas, NV/AZ MSA	741,459	1,563,282	N/A	111%	N/A
Study Area Census Tracts	N/A	57,615	N/A	N/A	N/A
Clark County, NV	770,280	1,394,440	1,620,478	81%	16%
State of Nevada	1,236,130	2,023,378	2,296,566	64%	14%

Note:
[1] Estimates began in 1996.

Source: NV State Demographer 2004.

The State's high population growth reflects the fact that Clark County's population made up 71 percent of the State's population in 2003. Clark County's population growth during the 1990s far outpaced the national average of 13.2 percent (USBOC 1990, 2000a).

Primary causes of the recent population surge is an influx of new residents moving to the Las Vegas metropolitan area to take advantage of increased economic opportunity, relatively low housing costs, a relatively low cost of living, outdoor recreation possibilities, and a warm, dry climate. Booming employment in the construction, hotel/casino, public schools, government, and services industries provides an incentive for new residents to the Las Vegas metropolitan area.

The average annual growth rate is predicted to increase 2.7 percent in Clark County and 2.3 percent in the State from 2000 to 2020.

3.11.3 Housing

Housing in Clark County, NV is concentrated almost entirely in the Las Vegas metropolitan area, in the cities of Las Vegas, North Las Vegas, Henderson, Boulder City, and the unincorporated areas in the Valley.

In Clark County, the number of new homes bought in 2002 was 22,502 while there were 38,621 homes resold. The median price of a new home in Clark County was $239,145 in May 2004, which represents an increase of 19 percent from 2003. The median resale price for a

home in Clark County was $230,000 in May 2004, which was 41 percent higher than in 2003 (UNLV 2004). Even with the rise in housing costs, the average home price is very affordable compared to the Los Angeles metropolitan area, where a majority of new residents originate. The median monthly rent for an apartment in Clark County was $747 in 2004 (UNLV 2004).

Table 3.11-5 provides housing characteristics for the Project Region and the Study Area. Within the Project Region, Boulder City had the highest rate of owner-occupied housing units (76.2 percent); Las Vegas had the lowest (59.1 percent). The percentage of owner-occupied housing units in the Las Vegas MSA, Clark County, and the State of Nevada were all slightly lower than the national average, which is 66.2 percent.

On average, the study area census tracts recorded a percentage of owner-occupied housing units (at 74.6 percent) that was consistent with rates in Boulder City and Henderson, but substantially higher than Las Vegas, the town of Whitney, the Las Vegas MSA, Clark County, and the State of Nevada. Study area census tracts that recorded unusually low percentages of owner-occupied housing units included Clark County tracts 50.08, 49.11, and 50.06. The majority of the study area census tracts had unusually high percentages of owner-occupied housing units.

Most new building permits (94 percent each year) were for single-family homes, and the number of permits increased each year. Home valuation for single-family homes increased from $801 million in 1999 to $1,453 million in 2003. The total number of residential building permits increased from 7,470 in 1999 to 11,824 in 2003 (Clark County 2003b).

3.11.4 Schools

The Clark County School District is the only school district in the County. It was ranked as the sixth largest school district in the U.S. for the school year 2003-2004 and is one of the fastest growing districts. Enrollment increased by 50 percent from the 1996-1997 school year to the 2003-2004 school year. Enrollment has been growing by approximately 5 percent per year and is projected to continue at that rate through the 2006-2007 school year. A typical year of growth planning for the school district includes 14,000 new students, 12 to 14 new schools, 2,300 new teachers, 100 new buses, and 560 portable classrooms. For the 2004-2005 school year there are seven new elementary schools, three middle schools, and three high schools scheduled to open (Clark County School District 2003).

3.11.5 Government Taxation and Revenue

In Clark County the sales and use tax is 7.5 percent. This 7.5 percent tax is several taxes combined, based on Nevada's Statutes and locally adopted option taxes. All counties in Nevada charge a 6.5 percent tax, as follows: Sales Tax-General Fund (2.00 percent), Local School Support Tax (2.25 percent), Basic City-Council Relief Tax (0.50 percent), and Supplemental City-County Relief Tax (1.75 percent). Clark County charges an additional 1 percent tax: Public Mass Transportation and Construction of Roads (0.50 percent), Control of Floods (0.25 percent), and Infrastructure (0.25 percent) (Nevada Department of Taxation 2003).

Table 3.11-5 Project Region and Study Area Housing Characteristics, 2000. [1]

Place/Study Area Census Tracts (Refer to Figure 3.11-1)	Number of Occupied Household Units	Owner Occupied Units	Percent Owner Occupied Units	Renter Occupied Units	Percent Renter Occupied Units
Clark County, NV Census Tracts					
49.11 (01)	1,359	637	46.9	722	53.1
49.22 (02)	1,492	1,422	95.3	70	4.7
50.06 (03)	1,988	983	49.4	1,005	50.6
50.07 (04)	155	145	93.5	10	6.5
50.08 (05)	1,335	594	44.5	741	55.5
50.09 (06)	1,548	1,370	88.5	178	11.5
50.12 (07)	1,121	1,048	93.5	73	6.5
54.11 (08)	1,900	1,573	82.8	327	17.2
54.31 (09)	1,465	1,352	92.3	113	7.7
55.01 (10)	2,116	1,864	88.1	252	11.9
56.13 (11)	1,383	1,070	77.4	313	22.6
61.01 (12)	651	625	96.0	26	4.0
Mohave County, AZ Census Tract					
95.04 (13)	2,143	1,913	89.3	230	10.7
Total/Average of Census Tracts	22,156	16,537	74.6	5,619	25.4
Project Region					
Boulder City, NV	6,385	4,863	76.2	1,522	23.8
Henderson, NV	66,541	46,948	70.6	19,593	29.4
Las Vegas, NV	176,848	104,514	59.1	72,334	40.9
Town of Whitney, NV	6,922	4,468	64.5	2,454	35.5
Las Vegas, NV/AZ MSA	588,371	359,233	61.1	229,138	38.9
Clark County, NV	512,253	302,842	59.1	209,411	40.9
State of Nevada	751,165	457,245	60.9	293,920	39.1

Note:

[1] Latest data available at the census tract level.

Source: USBOC 2000a.

Clark County receives the local-option infrastructure tax back from the State of Nevada, and allocates this funding primarily to water and wastewater projects. The CCWRD is allocated the wastewater portion of this funding, and will use these funds (in part) to finance the proposed project (King 2003).

Sales tax is charged at retail on the sale of tangible personal property unless exempt by statute. There is no sales tax on food items used for home consumption or prescribed medical goods (Nevada Department of Taxation 2003). Gasoline is taxed at 23 cents per gallon and diesel fuel is taxed at 27 cents per gallon. There is also a motor vehicle tax in which the valuation of the vehicle is determined at 35 percent of the manufacturer's suggested retail price, without accessories (Nevada Development Authority 2003). There are five principle types of gaming taxes. Gross gaming revenue tax, taxable tax, and slot taxes are levied by the state. The counties levy the county table tax. There are no corporate or personal income taxes in Nevada (Nevada Development Authority 2003).

Nevada's constitutional limit on property tax is $5 per $100 of assessed valuation while the statutory limit is $3.64 per $100. Assessment is at 35 percent of taxable value, and the tax rate is applied to the assessed value. The tax rate for 2003-2004 in the CLV is $3.2877 per $100 of assessed value (Clark County 2003c). The taxable value for real property (land) is full cash value. The Assessor is required by Nevada law to physically reappraise all property at least once every 5 years.

Table 3.11-6 provides property tax information for tax jurisdictions that are within the study area. Within the study area, during the 2003-2004 fiscal year, the tax per $100 of property value is between $2.4571 and $2.9342. Also, the net assessed value and the property taxes collected for the 2003 tax year are provided for each property tax jurisdiction.

3.12 Environmental Justice

Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations* (1994), directs federal agencies to determine whether their programs, policies, and activities have disproportionately high and adverse human health or environmental effects on minority and low-income populations.

An environmental justice population is a population group being at least half minority status or at least half low-income status. A minority is defined as Black or African American, Hispanic or Latino, Asian, American Indian and Alaskan Native, Native Hawaiian and other Pacific Islander. The USBOC data was used to assess population groups within the project study area.

3.12.1 Environmental Justice Populations

Census tracts and block data from the USBOC were used to determine the census tracts located within the project area. Census tracts are small, relatively permanent statistical subdivisions of a county and usually have between 2,500 and 8,000 persons. When the census tracts are first delineated, they are designed to be homogeneous with respect to population characteristics,

Table 3.11-6 Study Area Tax Jurisdictions.

Tax District Number and Name (Tax Districts Located within the Detailed Study Area)	2003-2004 Tax Rate (dollars/$100 value)	Net Assessed Value 2003-2004	Property Taxes Collected 2003-2004
050 Boulder City Library	$2.4929	$306,259,500	$7,191,088
051 Boulder City Colorado River	$2.4929	$19,119,782	$462,649
060 Boulder City Library	$2.5691	$0	$0
061 Boulder City Library Colorado River	$2.5691	$6,529,676	$172,500
100 Unincorporated Clark County	$2.5013	$37,448,010	$581,227
340 Sunrise Manor	$2.9342	$2,165,968,775	$59,903,302
500 Henderson City	$2.8879	$460,806,958	$12,331,562
505 Henderson Artesian Basin	$2.8897	$4,193,070,897	$112,693,786
507 Henderson Library	$2.9339	$544,229,056	$18,039,030
510 Henderson Library	$2.4571	$3,609,413	$86,316
513 Henderson City Redevelopment	$2.9125	$14,436,247	$280,535
515 Henderson Library Fire	$2.6818	$6,300	$166
550 Whitney Town	$2.9324	$2,905	$78
570 Whitney Artesian Basin	$2.9342	$299,630,238	$8,166,287

Sources: Clark County 2003c, f.

economic status, and living conditions. Census tracts do not cross county boundaries. The study area for the proposed project includes 12 census tracts (Figure 3.12-1).

Statistics for the State of Nevada, Clark County, Las Vegas MSA (regional area), and incorporated cities adjacent to the project area have been included in this study for comparison purposes (Table 3.12-1).

On average there is a smaller percentage of ethnic minorities in the study area than in Clark County and the State of Nevada. Census tract 49.11 has the highest percent of minority populations and census tract 55.01 has the lowest. There is however, a wide variety in minority populations among the 12 census tracts. There are no census tracts within the study area that have a minority population of 50 percent or higher.

Although minority populations are found in most census tracts in the study area, the demographic profile of the populations within each census tract is predominantly white (Figure 3.12-1).

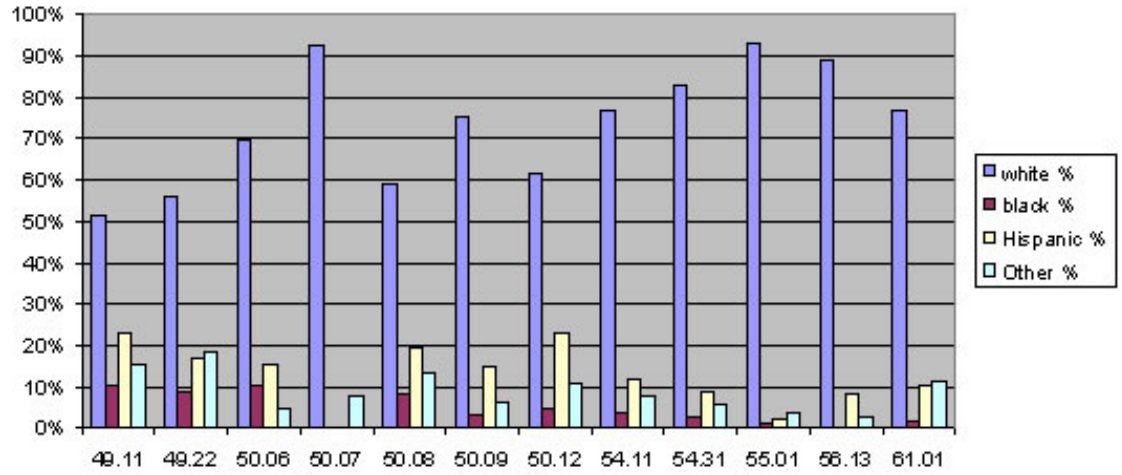


Figure 3.12-1 Population Demographics Census Tracts.

3.12.2 Income and Poverty Levels

The USBOC defines the average poverty threshold for a family of four as a maximum annual income of $18,725 or less for the year 2003 (USBOC 2004). There is a wide range in income and percent of populations living below poverty levels among the 12 census tracts (Table 3.12-2).

On average, the median household income is higher in the study area than in the project region. The percent of populations living below the established poverty level in the census tracts is lower than in Las Vegas, Clark County, and the State of Nevada. The percent of populations living below the established poverty level (Figure 3.12-2) is higher than in Boulder City and Henderson, NV. None of the study area tracts have 50 percent or more of the population living at or below poverty levels.

The proposed project traverses through several areas that contain an extensive variety of populations. Some of the study area census tracts contain higher percentages of minority and low-income populations, but none of the census tracts have at least half minority status or at least half low-income status.

3.12.3 Indian Trust Assets

A federally recognized Indian Tribe is a group of Indians officially recognized by the U.S. government. This recognition establishes a tribe as an entity with the capacity to engage in government-to-government relations with the U.S. or individual states, and also as one eligible to receive federal services. Federal recognition is established as a result of historical and continuedexistence of a tribal government by EO or legislation, and through the federal recognition process recently established by Congress.

Table 3.12-1 Study Area Ethnic Profile.

Area Census Tracts (Key to Figure 3.11-1)	Population	Percent White	Percent African American	Percent Hispanic	Percent Other
49.11 (01)	3,567	51.6	10.2	22.9	15.3
49.22 (02)	4,973	56.1	8.9	16.8	18.2
50.06 (03)	4,752	69.6	10.3	15.2	4.8
50.07 (04)	327	92.4	0.0	0.0	7.6
50.08 (05)	3,097	59.1	8.1	19.4	13.5
50.09 (06)	3,686	75.5	3.4	14.8	6.3
50.12 (07)	3,080	61.7	4.7	22.8	10.9
54.11 (08)	4,865	76.8	3.7	11.9	7.6
54.31 (10)	4,353	82.7	2.6	8.8	5.9
55.01 (11)	4,365	93.2	0.9	2.4	3.5
56.13 (12)	4,222	88.8	0.3	8.2	2.6
61.01 (14)	1,897	76.8	1.7	10.3	11.3
Total/Average of Study Area Census Tracts	**43,184**	**73.7**	4.6	12.8	8.0
Project Region					
Boulder City, NV	14,966	92.7	0.4	4.2	2.7
Henderson, NV	176,048	78.0	3.8	10.6	7.6
Las Vegas, NV	478,868	57.9	10.1	23.6	8.4
Whitney, NV	17,731	58.4	6.9	27.0	7.7
Las Vegas, NV/AZ MSA	1,563,282	63.0	7.7	20.6	8.7
Clark County, NV	1,375,765	60.1	8.7	21.9	9.2
State					
Nevada	1,998,257	65.1	6.5	19.7	8.7

Source: USBOC 2000a.

Table 3.12-2 Income and Poverty Levels State, Region, and Census Tracts.

Area Census Tracts (Key to Figure 3.11-1)	Total Population [1]	Percent Below Poverty (average)	Median Household Income (1999) [2] (average)
49.11 (01)	3,567	17.3	$41,238
49.22 (02)	4,973	4.1	$59,219
50.06 (03)	4,752	12.8	$39,721
50.07 (04)	327	0.0	$79,578
50.08 (05)	3,097	10.0	$32,188
50.09 (06)	3,686	1.4	$41,451
50.12 (07)	3,080	13.1	$51,054
54.11 (08)	4,865	4.4	$55,763
54.31 (10)	4,353	1.4	$66,356
55.01 (11)	4,365	14.8	$47,083
56.13 (12)	4,222	6.5	$45,417
61.01 (14)	1,897	3.7	$89,497
Total of the Study Area Census Tracts	43,184	8.0	$54,047
State of Nevada	1,998,257	10.3	$44,581
Region			
Boulder City, NV	14,966	6.6	$50,523
Henderson, NV	176,048	5.6	$55,949
Las Vegas, NV	478,868	11.7	$44,069
Whitney, NV	17,731	9.7	$36,536
Las Vegas, NV/AZ MSA	1,563,282	10.9	$42,468
Clark County, NV	1,375,765	10.6	$44,616
Average of Region			$53,124

Notes:

[1] Population figures from USBOC 2000a.

[2] Latest figures available.

Source: USBOC 2000a.

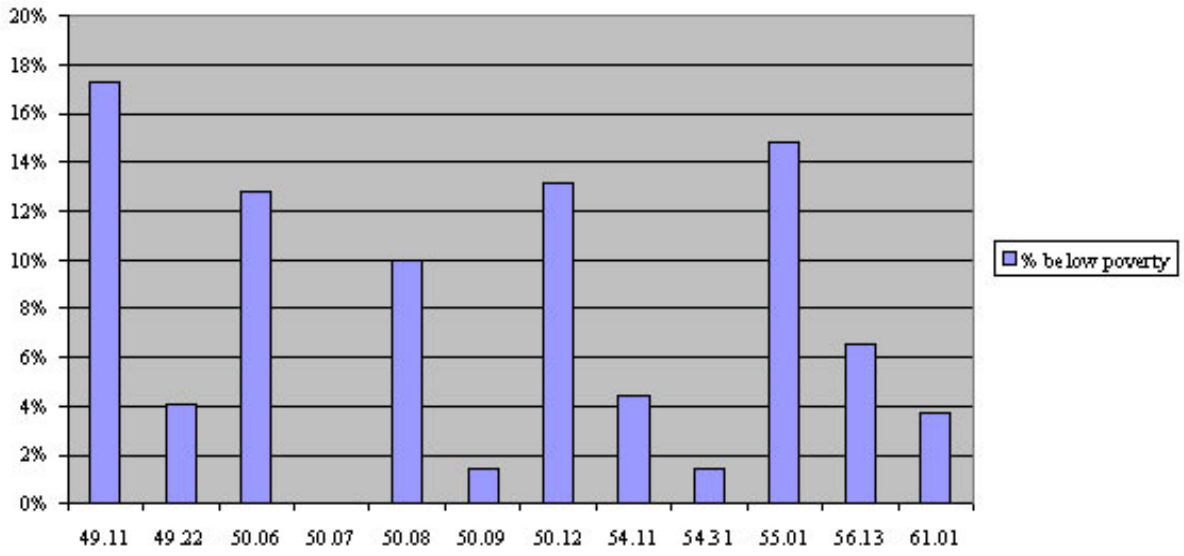


Figure 3.12-2 Percent of Population Below Poverty Census Tracts.

The relationship between the U.S. government and those tribes is characterized as one of guardian to ward. As a part of its guardian role, the federal government is obligated to protect Tribal interests, a duty that is referred to as trust responsibility. This trust doctrine is defined through treaties, laws, EOs, judicial decisions, and agreements. Indian Trust Assets are legal interests in property held in trust by the U.S for federally recognized Indian Tribes or individual Indians, or property the U.S. is charged to protect by law.

Department of the Interior, SO 3175 (1994) clarifies the responsibility of the DOI agencies to ensure that the trust resources of federally recognized Indian tribes that may be affected by the activities of the agencies are identified and protected. Secretarial Order 3175 (codified in the DOI Department Manual [DM] as 512 DM 2) requires that (1) agencies are to consult with Indian tribes when trust property may be affected, and (2) environmental and planning documents should "clearly state that the rationale for the recommended decision will be consistent with the Department's trust responsibilities." Indian Trust Assets should be considered early in the NEPA process and initially identified. Identification of ITAs should involve consultation with (1) potentially affected tribes, Indian organizations, or individuals; and (2) the BIA, the Office of American Indian Trust, the Solicitor's Office, BLM, or the Regional Native American Affairs Coordinator, all of which are in the DOI.

Examples of resources that are ITAs include lands, minerals, hunting and fishing rights, and water rights. No ITAs have been identified by Reclamation and NPS in the vicinity of Lake Mead.

The information presented in the following paragraphs regarding ITAs located along the lower Colorado River was taken from the *Lower Colorado River Multi-Species Conservation Program Final Programmatic Environmental Impact Statement* (Reclamation et al. 2004). Five tribes possess present perfected Federal reserved rights to Colorado River water. Typically, those tribes have the senior water rights on the river (present perfected). These tribes are the Fort Mojave Indian Tribe, the Chemehuevi Tribe, the Colorado River Indian Tribe (CRIT), the Fort Yuma

Quechan Tribe, and the Cocopah Indian Tribe. Taken together, these five tribes have present perfected Federal reserved rights to 920,718 acre-feet per year (AFY) of Colorado River water.

The Fort Mojave Indian Reservation is located on the Colorado River near the point where the boundaries of Arizona, California, and Nevada meet. The tribe has reservation land in, and possesses present perfected Federal reserved water rights to Colorado River water in all three states, as specified in the Decree in *Arizona v. California* and the supplemental Decrees of 1979 and 1984. The tribe has rights to 129,767 AFY of Colorado River water, including 103,535 AFY in Arizona, 13,698 AFY in California, and 12,534 AFY in Nevada (Reclamation 2000).

The Chemehuevi Indian Reservation is located in southern California on plateau lands near the western shoreline of Lake Havasu. Pursuant to the Decree in *Arizona v. California* and the supplemental Decrees of 1979 and 1984, the tribe possesses present perfected Federal reserved water rights to 11,340 AFY of Colorado River water (Reclamation 2000).

The CRIT Reservation is located in southwestern Arizona and southeastern California, south of Parker, Arizona. In accordance with the Decree in *Arizona v. California* and the supplemental Decrees of 1979 and 1984, the CRIT possess present perfected Federal reserved water rights to 717,148 AFY of Colorado River water, including 662,402 AFY in Arizona and 54,746 AFY in California (Reclamation 2000).

The Fort Yuma Indian Reservation is located in southwestern Arizona and southeastern California north and west of Yuma, Arizona. Water for the tribe is diverted from the Colorado River at Imperial Dam and is delivered through the Yuma Project Reservation Division-Indian Unit. The tribe also has small uses at homestead sites south of Yuma. Pursuant to the Decree in *Arizona v. California* and the supplemental Decrees of 1979 and 1984, the Fort Yuma Quechan Tribe possesses present perfected Federal reserved water rights to 51,616 AFY of Colorado River water (Reclamation 2000).

The Cocopah Indian Reservation is located in southwestern Arizona, south of Yuma. The Cocopah Indian Tribe possesses present perfected Federal reserved water rights to 10,847 AFY of Colorado River water. The AFY figure cited here includes only that water diverted directly from the Colorado River at Imperial Dam (Reclamation 2000).

No Native American tribes, groups, or individuals have identified any specific ITAs during the public participation process for SCOP.

3.13 Traffic

This section describes the existing transportation and traffic conditions within the proposed project areas. Brief descriptions of the highways and roads are presented. Information regarding traffic conditions and levels of service is presented as background to describe the current operating conditions for the roadway segments in the proposed project area.

3.13.1 Existing Roadway Network

The roadway network in the study area is primarily located in the outskirts of the Valley. Principal regional highways and local arterials comprise the roadway network in the vicinity of the proposed project.

3.13.1.1 Principal Regional Highways

The following principal regional highways are located within the study area.

3.13.1.1.1 US 93

A major highway, US 93 extends from Hoover Dam northwest through Boulder City and Henderson. The highway crosses through the LMNRA as shown on Figure 2.2-4. Eventually, US 93 turns into US 95/US 515 north of the Railroad Pass interchange. Traffic on US 93 includes all types of recreational vehicles at Lake Mead, commuter vehicles, construction vehicles, and large commercial trucks traveling between Arizona and Nevada.

3.13.1.1.2 Boulder Highway

Boulder Highway, also known as State Route (SR)-582, proceeds northwest from Boulder City, through Henderson, and into Las Vegas. Once within the CLV, Boulder Highway becomes a primary route that bisects the CLV. In the vicinity of the proposed project, Boulder Highway is a one or two lane road in each direction. Traffic on Boulder Highway consists mainly of commuter vehicles and commercial vehicles traveling to and from work or places of business.

3.13.1.1.3 Lake Mead Parkway

Lake Mead Parkway, also known as SR-146, runs east-west along the southern portion of the Valley through Henderson between US 515 and I-15, and turns into Lakeshore Drive (Figure 2.2-4). In the vicinity of the proposed project, Lake Mead Parkway is a local highway that has a functional classification of principal and minor arterial. The roadway has between two and three travel lanes in each direction and is located south of the proposed project. The majority of the vehicles on Lake Mead Parkway are recreational vehicles traveling to Lake Mead, or construction vehicles going to project sites.

3.13.1.1.4 Lake Mead Boulevard

Lake Mead Boulevard, also known as SR-147, a state highway, runs east-west between North Las Vegas and Lake Mead (Figure 2.2-4). The highway changes direction on the east side of Frenchman Mountain and runs southwest through the LMNRA to the COH. State Road-147 carries mostly recreational vehicles and has one travel lane in each direction within the proposed project area. State Road-147 turns into SR-146 at US 515.

3.13.1.1.5 Lakeshore Drive

Lakeshore Drive, also known as Boulder Beach Road, is a rural highway that runs north-south along the western shoreline of Lake Mead. The roadway primarily carries recreational vehicles. Lakeshore Drive has one travel lane in each direction.

3.13.1.2 Local Arterials

South Hollywood Boulevard is an open public road that would provide access to the EI portion of the proposed project (Figure 2.2-4). This road is currently unpaved and under construction in association with other project improvements in the area (e.g., Desert Inn Master Planned community), therefore the conditions of the road are expected to improve. Continuing further south along the EI alignment, South Hollywood Boulevard turns into Telephone Line Road just east of the CCWRD AWT. Both roads are open to the public. The majority of the traffic on these roads consists of construction and maintenance vehicles (e.g., trucks and large earth-moving equipment) accessing the Las Vegas Wash and the AWT facility. Minimal residential vehicles use this road.

Other roads north of the proposed EI and perpendicular to Telephone Line Road include Kodachrome Road, Rainbow Gardens Road, and Lava Butte Road. The roads lead into Rainbow Gardens and the SMA. Traffic on these roads is minimal consisting of recreational vehicles.

Roads located south and east of the EI include Lake Las Vegas Parkway, Montelago Boulevard, Pabco Road, and Rebel Road (Figure 2.2-4). Traffic on these roads is mainly construction vehicles.

3.13.2 Level of Service

Perhaps the single most reliable statistic available to guide the highway engineer and the project planners are the type and volume of traffic on each section of highway that may be impacted by the proposed project. The Nevada Department of Transportation (NDOT) collected traffic volumes in short periods (7 days) and calculated to Annual Average Daily Traffic at various intersections throughout the Valley (NDOT 2002).

The Level of Service (LOS) is a term that describes the quality of traffic flow. There are six defined LOSs, A through F, which relate to traffic congestion from best to worst, respectively. In general, level A represents free-flow conditions with no congestion or delay. Conversely, level F represents severe congestion with stop-and-go conditions.

Table 3.13-1 summarizes the LOS definitions. These criteria are based upon the *Highway Capacity Manual* (Transportation Research Board [TRB] 1985). Calculating LOS for roadway segments involves the computation of a roadway's supply and demand characteristic. Supply is characterized as the roadway segment's carrying capacity expressed in some unit of time such as vehicles per day. Demand is characterized as the volume of traffic on the roadway segment, also expressed in a unit of time such as vehicles per day.

Once the supply and demand of the roadway segment are determined, the segment's volume to capacity ratio (V/C) is calculated and the LOS for a particular traffic demand is identified. Maximum traffic carrying capacities for typical roadway cross sections would be used for volume to capacity calculations, as shown in Table 3.13-2. Existing LOS conditions for major roadways and intersections, potentially within the proposed project area, are provided in Table 3.13-3. All roadway segments for which traffic data is available currently operate at favorable conditions LOS A, except one. Boulder Highway north of Water Street currently operates at a LOS F (Table 3.13-1).

3.14 Paleontological Resources

Paleontological resources (fossils) are the evidence of past life found in the geologic record. This evidence contains the remains or traces of plants and animals that existed during the 600 million year geological history of southern Nevada. Because of the infrequency of fossil preservation, fossils are unique, non-renewable resources that provide clues to the history of life on earth and, as such, have scientific value.

The State of Nevada made statutory provisions for the protection of paleontologic resources in the *State of Nevada Antiquities Law of 1959* (NRS 382-195-227). This statute made the Board of Trustees of the Nevada State Museum responsible for the preservation of prehistoric and historic sites on state lands through the issuance of antiquities permits to qualified persons and institutions.

Section 3.8 provides a description of the geologic formations in the SCOP project area. Areas that have a high potential for containing significant paleontologic resources are designated as high sensitivity areas. The Horse Spring Formation and Muddy Creek Formation were determined to have high paleontologic sensitivity (Figure 3.14-1).

The Horse Spring Formation has been characterized as being poorly fossiliferous (containing fossils). Longwell and others (1965) stated, "(t)he only fossils reported from the Horse Spring Formation in and near Moapa Valley are fragmentary plant stems and leaves."

However, certain zones within this formation have documented occurrences of plant fossils and ichnites (fossilized animal trackways) near the SCOP project area.

The Muddy Creek Formation has long been recognized as having high paleontologic sensitivity. Vertebrate fossils of extinct Miocene (23.3 million years before present), and Pliocene (5.2 million years before present) taxa including camels, rhinoceroses, horses, and smaller animals such as amphibians and reptiles, have been previously reported. Ichnites are also known to occur in the Muddy Creek Formation. Although fossils recovered from this formation are occasionally locally abundant, when found they often consist of isolated and poorly-diagnostic remains. "Diagnostic" refers to the usefulness of the fossil with regard to obtaining information of scientific worth. Therefore, while the Muddy Creek Formation is fossiliferous, and consequently assigned high paleontologic sensitivity, diagnostic fossils are infrequent at best; only occasionally are localized concentrations of diagnostic fossils found (San Bernardino County Museum [SBCM] 2004).

Table 3.13-1 Level of Service Criteria for Roadway Segments.

Level of Service	Interpretation	Nominal Range of Volume-to-Capacity Ratio
A	Low volumes, primarily free-flow operations. Density is low, and vehicles can freely maneuver within the traffic stream. Drivers can maintain their desired speeds with little or no delay.	0.00 – 0.60
B	Stable flow with potential for some restriction of operating speeds due to traffic conditions. Maneuvering is only slightly restricted. The stopped delays are not bothersome, and drivers are not subject to appreciable tension.	0.61 – 0.70
C	Stable operations, however, the ability to maneuver are more restricted by the increase in traffic volumes. Relatively satisfactory operating speeds prevail, but adverse signed coordination or longer queues cause delays.	0.71 – 0.80
D	Approaching unstable traffic flow, where small increases in volume could cause substantial delays. Most drivers are restricted in their ability to maneuver and in their selection of travel speeds. Comfort and convenience are low but tolerable.	0.81 0.90
E	Operations characterized by significant approach delays and average travel speeds of one-half to one-third the free-flow speed. Flow is unstable and potential for stops of brief duration.	0.91 – 1.00
F	Forced-flow operations with high approach delays at critical signaled intersections. Speeds are reduced substantially, and stops may occur for short or long periods of time because of downstream congestion.	1.01 +

Table 3.13-2 Level of Service E Maximum Traffic-Carrying Capacities.

Facility Cross Section	Daily Capacity (vehicles/day)
2-Lane	15,000
4-Lane	30,000
6-Lane	45,000

Source: TRB 1980.

Table 3.13-3 Existing Roadway Characteristics.

Segment	Volume [1] (vehicles/day)	Capacity [2] (vehicles/day)	Lanes	V/C [3]	Level of Service
Lake Mead Blvd. north of SR-146 (Lake Mead Parkway) and Lakeshore Drive	1,920	15,000	2	0.13	A
Lakeshore Drive north of US 93	2,350	15,000	2	0.10	A
Lakeshore Drive north of Lake Mead Fish Hatchery Road	1,700	15,000	2	0.11	A
US 93 North of Lakeshore Drive	13,300	22,500	3	0.59	A
SR-582 (Boulder Highway) north of Water Street	36,700	30,000	4	1.22	F
Lake Las Vegas Parkway north of SR-146 (Lake Mead Parkway)	3,800	15,000	2	0.25	A
Hollywood Blvd. south of Vegas Valley Drive	1,500	15,000	2	0.10	A

Notes:

[1] Actual volume of traffic.

[2] Roadway capacity.

[3] V/C ratios are calculated based on typical traffic-carrying capacities from the Highway Capacity Manual (TRB 1985) Table 3.13-3.

Sources: NDOT 2002, TRB 1985.

Field surveys were conducted by SBCM from September 2003 through February 2004 at areas in the Valley. One previously unrecorded paleontologic resource locality was identified from the Horse Spring Formation. The location of the site was recorded using handheld GPS transceivers, and the presence of the fossils was documented in field notes that included preliminary field identifications. The locality data for this site has been entered into the Regional Paleontologic Locality Inventory at the SBCM. In accordance with the survey permit requirements no fossils were collected. There were no paleotological resources found in the Muddy Creek Formation (SBCM 2004).

Based on the level of existing disturbance in relation to the proposed EI alignment, any paleontological resources that may have existed previously have been destroyed through previous construction activities. The LCS portion of the proposed project would include underground drilling up to 515 ft (157 m) below the surface. The LCS portion of the proposed project is not in an area designated as having high paleontologic sensitivity (Figure 3.14-1).

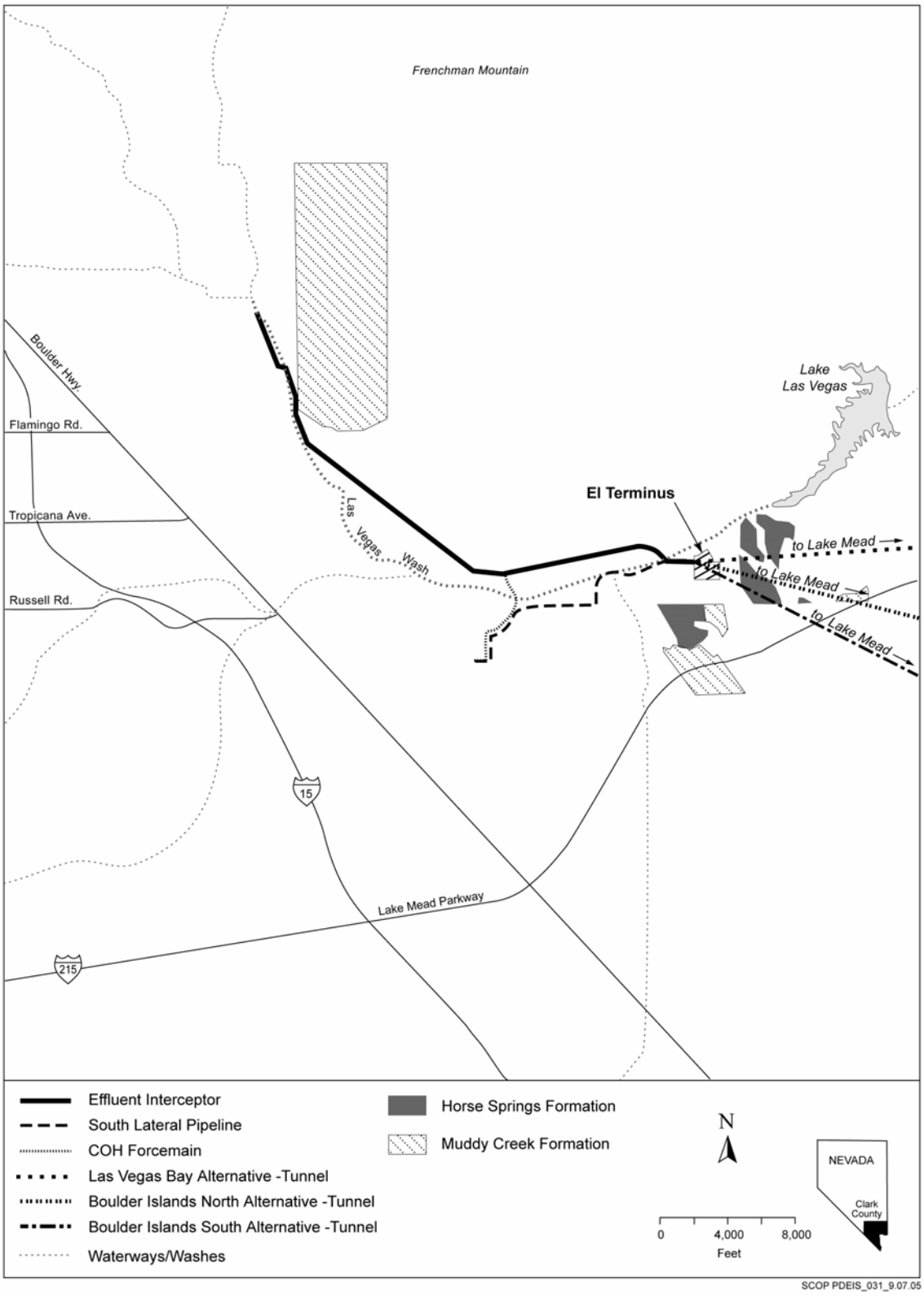


Figure 3.14-1 Areas of Potentially High Paleontological Sensitivity.

Chapter 4

Environmental Consequences

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4.0 Environmental Consequences

This chapter presents the environmental consequences, direct and indirect effects, of implementing the five alternatives described in Chapter 2, Description of Alternatives. Resources are detailed based on the environmental setting specific to the described resource (Chapter 3) as they are potentially impacted. Environmental consequences are detailed in the order of presentation of the fourteen resources described in Chapter 3. Therefore, Chapter 2 described the proposed alternatives, Chapter 3 described the environmental setting into which the action is being proposed, and Chapter 4 describes the environmental consequences of implementing the alternatives. The detailed description of each alternative is presented in Chapter 2. To assist the reader, a brief description of the alternatives is presented below.

No Action Alternative

Under the No Action Alternative the CWC would not construct pipelines to transport effluent from the treatment facilities. The three treatment agencies would expand and optimize their facilities to handle the increasing quantities of wastewater through 2050. Current, conventional treatment processes would continue to be used to attempt to meet the requirements set by the NDEP through the NPDES permitting program. Plant optimization would be implemented when current treatment processes alone could not treat wastewater to levels needed to meet water quality objectives. Facility expansions and modifications would occur on lands currently owned by the CLV, Clark County, and COH.

Boulder Islands North Alternative (Preferred Alternative)

This alternative includes increased treatment (as needed) and a pipeline that would bypass the majority of the lower Las Vegas Wash via the EI. Highly treated effluent discharged from each of the treatment facilities would be collected and transported to a receiving area in the vicinity of the Boulder Islands. Hydroelectric power would be generated at the HPRS located on NPS land near the AMSWTF. The power would be transmitted for use at the AMSWTF. The three wastewater treatment agencies would expand their facilities to handle the increasing quantities of wastewater through 2050. Current, conventional treatment processes and plant optimization, as needed, would be used to meet the requirements set by the NDEP through the NPDES permitting program. The TP loading from effluent discharged through the LCS and the Las Vegas Wash into the Boulder Basin would not exceed the current WLA on an average annual basis during ordinary conditions. As described in Section 2.2.2.6, the Boulder Basin AMP would be implemented to address concerns about the effects that may result from the discharge of highly treated effluent into Lake Mead in the vicinity of the Boulder Islands. This alternative is broken up into two main pipeline segments: the EI-Alignment A and the Boulder Islands North LCS. The EI-Alignment A portion would include connection structures to the treatment plants. The Boulder Islands North LCS would include a HPRS near the AMSWTF, a diffuser, and working shafts.

Boulder Islands South Alternative

This alternative includes increased treatment (as needed) and a pipeline that would bypass the majority of the lower Las Vegas Wash via the EI. Highly treated effluent discharged from each of the treatment facilities would be collected and transported to either the Las Vegas Wash upstream of Lake Las Vegas,

or transported to a receiving area in the vicinity of the Boulder Islands. The three wastewater treatment agencies would expand their facilities to handle the increasing quantities of wastewater through 2050. Current, conventional treatment processes and plant optimization, as needed, would be used to meet the requirements set by the NDEP through the NPDES permitting program. The TP loading from effluent discharged through the LCS and the Las Vegas Wash into the Boulder Basin would not exceed the current WLA on an average annual basis during ordinary conditions. As described in Section 2.2.2.6, the Boulder Basin AMP would be implemented to address concerns about the effects that may result from the discharge of highly treated effluent into Lake Mead in the vicinity of the Boulder Islands. This alternative is broken up into two main pipeline segments: the EI-Alignment B and the Boulder Islands South LCS. The EI-Alignment B portion would include connection structures to the treatment plants and the EI Terminus facility. The Boulder Islands South LCS would include a PRS near the end of the Boulder Islands LCS, a diffuser, and working shafts.

Las Vegas Bay Alternative

This alternative would also include increased treatment (as needed) and a pipeline that would bypass the majority of the lower Las Vegas Wash via the EI, with the associated facilities. Highly treated effluent discharged from each of the CWC's treatment facilities would be collected in a pipeline and transported to an alternate receiving area in the Las Vegas Bay. The three treatment agencies would expand their facilities to handle the increasing quantities of wastewater through 2050. Current, conventional treatment processes and optimization, as needed, would be used to meet the requirements set by the NDEP through the NPDES permitting program. The TP loading from effluent discharged through the LCS and the Las Vegas Wash into the Boulder Basin would not exceed the current WLA on an average annual basis during ordinary conditions. As described in Section 2.2.2.6, the Boulder Basin AMP would be implemented to address concerns about the effects that may result from the discharge of highly treated effluent into Lake Mead in the vicinity of the Las Vegas Bay. The Las Vegas Bay LCS would include a PRS, a diffuser, and working shafts.

Process Improvements Alternative

Under the Process Improvements Alternative, a pipeline would not be constructed. Highly treated effluent would continue to be discharged to the Las Vegas Wash at the existing discharge locations, and effluent flows would continue to enter the Las Vegas Bay for mixing and diffusion in an uncontrolled fashion.

In addition to current, conventional treatment processes and plant optimization, best available technologies would be implemented to maintain an acceptable TP loading. Membranes (MF/UF) are presented as an example of the type of technology that may be implemented to achieve the target TP levels. However, as technologies change and improve, other technologies may be implemented.

Direct and Indirect Effects, and Impairment of LMNRA Resources

The terms "impact" and "effect" are synonymous. Impacts can be direct, indirect, or cumulative. A direct impact is caused by the action and occurs at the same time and place. An indirect impact occurs later in time or farther removed in distance but is related to the action by a chain of cause and effect.

Indirect impacts may reach beyond the natural and physical environment (i.e., environmental impact) to include effects related to induced changes to resources users (i.e., non-environmental impact).

An impact is defined as adverse or beneficial. An impact is considered adverse when the outcome of the action results in undesirable effects. A beneficial impact can result if the current condition is improved or if an existing undesirable effect is lessened. The analysis focuses on those impacts that were adverse to determine whether the effects were significant or insignificant. The criteria used to differentiate between significant and insignificant are introduced in each resource section.

The NPS is prohibited from impairing LMNRA resources and values as directed by the *National Park Service Organic Act* (16 USC 1). The NPS *Management Policies* (NPS 2001a) state "an impairment…is an impact that, in the professional judgment of the responsible NPS manager, would harm the integrity of park resources or values, including the opportunities that otherwise would be present for the enjoyment of those resources or values." Impairment to LMNRA resources and values has been analyzed within this document. An impact would be more likely to constitute an impairment to the extent that it affects a resource or value whose conservation is necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the LMNRA, is the key to the natural or cultural integrity of the LMNRA or to opportunities for enjoyment of the LMNRA, or is identified as a goal in the LMNRA's *General Management Plan* (NPS 1986) or other relevant NPS planning documents. An impact would be less likely to constitute an impairment to the extent that it is an unavoidable result, which cannot be reasonably further mitigated, of an action necessary to preserve or restore the integrity of LMNRA resources or values. In addition, NPS *Management Policies* state "whether an impact meets this definition depends on the particular resources and values that would be affected; the severity, duration, and timing of the impact; the direct and indirect effects of the impact; and the cumulative effects of the impact in question and other impacts" (NPS 2001a).

The determination of impairment is closely tied to the outcome of the resource impact analysis. This determination is also made with a parallel consideration of the LMNRA's legislative mandates (purpose and significance) and resource management objectives as defined in the park's *General Management Plan* (NPS 1986), *Strategic Plan* (NPS 2001c), and *Resource Management Plan* (NPS 1999).

In addition to NPS Management Policies, the LMNRA was directed by Congress to be managed for general purposes of public recreation, benefit, and use, and in a manner that will preserve, develop, and enhance, so far as practicable, the recreation potential, and in a manner that will preserve the scenic, historic, scientific, and other important features of the area, consistently with applicable reservations and limitations relating to such area and with other authorized uses of the lands and properties within such area (PL 88-639).

Significance Criteria

The NEPA requires consideration of significance of affect in both context and intensity. Context means the significance of the action must be analyzed looking at several factors such as society as a whole, the affected region, specific interests, and the locality. Both short- and long-term effects are relevant. The level of significance varies with the proposed action and its possible effect on specific resources.

Intensity refers to the severity of impact to each specific resource. Impacts may be both beneficial and adverse. A significant effect may exist even if the federal agency believes that on balance, the effect

would be beneficial. Intensity is measured by the degree to which the proposed actions affect each specific resource. Federal, state, and local laws are also considered in evaluating the level of intensity an effect may have on specific resources.

The following process was used to determine whether the SCOP alternatives would have the potential to impair LMNRA resources and values:

- The LMNRA's *Enabling Legislation* (PL 88-639), *General Management Plan* (NPS 1986, *Strategic Plan* (NPS 2001c), and *Resource Management Plan* (NPS 1999) were reviewed to ascertain the LMNRA's purpose and significance, resource values, and resource management goals or desired future conditions.
- Management objectives specific to resource protection goals at the LMNRA were identified.
- Thresholds were established for each resource of concern to determine the context, intensity, and duration of impacts.
- An analysis was conducted to determine if the magnitude of the impact reaches the level of impairment defined in NPS Management Policies (NPS 2001a). The impact analysis includes any findings of impairment to LMNRA resources and values for each of the SCOP alternatives.

Mitigation

Mitigation measures are used to lessen adverse environmental impacts. Specific actions that may be considered when determining mitigation measures include:

- Avoiding the impact altogether by not taking a certain action or parts of an action;
- Minimizing impacts by limiting the degree or magnitude of the action and its implementation;
- Correcting the impact by repairing, rehabilitating, or restoring the affected environment;
- Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; and
- Compensating for the impact by replacing or provide substitute resources or environments.

Each alternative represents a different possible impact to individual resources; therefore the level of proposed mitigation measures differs with each resource. Although mitigation measures are typically implemented to minimize or eliminate significant impacts, actions that would minimize or eliminate insignificant impacts are also described in the following sections.

4.1 Water Resources

This section focuses on the potential impacts to surface water and drainage, groundwater, and water quality that may result from the proposed alternatives.

Water quality impacts to the Las Vegas Wash, Lake Mead, and downstream of Hoover Dam as a result of the SCOP alternatives were considered. Water quality impacts to the Las Vegas Wash were analyzed using the Las Vegas Wash Model, which is discussed in detail in the *Final Las Vegas Wash Modeling Report* (Black & Veatch 2005a), and impacts to Lake Mead were analyzed using the Lake Mead Model, which is discussed in detail in the *Lake Mead Water Quality Modeling Report* (Black & Veatch 2005b).

Water quality impacts to water resources downstream of Hoover Dam were analyzed using the Lake Mohave Model, which is described in the *Lake Mohave Model Report* (J.E. Edinger Associates 2003). Additional information about the models is presented in Appendix D. In addition to using the models, water quality impacts were investigated by reviewing and evaluating data, scientific studies, historical reports, and other documents; and by consulting with persons with special knowledge or expertise about the issue.

The goal of the Las Vegas Wash modeling effort was to analyze the effects on water quality in the Las Vegas Wash from the various effluent flows. The Las Vegas Wash Model was created in a Microsoft Excel workbook format based on existing data and then used to model flow, temperature, TIN, TP, selenium, and TDS in the Las Vegas Wash. The Las Vegas Wash Model generally uses a mass balance approach, which assumes whatever exits a segment of the Las Vegas Wash is equal to whatever enters the segment (plus any gains or losses through the segment). It also considers the Las Vegas Wash as a set of cells rather than focusing only on sampling locations. Additional information regarding the methodology used during the Las Vegas Wash modeling effort is presented in Appendix D.

The primary goal of the Lake Mead modeling effort was to study the consequences of alternate discharge locations on water quality in the Boulder Basin of Lake Mead. Water quality impacts to Lake Mead from each of the alternatives were analyzed using two steps: a hydrodynamic simulation and a biochemical simulation. Two linked models were used to perform the analysis: the ELCOM and the CAEDYM. The ELCOM is a stand-alone three-dimensional hydrodynamic code, whereas CAEDYM is a water quality module that uses ELCOM as its hydrodynamic "driver." The outcome of the hydrodynamic simulation, ELCOM, is a detailed characterization of water movement and mixing in the Lake, coupled with a description of the thermal stratification. The biochemical simulation, CAEDYM, computes interactions between biological organisms and the chemistry of their nutrient cycle. The coupled models proved to be an effective tool to study the spatial and temporal relationships between physical, biological, and chemical variables in Lake Mead. Although, all models have uncertainties, they are useful for comparison purposes and they provide a good replication of trends that may be expected.

The errors of the model output are identified by determining the differences between the field and model averages. These errors are then combined over the four calendar years using the conservative "Root Mean Square" (RMS) method (Lorden 2004). Specifically, the RMS error is obtained by averaging the squares of the errors and taking the square root of the result. The percent RMS errors generally range from 10.4 percent to 13.5 percent.

The estimated percentage of model confidence for all modeled parameters is shown in Table 4.1-1. The confidence levels are a statistical indication of the modeled data matching with the actual data sets. The confidence level does not imply a greater or less certainty about the model results. It is only an indication of how the model, which uses an hourly averaging to determine modeled data, compares with a data set that is collected on a bi-monthly basis, and in many cases, the raw data sets are for a 6 to 9 month period of a given year. The confidence levels shown in Table 4.1-1 are interpreted as: the modeled temperature was within 13 percent of the actual temperature for specified dates/times; the modeled TP levels were within 25 percent of the actual levels measured. It should be noted that the percentage model confidence limits for each parameter are relative to the change in concentration above the background level. A detailed description of the methodology used to calculate the confidence levels for the model estimates is provided in Appendix D.

Table 4.1-1 Estimated Model Confidence Levels for Parameters.

Parameter	Estimated Percentage [1] Model Confidence Levels (percent)
Temperature (°C [°F])	13
Perchlorate (µg/L)	13
Effluent Tracer (%)	13
Conductivity (µS/cm)	13
Total Dissolved Solids (mg/L)	13
Dissolved Oxygen (mg/L)	25
Chlorophyll (µg/L)	35
Total Phosphorus (mg/L)	25
Total Nitrogen (mg/L)	25
Total Ammonia Nitrogen (mg/L)	25
Un-ionized Ammonia (mg/L) (NH_3)	25
Bromide (mg/L)	13
Sulfate (mg/L)	13
Chloride (mg/L)	13

Note:
[1] Relative to the difference between model estimate and background level.

The models are described in the *Lake Mead Water Quality Modeling Report* (Black & Veatch 2005b). The year 2002 was selected as the baseline year because there is a large amount of in-lake water quality data and inflow/outflow data available for this period and because Lake levels had dropped substantially from previous levels by 2002. Simulations using the ELCOM/CAEDYM model were performed for the years 1999 through 2003 (Black & Veatch 2005b). Of those years, complete destratification of Lake Mead occurred in 1999, 2001, and 2002. Complete destratification did not occur in 2000 and 2003 (LaBounty & Burns 2005). The modeling indicates that there is no accumulation of effluent when it is discharged into the hypolimnion through a diffuser, whether complete destratification of the Lake occurs or not. This is mainly a result of the effluent being significantly warmer and thus less dense than the ambient reservoir water (see Attachment 1 in Appendix D). Additional information regarding the baseline year is presented in Section 3.1.3 and Appendix D, and additional information regarding the modeling results is provided in Appendix D.

Although the models provide water-quality data throughout all of Boulder Basin, several locations were identified as representative of particular areas (Figure 4.1-1). Stations LVB1.85M and LVB2.7 were selected to represent the inner Las Vegas Bay near the mouth of the Las Vegas Wash. The first of these two stations is mobile, and is located where the water depth is 16 to 18 m (52 to 59 ft); it compensates for dropping Lake levels by moving farther out into the Las Vegas Bay. The second of these stations, LVB2.7 is fixed, and it therefore does not compensate for falling Lake levels. As the Lake decreases the water levels at LVB2.7 decrease until it goes dry.

Station CR346.4, near Sentinel Island, was selected to generally represent the Boulder Basin. Boulder Beach was selected for beachfront water quality. The SNWA intakes were selected to represent raw drinking water quality. The combined flow from the upper and lower penstocks at Hoover Dam was selected to characterize flows going through the dam.

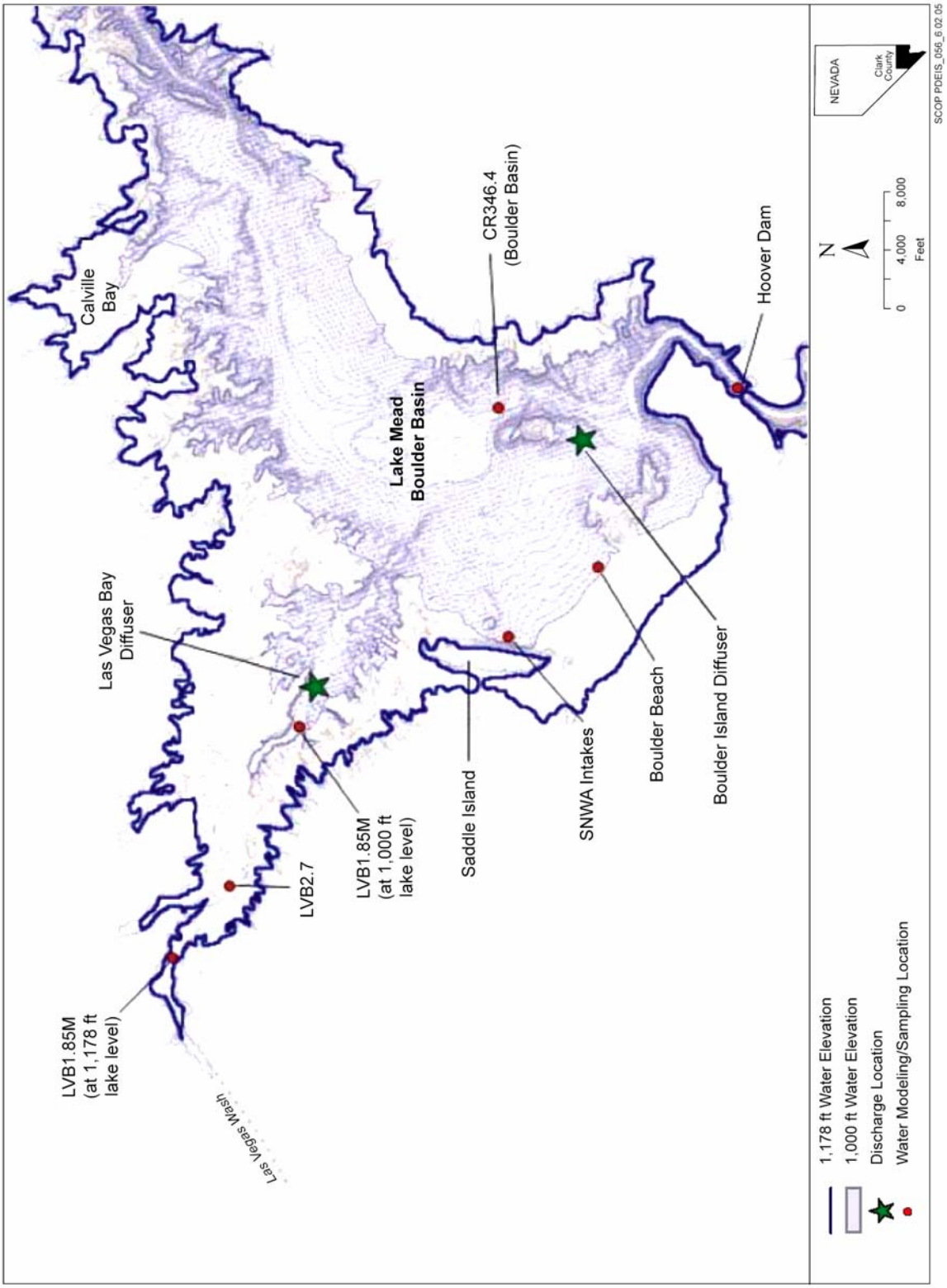


Figure 4.1-1 Water Quality Modeling/Sampling and Discharge Locations in Lake Mead.

In November 2004, the Nevada State Environmental Commission changed the station locations used for determining compliance with water-quality standards for chlorophyll. New stations will be used for data collection, and for determining compliance with standards in the future. Existing stations are used in evaluating water quality effects in this EIS, because until recently all data have been collected from existing stations.

Each alternative discharge location was evaluated with total annual effluent flows of 300 mgd (462 cfs), which is the average effluent flow expected in 2030 (see Table 2.1-1), and at the higher average effluent flow of 400 mgd (616 cfs) expected in 2050. Furthermore, each of these future flow conditions (2030 and 2050) were evaluated for a nominal Lake level of 1,178 ft (359 m), which was the initial Lake level in the model baseline year of 2002, and for a nominal Lake level of 1,000 ft (305 m), the lowest level that Lake Mead is expected to fall during a severe drought. As discussed in Section 1.5, the 1,000-ft (305 m) Lake level is used for planning purposes in this EIS because it is the level that has been discussed by the Colorado River states to be "protected" in future drought conditions, and has most recently been agreed to in the *Seven Basin States' Preliminary Proposal Regarding the Colorado River Interim Operations.*

To compare increased future wastewater effluent discharges in 2030 against the baseline, the models used the same hydrology and weather that occurred in 2002, but with an increased wastewater effluent flow of 300 mgd (462 cfs). In all simulations, the Lake begins the year at the nominal level of either 1,178 ft (359 m) or 1,000 ft (305 m), and then drops by approximately 25 to 35 ft (8 to 11 m) by the end of the year. The Las Vegas Bay would be reduced to approximately 10 percent of its volume than when the Lake was full, and would be somewhat isolated from the rest of Lake Mead when Lake levels reach 1,000 ft (305 m), as shown on Figure 4.1-1.

The tables in the following sections present data that were either interpolated or extrapolated from modeling results. The data for the No Action Alternative in 2030 and 2050 were extrapolated from simulations with effluent flow rates of 300 mgd (462 cfs) and 400 mgd (462 cfs) and effluent TP loadings of 275 and 334 lbs/day (125 and 151 kg/day). The data for the pipeline alternatives in 2030 were interpolated from simulations with effluent flow rates of 300 mgd (462 cfs) and effluent TP loadings of 275 and 467 lbs/day (125 and 212 kg/day). The data for the pipeline alternatives in 2050 were interpolated frm simulations with effluent flow rates of 300 mgd (462 cfs) and effluent TP loadings of 275 lbs/day (125 kg/day) and 467 lbs/day (212 kg/day) , and simulations with effluent flow rates of 400 mgd (616 cfs) and effluent TP loadings of 275 lbs/day (125 kg/day). The data for the Process Improvements Alternative in 2030 and 2050 for a lake level of 1,178 ft were interpolated from the same model simulations as the pipeline alternatives. The data for the Process Improvements Alternative in 2030 and 2050 at a Lake level of 1,000 ft were extrapolated from the same modeling simulations used to interpolate concentrations for a Lake level of 1,178 ft.

The parameter concentrations may be presented using up to four significant figures depending on the concentration level. Confusion may occur because the value presented in the table is below the minimum detection limit for that parameter. For example, the TP data collected has a detection limit of 0.01 mg/L, but the tables report some levels between 0.005 and 0.006 mg/L (5 to 6 ppb). This may cause one to doubt the reliability of the modeling results. However, the main purpose of the tables is to present a *direct* comparison of model results between various project scenarios under *identical* operating conditions and general assumptions.

The primary goal of the Lake Mohave modeling effort was to test the sensitivity of changing nutrient input to Lake Mohave on 1) the in-lake (Lake Mohave) water quality and 2) the nutrient discharged downstream of Davis Dam. CE-QUAL-W2, a time varying, longitudinal-vertical hydrodynamic and water quality model maintained by the Waterways Experiment Station of the USACE, was chosen for application to Lake Mohave. The setup of the Lake Mohave model included a representation of the Lake Mohave bathymetry and development of time varying boundary condition data sets for the periods from 1977 to 1978 and 1981 to 1982. Model simulations of these periods were compared to observations and some model coefficients were adjusted to ensure that the model adequately reproduced the observed behavior. Temperature simulations were compared to observations for both simulation periods, but water quality simulations were compared to observations only for 1981 to 1982.

For illustration purposes, two simple load increase scenarios were used in the model. In these two scenarios, all nutrient inputs at Hoover Dam were increased by 25 percent and 100 percent. The loading factors for Lake Mohave were selected to provide a sensitivity level that would negatively impact Lake Mohave. The Lake Mohave model indicates that a 25 percent increase in TP loading would not negatively impact Lake Mohave. The loading through Hoover Dam is not expected to exceed a 25-percent increase under any alternative. Therefore, the project would not result in a negative impact to Lake Mohave.

Results of these two scenarios, which were developed using upstream boundary and meteorological data available for year 2000, suggest that a portion of the nutrient added in excess of the baseline load will be retained in Lake Mohave. The retention of excess load appears to be higher than the retention of the baseline load.

The surface water quality analysis in this EIS uses the approach illustrated in Figure 4.1-2. The results for each alternative were compared to the baseline (2002) modeled conditions, which are presented in Chapter 3. All of the scenarios (years 2030 and 2050, each at 1,178 ft and 1,000 ft lake levels) were compared to baseline conditions.

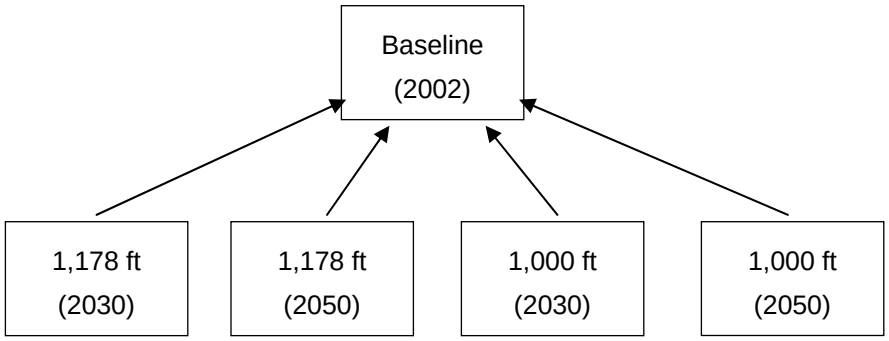


Figure 4.1-2 Water Quality Analysis Approach.

The current total WLA limit on phosphorus discharges to the Las Vegas Wash from the three municipal treatment facilities is 334 lbs/day (152 kg/day). For the No Action Alternative, the treatment facilities would be able to reliably achieve a combined total effluent phosphorus concentration of 0.14 mg/L on an annual average basis. In 2030, when flows are expected to be 300 mgd (462 cfs), at the TP concentration of 0.14 mg/L, the loading is 350 lbs/day (159 kg/day). In 2050, when flows are expected to be 400 mgd (616 cfs), at the TP concentration of 0.14 mg/L, the loading is 467 lbs/day (212 kg/day). Therefore, the No Action Alternative was analyzed for future (2030 and 2050) conditions using the TP loadings of 350 lbs/day (159 kg/day) and 467 lbs/day (212 kg/day), respectively.

Under the pipeline alternatives, a minimum of 30 mgd of treated effluent would be discharged to the Las Vegas Wash. The adaptiveness of these alternatives would allow for more flows to be discharged to the Las Vegas Wash if needed. However, the combined TP loading between the Las Vegas Wash and the diffuser for the pipeline alternatives would not exceed 334 lbs/day (152 kg/day). Therefore, a combined TP loading of 334 lbs/day (152 kg/day) for both the 2030 and 2050 conditions were analyzed for the Boulder Island alternatives and the Las Vegas Bay Alternative.

Under the Process Improvements Alternative, effluent flows would increase and continue to be discharged to the Las Vegas Wash. Membrane technologies such as MF/UF would be implemented to meet water quality standards. A TP loading of 334 lbs/day (152 kg/day) would meet water quality standards when the Lake level is at 1,178 ft. Therefore, a TP loading of 334 lbs/day (152 kg/day) was analyzed for future (2030 and 2050) conditions for the Lake level of 1,178 ft. However, the MF/UF process would only be able to reduce the TP loading to 165 lbs/day (75 kg/day). Therefore, the TP loading of 165 lbs/day (75 kg/day) was analyzed for future (2030 and 2050) conditions for the Lake level of 1,000 ft.

The project would have a significant impact on water resources if the project:

- Violates any water-quality standards or waste discharge requirements;
- Substantially depletes groundwater supplies or interferes substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level;
- Substantially alters the existing drainage pattern of the site or area, including the alteration of the course of a stream or river, in a manner that would result in substantial erosion or siltation on- or off-site;
- Substantially alters the existing drainage pattern of the site or area, including substantially increasing the rate or amount of surface runoff in a manner that would result in flooding on- or off-site;
- Creates or contributes runoff water that would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff; or
- Substantially degrades water quality.

The impairment analysis for water resources and water quality used the following criteria.

- *Negligible impacts*: Impacts are not detectable, are well within water-quality standards and/or historical ambient or desired water quality conditions, and have no principal effect on aquatic resources and systems.

- *Minor impacts*: Impacts are detectable but well within water-quality standards and/or historical ambient or desired water quality conditions; impacts are not expected to have an overall effect on aquatic community structure.
- *Moderate impacts*: Impacts are detectable, within water-quality standards, but historical baseline or desired water quality conditions are being altered on a short-term basis; impacts could have an appreciable effect on individual species dynamics, community ecology, or natural aquatic processes.
- *Major impacts*: Impacts are detectable and significantly and persistently alter historical baseline or desired water quality conditions. Water-quality standards are locally approached, equaled, or slightly singularly exceeded on a short-term and temporary basis; impacts have a substantial effect on individual species, community ecology, or natural aquatic processes.
- *Impairment*: Impacts are effects that alter baseline or desired water quality conditions on a long-term basis. Water-quality standards are exceeded several times on a short-term and temporary basis. Impacts result in the deterioration of water quality to the extent that the LMNRA's aquatic life and habitat no longer function as a natural system. Water quality impairment can affect other aspects of the natural environment dependent on the condition of this resource. Aquatic life are affected over the long-term to the point that the LMNRA's purpose (*Enabling Legislation* [PL 88-639], *General Management Plan* [NPS 1986], *Strategic Plan* [NPS 2001c]) could not be fulfilled and the resource could not be experienced and enjoyed by future generations.

4.1.1 No Action Alternative

The potential impacts to water resources that may result from the implementation of the No Action Alternative are described in this section. Under the No Action Alternative, the pipeline would not be built, and the treated effluent would continue to be discharged to the Las Vegas Wash. The three treatment agencies would expand their facilities to handle the increasing quantities of wastewater. Current, conventional treatment processes would continue to be used to attempt to meet the requirements set by the NDEP through the NPDES permitting program. Plant optimization would be implemented when current treatment processes alone could not treat wastewater to levels needed to attempt to meet water-quality objectives. The combined effluent discharge from the treatment plants into the Las Vegas Wash is projected to be 300 mgd (462 cfs) and 400 mgd (616 cfs) by the year 2030 and 2050 respectively (compared with the current discharge of 174 mgd [268 cfs]). If optimized treatment levels are implemented under this alternative, the phosphorus loading for 2030 and 2050 would be 350 lbs/day (159 kg/day) and 467 lbs/day (212 kg/day), respectively.

4.1.1.1 Surface Water & Drainage

The effluent discharged from the treatment plants is the largest source of flow in the Las Vegas Wash during dry weather. Erosion and degradation that has occurred over the last 50 years is in part due to the effluent flows, and in part due to storm events. An increase in the volume of water conveyed in the Las Vegas Wash during dry-weather flows would not significantly increase erosion and channel degradation. The SNWA's ongoing construction of ECSs and bank protection reduces the potential for future erosion in the Las Vegas Wash.

Wastewater flows would continue to be discharged to the Las Vegas Wash under the No Action Alternative. The process used to account for return flow credits would continue to be used. There would be no impact to return flow credits under the No Action Alternative.

4.1.1.2 Groundwater

Construction of the EI and LCS pipelines would not occur under the No Action Alternative. No impacts to the existing groundwater system would result from implementation of the No Action Alternative.

4.1.1.3 Surface Water Quality

This section addresses the effects of the No Action Alternative on surface water quality in the Las Vegas Wash and Lake Mead, including Las Vegas Bay, Boulder Basin, Boulder Beach, the SNWA intake structures, and at Hoover Dam. The impacts of this alternative are analyzed at projected 2030 flows, projected 2050 flows, and at Lake levels of 1,178 (359 m) and 1,000 ft (305 m).

4.1.1.3.1 Las Vegas Wash

Under the No Action Alternative, there would be an increase in effluent flows, but no expected increase in groundwater/urban runoff base flows in the Las Vegas Wash. Despite the increased population of the Valley, surfacing groundwater and urban over-watering are not expected to increase because of water conservation measures, which are described in Section 1.4.1.3.

As discussed in Section 3.1.3.3.1, dry-weather urban discharge and intercepted shallow groundwater currently contribute about 20 mgd, which is almost 15 percent of the annual flows in the Las Vegas Wash. The shallow groundwater contains high levels of TDS and many other substances including selenium and perchlorate. Although non-point source base flows would remain the same under the No Action Alternative, there would be increased dilution of groundwater constituents because effluent flows would increase. The extrapolations for the No Action Alternative in the Las Vegas Wash for the year 2030 and an effluent TP of 350 lbs/day are shown on Table 4.1-2. The extrapolations for the No Action Alternative in the Las Vegas Wash for the year 2050 and effluent TP of 467 lbs/day is shown on Table 4.1-3. The results show that TDS concentrations would decrease from the baseline 1,675 mg/L to 1,357 mg/L in 2030 and to 1,311 mg/L in 2050. Selenium concentrations would decrease from the 2.5 µg/L baseline condition to 2.0 µg/L in the year 2030 and 2050 conditions because of increased dilution. These changes are not likely to have significant environmental effects.

The level of perchlorate in the Las Vegas Wash was approximately 900 to 1,000 lbs/day (408 to 454 kg/day) in 1998, and decreased to approximately 120 to 130 lbs/day (54 to 59 kg/day) in 2004 (Croft 2004a). The decrease in perchlorate concentrations is the result of the groundwater remediation program, and levels are expected to be much lower in the future. Additional effluent flows in the Las Vegas Wash would provide additional dilution, which would lower perchlorate concentrations in the Las Vegas Wash, but not affect total pounds of load to Lake Mead.

Table 4.1-2 Las Vegas Wash Baseline Conditions and Extrapolations for the No Action Alternative [1] (year 2030 and effluent TP = 350 lbs/day).

Parameter	Baseline Conditions [2]	No Action Alternative [3]
Effluent Flow (mgd [cfs])	150 [231]	300 [462]
Temperature (°C [°F])	23 [73]	21 [69]
Total Inorganic Nitrogen (mg/L) – 95th percentile	15.0	14.6
Total Phosphorus (mg/L)	0.2	0.14
Total Dissolved Solids (mg/L)	1,675	1,357
Selenium (µg/L)	2.5	2.0

Notes:

[1] Location: LW 0.55 (Figure 4.1-1). This table is for comparison purposes. Other baseline parameters for the Las Vegas Wash are shown on Table 3.1-3.

[2] Source: COH 2002d.

[3] Results were extrapolated from model simulations with effluent flow rates of 300 mgd (462 cfs) and 400 mgd (462 cfs) and effluent TP loadings of 275 and 334 lbs/day. Source: Black and Veatch 2004d.

Table 4.1-3 Las Vegas Wash Baseline Conditions and Extrapolations for the No Action Alternative[1] (year 2050 and effluent TP = 467 lbs/day).

Parameter	Baseline Conditions [2]	No Action Alternative [3]
Effluent Flow (mgd [cfs])	150 [231]	400 [616]
Temperature (°C [°F])	23 [73]	21 [69]
Total Inorganic Nitrogen (mg/L) – 95th percentile	15.0	14.8
Total Phosphorus (mg/L)	0.2	0.14
Total Dissolved Solids (mg/L)	1,675	1,311
Selenium (µg/L)	2.5	2.0

Notes:

[1] Location: LW 0.55 (Figure 4.1-1). This table is for comparison purposes. Other baseline parameters for the Las Vegas Wash are shown on Table 3.1-3.

[2] Source: COH 2002d.

[3] Results were extrapolated from model simulations with effluent flow rates of 300 mgd (462 cfs) and 400 mgd (462 cfs) and effluent TP loadings of 275 and 334 lbs/day. Source: Black and Veatch 2004d.

Additional SNWA ECSs are being installed in the Las Vegas Wash, thereby reducing velocities and settling out sediments. Because of these ECSs, TSS concentrations are not expected to increase above current conditions. Other parameters are not expected to change significantly. For example, the increase in effluent flow is not expected to cause a significant deviation in pH from the existing level, because effluent pH is not expected to change. The DO concentration is not expected to change because the level of oxygen-demanding substances would remain low.

Under the No Action Alternative, parameters contained within wastewater effluent discharges in 2030 and 2050 are expected to remain as they were in 2002, except that flows would increase. The presence of constituents such as EDCs and other emerging compounds of concern would increase as effluent flows to the inner Las Vegas Bay increase. The wastewater treatment facilities would be expanded to provide greater capacity for the increased wastewater flows, using current conventional treatment processes and plant optimization.

Tables 4.1-2 and 4.1-3 show that the 95th percentile RMHQ standard for TIN of 17 mg/L (Table 3.1-2) would not be exceeded in the Las Vegas Wash. In addition, TIN is expected to decrease in 2030 and 2050 to less than baseline conditions (Table 3.1-3). The treatment plants have had some exceedances in recent years. Water conservation measures in the Valley have increased the influent and effluent concentrations of many substances, including TIN. Furthermore, in some treatment processes, the concentration of effluent TIN is inversely related to the concentration of effluent phosphorus. If treatment processes are adjusted to remove additional phosphorus, the effluent concentration of TIN is likely to increase. Conversely, if treatment processes are adjusted to maintain TIN within standards, the plants may not be able to remove as much phosphorus. The standard for iron may also be exceeded. However, the source of iron is believed to be eroded soil, and the ECSs are expected to reduce soil erosion.

4.1.1.3.2 Lake Mead

Table 4.1-4 presents the concentrations predicted in Boulder Basin of Lake Mead from the No Action Alternative for the year 2030 when the projected annual average effluent flow is 300 mgd (462 cfs). The results are based upon a Lake level of 1,178 ft (359 m) and an effluent TP loading of 350 lbs/day (159 kg/day).

Most of the parameters modeled in Lake Mead and reported in Table 4.1-4 are not significantly affected by the No Action Alternative in 2030. There are slight increases in the concentration of most parameters, but the increases are minimal and do not result in exceedances of water-quality standards (Table 3.1-2). The concentrations at the SNWA intakes of many inorganic substances, including bromide, sulfate, and chloride, which are relevant to drinking water, are similar in all simulations to the baseline conditions. The same would be true for perchlorate, which is also relevant to drinking water and originates in groundwater discharged into the Las Vegas Wash; however, the concentrations of perchlorate are expected to be lower than baseline due to the groundwater remediation program as discussed in Sections 3.1.3.2 and 4.1.1.3.1. Because these parameters are not significantly affected by the No Action Alternative, they receive little discussion in the following sections.

Table 4.1-5 and Figure 4.1-3 show that the No Action Alternative does not improve, and actually increases existing elevated chlorophyll concentrations in the inner Las Vegas Bay, Boulder Basin, and Boulder Beach in the year 2030 with a Lake level of 1,178 ft. Baseline chlorophyll levels are shown on Figure 3.1-11. Phosphorus loadings entering the Lake through the Las Vegas Wash would continue to be mixed into the epilimnion, as they are under baseline conditions, and would continue to produce elevated chlorophyll concentrations in the inner Las Vegas Bay. In the inner Las Vegas Bay, phosphorus is mixed into the epilimnion where there is sufficient light for algae to grow.

Table 4.1-4 Lake Mead Extrapolations for the No Action Alternative[1]
(1,178-ft [359-m] Lake level for year 2030 with effluent flows of 300 mgd [462 cfs] and effluent TP = 350 lbs/day).

Parameter	Inner Bay (LVB1.85M) [2]		Inner Bay (LVB2.7)		Boulder Basin (CR346.4)		Boulder Beach		Hoover Dam Discharge [3]		SNWA Intake [4]	
	Baseline	2030	Baseline	2030	Baseline	2030	Baseline	2030	Baseline	2030	Baseline	2030
Temperature (°C [°F])	20.3 [68.5]	20.6 [69.1]	20.3 [68.5]	20.6 [69.1]	19.6 [67.3]	19.6 [67.3]	19.3 [66.7]	19.3 [66.7]	13.2 [55.8]	13.2 [55.8]	13.0 [55.4]	13.0 [55.4]
Perchlorate (µg/L)	45.2	10.2	46.7	10.9	12.9	3.2	13.9	3.4	6.6	1.7	5.8	1.5
Conductivity (µS/cm)	1,085	1,167	1,094	1,187	947	972	952	979	901	913	896	907
Total Dissolved Solids (mg/L) [5]	687	739	693	751	599	615	603	620	570	578	567	574
Dissolved Oxygen (mg/L)	8.7	8.7	8.7	8.7	8.3	8.2	8.3	8.2	7.7	7.5	7.5	7.5
Chlorophyll Growing Season Average (µg/L) [6]	12.4	13.0	12.4	13.0	2.0	3.2	2.1	3.2	≤ 0.01	≤ 0.01	≤ 0.01	≤ 0.01
Chlorophyll Annual 95th percentile (µg/L) [6]	23	24.9	23	24.9	3.8	5.3	4.1	5.8	0.2	0.3	0.1	0.2
Secchi Depth (m)	3.2	3.3	3.2	3.3	8.5	6.9	8.8	6.8	ND [6]	ND [6]	ND [6]	ND [6]
Total Phosphorus (mg/L)	0.018	0.027	0.018	0.029	0.005	0.006	0.005	0.006	0.005	0.005	0.004	0.005
Soluble Phosphorus (mg/L)	0.009	0.019	0.009	0.020	0.003	0.004	0.003	0.004	0.004	0.005	0.004	0.004
Total Nitrogen (mg/L)	1.61	3.35	1.68	3.66	0.42	0.68	0.44	0.74	0.34	0.45	0.36	0.46
Total Inorganic Nitrogen (mg/L) [8]	1.57	3.25	1.64	3.54	0.40	0.65	0.43	0.71	0.32	0.43	0.33	0.42
Nitrate (mg/L)	1.56	3.20	1.63	3.49	0.39	0.64	0.42	0.70	0.31	0.42	0.31	0.40
Total Ammonia Nitrogen (mg/L)	0.012	0.046	0.013	0.050	0.010	0.014	0.011	0.014	0.014	0.016	0.019	0.021
Un-ionized Ammonia (mg/L) [9]	0.0008	<0.003	0.0008	<0.003	0.0002	≤0.003	0.0004	≤0.003	0.0002	≤0.003	0.0003	≤0.003

Table 4.1-4 Lake Mead Extrapolations for the No Action Alternative [1]
(1,178-ft [359-m] Lake level for year 2030 with effluent flows of 300 mgd [462 cfs] and effluent TP = 350 lbs/day) (continued).

Parameter	Inner Bay (LVB1.85M) [2]		Inner Bay (LVB2.7)		Boulder Basin (CR346.4)		Boulder Beach		Hoover Dam Discharge [3]		SNWA Intake [4]	
	Baseline	2030	Baseline	2030	Baseline	2030	Baseline	2030	Baseline	2030	Baseline	2030
Bromide (mg/L)	0.106	0.116	0.107	0.119	0.086	0.089	0.087	0.089	0.080	0.081	0.080	0.080
Sulfate (mg/L)	295	290	297	294	257	257	259	258	243	244	242	243
Chloride (mg/L)	107	129	108	133	85	92	85	93	79	83	78	82
Fecal Coliform (MPN/100mL) [10]	1.0	1.3	1.1	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
pH	8.1	8.0	8.1	8.0	8.0	8.0	8.0	8.0	7.7	7.7	7.7	7.7

Notes:

[1] Unless otherwise specified, sampling depth is surface to 1 m (3.3 ft) except at SNWA and Hoover Dam, which were sampled at the intake depths. All data is the annual average, except for chlorophyll, which includes the growing season average (April 1 to September 30) and the annual 95th percentile, and Secchi depth, which includes the growing season average. Year 2030 results were extrapolated from model simulations with effluent flow rates of 300 mgd (462 cfs) and 400 mgd (462 cfs) and effluent TP loadings of 275 and 334 lbs/day.

[2] M = Mobile. LVB1.85M is mobile and located at a depth of 16 to 18 m (52 to 59 ft) near the confluence of Las Vegas Wash and Lake Mead. All other locations are stationary (See Figure 4.1-1). The position of LVB1.85M for the initial lake level of 1178 ft is the same as LVB2.7 for the entire growing season, but moves away from the Las Vegas Wash later in the year as the lake level drops. Therefore the chlorophyll concentrations (which are averaged over the growing season) are the same at LVB1.85M and LVB2.7, while other parameters (averaged over the entire year) are slightly different.

[3] Hoover Dam discharge data is from upper and lower intakes combined.

[4] SNWA data is for intake located at 1,000 ft.

[5] Total Dissolved Solids (TDS) are not simulated. It is computed from the correlation, TDS (mg/L) = 0.633 Conductivity (µS/cm).

[6] Sampling depth for chlorophyll was averaged over the top 5 m (16 ft), except at SNWA and Hoover Dam, which were sampled at the intake depths.

[7] ND = No Data. No Secchi depth data exists for Hoover Dam Discharge and SNWA Intake because Secchi depth is a property of lake surface.

[8] Total Inorganic Nitrogen is not simulated. It is computed as Nitrate + Total Ammonia Nitrogen. Nitrite is not simulated.

[9] Un-ionized ammonia is averaged over the entire depth.

[10] Most Probable Number per 100mL (1 deciliter).

Source: Black & Veatch 2004d.

Table 4.1-5 Lake Mead Chlorophyll Concentrations for Baseline Conditions and the No Action Alternative [1] (1,178-ft Lake level for year 2030 with effluent flows of 300 mgd [462 cfs] and effluent TP = 350 lbs/day).

Location [3]	Chlorophyll Growing Season Average (µg/L) [2]	
	Baseline Conditions	No Action Alternative [4]
Inner Bay (LVB 1.85M) [5]	12.4	13.0
Inner Bay (LVB 2.7)	12.4	13.0
Boulder Basin (CR 346.4)	2.0	3.2
Boulder Beach	2.1	3.3
Hoover Dam [6]	0	0
SNWA Intake [7]	0	0

Notes:

[1] This table is for comparison purposes. Other baseline parameters for Boulder Basin in Lake Mead are shown on Table 3.1-4.

[2] Sampling depth for chlorophyll was averaged over the top 5 m (16 ft), except at SNWA and Hoover Dam, which were sampled at the intake depths. Chlorophyll data is the seasonal average (April 1 to September 30).

[3] Sampling/monitoring locations are shown on Figure 4.1-1.

[4] Year 2030 results were extrapolated from model simulations with effluent flow rates of 300 mgd (462 cfs) and 400 mgd (462 cfs) and effluent TP loadings of 275 and 334 lbs/day.

[5] M = Mobile. LVB1.85M is mobile and located at a depth of 16 to 18 m (52 to 59 ft) near the confluence of Las Vegas Wash and Lake Mead. All other locations are stationary. The position of LVB1.85M for the initial lake level of 1178 ft is the same as LVB2.7 for the entire growing season, but moves away from the Las Vegas Wash later in the year as the lake level drops. Therefore the chlorophyll concentrations (which are averaged over the growing season) are the same at LVB1.85M and LVB2.7, while other parameters (averaged over the entire year) are slightly different.

[6] Hoover Dam discharge data is from upper and lower intakes combined.

[7] SNWA data is for intake located at 1,000 ft.

Source: Black and Veatch 2004d.

Under the No Action Alternative, parameter levels at the SNWA intake and Hoover Dam discharge would generally be unchanged when compared to baseline conditions. Total inorganic nitrogen would increase from 0.31 to 0.43 mg/L; however, it would not exceed water-quality standards (Table 3.1-2).

When annual effluent flow increases to 300 mgd (467 cfs) in 2030 and 400 mgd (616 cfs) in 2050 with a Lake level of 1,178 ft (359 m), current conventional treatment processes and plant optimization would not enable the plants to treat wastewater sufficiently to comply with the WLA, and chlorophyll concentrations would increase. Therefore, impacts to Lake Mead in the Las Vegas Bay (in 2030 and 2050 at a Lake level of 1,178 ft [359 m]) would be significant and impairment of water resources in the Las Vegas Bay may occur.

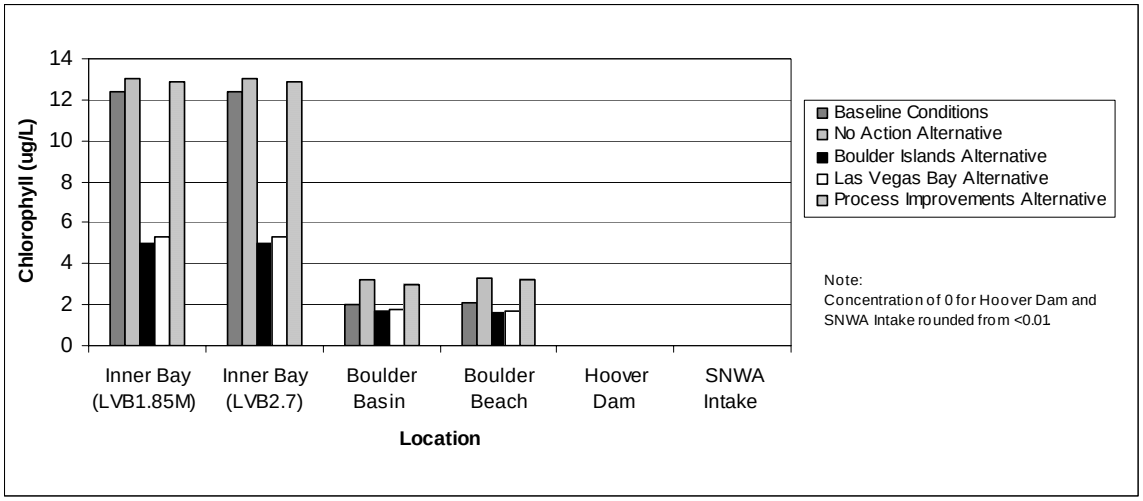


Figure 4.1-3 Chlorophyll Concentrations at a Lake Level of 1,178 ft (359 m) for year 2030 flows.

Table 4.1-6 shows water quality under the No Action Alterative at a Lake level of 1,178 ft (359 m) for the year 2050 with annual effluent flows of 400 mgd [616 cfs]. Table 4.1-7 and Figure 4.1-4 show that chlorophyll concentrations would increase in the inner Las Vegas Bay, Boulder Basin, and Boulder Beach.

Tables 4.1-8, 4.1-9, and Figure 4.1-5 show that the No Action Alternative with a Lake level of 1,000 ft (305 m) and year 2030 flows, increases chlorophyll concentrations in Boulder Basin compared with a Lake level of 1,178 ft (359 m). Chlorophyll levels in Boulder Basin would be at the water-quality standard of 5 µg/L, chlorophyll levels at Boulder Beach would exceed the 5 µg/L standard as shown on Figure 4.1-5. Therefore, impacts to the Las Vegas Bay and Boulder Basin (in 2030 at a Lake level of 1,000 ft [305 m]) from the No Action Alternative would be significant and major. Exceedances of water-quality standards would not necessarily result in impairment of LMNRA resources. However, continued exceedances for extended periods of time may result in impairment.

Under the No Action Alternative, phosphorus levels at Hoover Dam would increase from 0.005 to 0.006 mg/L (5 to 6 ppb) at lower Lake levels but the increases would not exceed water quality standards.

When annual effluent flows increase to 400 mgd (616 cfs) in 2050 with a projected Lake Level of 1,000 ft (305 m) (see tables 4.1-10 and 4.1-11, and Figure 4.1-6), the treatment plants would not be able to treat wastewater sufficiently to comply with the phosphorus WLA, and chlorophyll concentrations would increase. Therefore, impacts from the No Action Alternative to Lake Mead (at 2050 annual effluent flows and a Lake level of 1,000 ft [305m]) would be significant and major. Exceedances of water quality standards would not necessarily result in impairment of LMNRA resources. However, continued exceedances for extended periods of time may result in impairment. Mitigation measures to eliminate or minimize these impacts are presented in Section 4.1.6.3.

Table 4.1-6 Lake Mead Extrapolations for the No Action Alternative [1]
(1,178-ft [305-m] Lake level for year 2050 with effluent flows of 400 mgd [616 cfs] and effluent TP = 467 lbs/day).

Parameter	Inner Bay (LVB1.85M) [2]		Inner Bay (LVB2.7)		Boulder Basin (CR346.4)		Boulder Beach		Hoover Dam Discharge [3]		SNWA Intake [4]	
	Baseline	**2050**	**Baseline**	**2050**	**Baseline**	**2050**	**Baseline**	**2050**	**Baseline**	**2050**	**Baseline**	**2050**
Temperature (°C [°F])	20.3 [68.5]	20.7 [69.2]	20.3 [68.5]	20.7 [69.3]	19.6 [67.3]	19.6 [67.3]	19.3 [66.7]	19.3 [66.8]	13.2 [55.8]	13.2 [55.8]	13.0 [55.4]	13.0 [55.4]
Perchlorate (µg/L)	45.2	9.9	46.7	10.6	12.9	3.2	13.9	3.4	6.6	1.6	5.8	1.4
Conductivity (µS/cm)	1,085	1,203	1,094	1,227	947	984	952	991	901	919	896	911
Total Dissolved Solids (mg/L) [5]	687	762	693	777	599	623	603	627	570	582	567	577
Dissolved Oxygen (mg/L)	8.7	8.6	8.7	8.6	8.3	8.2	8.3	8.2	7.7	7.5	7.5	7.5
Chlorophyll Growing Season Average (µg/L) [6]	12.4	13.4	12.4	13.4	2.0	4.0	2.1	4.3	≤ 0.01	0.0	≤ 0.01	0.0
Chlorophyll Annual 95th percentile (µg/L) [6]	23.0	24.3	23.0	24.3	3.8	6.6	4.1	7.4	0.2	0.3	0.1	0.2
Secchi Depth (m)	3.2	3.5	3.2	3.5	8.5	6.5	8.8	6.3	ND [7]	N/A	ND [7]	N/A
Total Phosphorus (mg/L)	0.018	0.034	0.018	0.037	0.005	0.007	0.005	0.007	0.005	0.006	0.004	0.005
Soluble Phosphorus (mg/L)	0.009	0.024	0.009	0.027	0.003	0.004	0.003	0.005	0.004	0.006	0.004	0.005
Total Nitrogen (mg/L)	1.61	4.06	1.68	4.46	0.42	0.77	0.44	0.85	0.34	0.49	0.36	0.49
Total Inorganic Nitrogen (mg/L) [8]	1.57	3.93	1.64	4.31	0.40	0.74	0.43	0.82	0.32	0.46	0.33	0.46
Nitrate (mg/L)	1.56	3.87	1.63	4.25	0.39	0.73	0.42	0.80	0.31	0.45	0.31	0.43
Total Ammonia Nitrogen (mg/L)	0.012	0.057	0.013	0.062	0.010	0.015	0.011	0.016	0.014	0.016	0.019	0.021

Table 4.1-6 Lake Mead Extrapolations for the No Action Alternative [1]
(1,178-ft [305-m] Lake level for year 2050 with effluent flows of 400 mgd [616 cfs] and effluent TP = 467 lbs/day) (continued).

Parameter	Inner Bay (LVB1.85M) [2]		Inner Bay (LVB2.7)		Boulder Basin (CR346.4)		Boulder Beach		Hoover Dam Discharge [3]		SNWA Intake [4]	
	Baseline	2050	Baseline	2050	Baseline	2050	Baseline	2050	Baseline	2050	Baseline	2050
Un-ionized Ammonia (mg/L) [9]	0.0008	< 0.003	0.0008	< 0.003	0.0002	< 0.003	0.0004	< 0.003	0.0002	< 0.003	0.0003	< 0.003
Bromide (mg/L)	0.106	0.122	0.107	0.125	0.086	0.090	0.087	0.091	0.080	0.082	0.080	0.081
Sulfate (mg/L)	295	294	297	297	257	259	259	260	243	245	242	243
Chloride (mg/L)	107	137	108	141	85	94	85	95	79	84	78	82
Fecal Coliform (MPN/ 100mL) [10]	1.0	1.5	1.1	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
pH	8.1	8.0	8.1	8.0	8.0	8.0	8.0	8.1	7.7	7.7	7.7	7.7

Notes:

[1] Unless otherwise specified, sampling depth is surface to 1 m (3.3 ft) except at SNWA and Hoover Dam, which were sampled at the intake depths. All data is the annual average, except for chlorophyll, which includes the growing season average (April 1 to September 30) and the annual 95th percentile, and Secchi depth, which includes the growing season average. Year 2050 results were extrapolated from model simulations with effluent flow rates of 300 mgd (462 cfs) and 400 mgd (462 cfs) and effluent TP loadings of 275 and 334 lbs/day.

[2] M = Mobile. LVB1.85M is mobile and located at a depth of 16 to 18 m (52 to 59 ft) near the confluence of Las Vegas Wash and Lake Mead. All other locations are stationary (See Figure 4.1-1). The position of LVB1.85M for the initial lake level of 1178 ft is the same as LVB2.7 for the entire growing season, but moves away from the Las Vegas Wash later in the year as the lake level drops. Therefore the chlorophyll concentrations (which are averaged over the growing season) are the same at LVB1.85M and LVB2.7, while other parameters (averaged over the entire year) are slightly different.

[3] Hoover Dam discharge data is from upper and lower intakes combined.

[4] SNWA data is for intake located at 1,000 ft.

[5] Total Dissolved Solids (TDS) are not simulated. It is computed from the correlation, TDS (mg/L) = 0.633 Conductivity (µS/cm).

[6] Sampling depth for chlorophyll was averaged over the top 5 m (16 ft), except at SNWA and Hoover Dam, which were sampled at the intake depths.

[7] ND = No Data. No Secchi depth data exists for Hoover Dam Discharge and SNWA Intake because Secchi depth is a property of lake surface.

[8] Total Inorganic Nitrogen is not simulated. It is computed as Nitrate + Total Ammonia Nitrogen. Nitrite is not simulated.

[9] Un-ionized ammonia is averaged over the entire depth.

[10] Most Probable Number per 100mL (1 deciliter).

Source: Black & Veatch 2004d.

Table 4.1-7 Lake Mead Chlorophyll Concentrations for Baseline Conditions and the No Action Alternative [1] (1,178-ft Lake level for year 2050 with effluent flows of 400 mgd [616 cfs] and effluent TP = 467 lbs/day).

Location [3]	Chlorophyll Growing Season Average (µg/L) [2]	
	Baseline Conditions	No Action Alternative [4]
Inner Bay (LVB 1.85M) [5]	12.4	13.4
Inner Bay (LVB 2.7)	12.4	13.4
Boulder Basin (CR 346.4)	2.0	4.0
Boulder Beach	2.1	4.3
Hoover Dam [6]	0	0
SNWA Intake [7]	0	0

Notes:

[1] This table is for comparison purposes. Other baseline parameters for Boulder Basin in Lake Mead are shown on Table 3.1-4.

[2] Sampling depth for chlorophyll was averaged over the top 5 m (16 ft), except at SNWA and Hoover Dam, which were sampled at the intake depths. Chlorophyll data is the seasonal average (April 1 to September 30).

[3] Sampling/monitoring locations are shown on Figure 4.1-1.

[4] Year 2050 results were extrapolated from model simulations with effluent flow rates of 300 mgd (462 cfs) and 400 mgd (462 cfs) and effluent TP loadings of 275 and 334 lbs/day.

[5] M = Mobile. LVB1.85M is mobile and located at a depth of 16 to 18 m (52 to 59 ft) near the confluence of Las Vegas Wash and Lake Mead. All other locations are stationary. The position of LVB1.85M for the initial lake level of 1178 ft is the same as LVB2.7 for the entire growing season, but moves away from the Las Vegas Wash later in the year as the lake level drops. Therefore the chlorophyll concentrations (which are averaged over the growing season) are the same at LVB1.85M and LVB2.7, while other parameters (averaged over the entire year) are slightly different.

[6] Hoover Dam discharge data is from upper and lower intakes combined.

[7] SNWA data is for intake located at 1,000 ft.

Source: Black and Veatch 2004d.

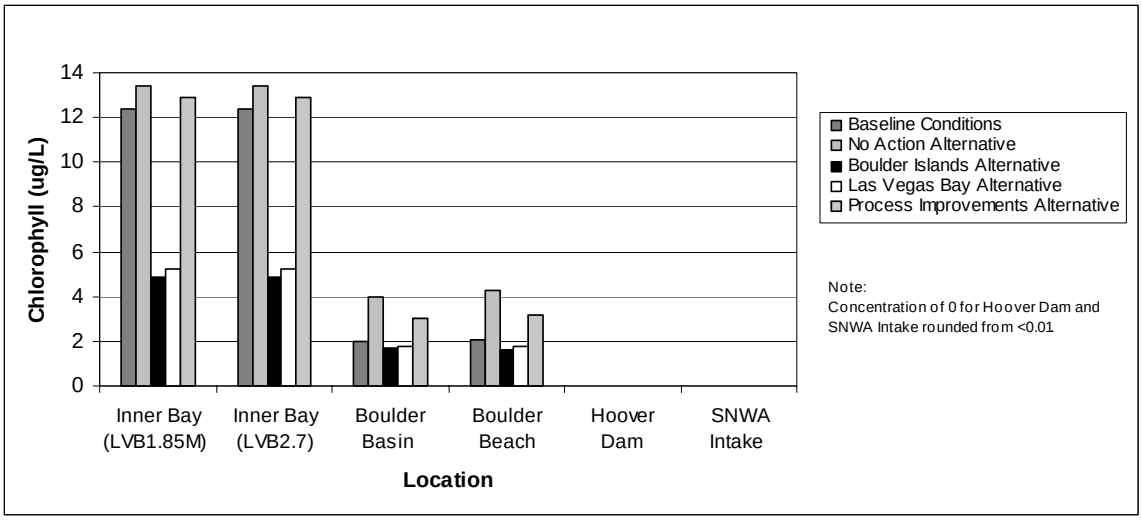


Figure 4.1-4 Chlorophyll Concentrations at a Lake Level of 1,178 ft for year 2050 Flows.

Table 4.1-8 Lake Mead Extrapolations for the No Action Alternative [1]
(1,000-ft [305-m] Lake level for year 2030 with effluent flows of 300 mgd [462 cfs] and effluent TP = 350 lbs/day).

Parameter	Inner Bay (LVB1.85M)[2]		Inner Bay (LVB2.7)[3]		Boulder Basin (CR346.4)		Boulder Beach		Hoover Dam Discharge [4]		SNWA Intake [5]	
	Baseline	**2030**	**Baseline**	**2030**	**Baseline**	**2030**	**Baseline**	**2030**	**Baseline**	**2030**	**Baseline**	**2030**
Temperature (°C[°F])	20.3 [68.5]	20.6 [69.0]	20.3 [68.5]	ND	19.6 [67.3]	19.6 [67.3]	19.3 [66.7]	19.5 [67.0]	13.2 [55.8]	14.8 [58.6]	13.0 [55.4]	ND
Perchlorate (µg/L)	45.2	11.1	46.7	ND	12.9	3.5	13.9	4.1	6.6	1.7	5.8	ND
Conductivity (µS/cm)	1,085	1,180	1,094	ND	947	971	952	987	901	911	896	ND
Total Dissolved Solids (mg/L) [6]	687	747	693	ND	599	615	603	625	570	577	567	ND
Dissolved Oxygen (mg/L)	8.7	8.4	8.7	ND	8.3	8.1	8.3	8.2	7.7	7.4	7.5	ND
Chlorophyll Growing Season Average (µg/L) [7]	12.4	11.4	12.4	ND	2.0	5.2	2.1	6.1	≤ 0.01	0.1	≤ 0.01	ND
Chlorophyll Annual 95th percentile (µg/L) [7]	23.0	22.6	23.0	ND	3.8	8.1	4.1	10.2	0.2	1.3	0.1	ND
Secchi Depth (m)	3.2	4.7	3.2	ND	8.5	6.5	8.8	6.3	ND [7]	ND [7]	ND [7]	ND [7]
Total Phosphorus (mg/L)	0.018	0.031	0.018	ND	0.005	0.007	0.005	0.008	0.005	0.006	0.004	ND
Soluble Phosphorus (mg/L)	0.009	0.022	0.009	ND	0.003	0.004	0.003	0.004	0.004	0.005	0.004	ND
Total Nitrogen (mg/L)	1.61	3.92	1.68	ND	0.42	1.01	0.44	1.18	0.34	0.65	0.36	ND
Total Inorganic Nitrogen (mg/L) [9]	1.57	3.79	1.64	ND	0.40	0.97	0.43	1.14	0.32	0.62	0.33	ND
Nitrate (mg/L)	1.56	3.73	1.63	ND	0.39	0.95	0.42	1.12	0.31	0.59	0.31	ND
Total Ammonia Nitrogen (mg/L)	0.012	0.058	0.013	ND	0.010	0.022	0.011	0.023	0.014	0.027	0.019	ND

Table 4.1-8 Lake Mead Extrapolations for the No Action Alternative [1]
(1,000-ft [305-m] Lake level for year 2030 with effluent flows of 300 mgd [462 cfs] and effluent TP = 350 lbs/day) (continued).

Parameter	Inner Bay (LVB1.85M) [2]		Inner Bay (LVB2.7) [3]		Boulder Basin (CR346.4)		Boulder Beach		Hoover Dam Discharge [4]		SNWA Intake [5]	
	Baseline	**2030**	**Baseline**	**2030**	**Baseline**	**2030**	**Baseline**	**2030**	**Baseline**	**2030**	**Baseline**	**2030**
Un-ionized Ammonia (mg/L) [10]	0.0008	0.003	0.0008	ND	0.0002	≤0.003	0.0004	≤0.003	0.0002	≤0.003	0.0003	ND
Bromide (mg/L)	0.106	0.120	0.107	ND	0.086	0.090	0.087	0.092	0.080	0.082	0.080	ND
Sulfate (mg/L)	295	292	297	ND	257	257	259	259	243	244	242	ND
Chloride (mg/L)	107	134	108	ND	85	94	85	97	79	83	78	ND
Fecal Coliform (MPN/100mL) [11]	1.0	1.4	1.1	ND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	ND
pH	8.1	8.0	8.1	ND	8.0	8.1	8.0	8.1	7.7	7.8	7.7	ND

Notes:

[1] Unless otherwise specified, sampling depth is surface to 1 m (3.3 ft) except at SNWA and Hoover Dam, which were sampled at the intake depths. All data is the annual average, except for chlorophyll, which includes the growing season average (April 1 to September 30) and the annual 95th percentile, and Secchi depth, which includes the growing season average. Year 2030 results were extrapolated from model simulations with effluent flow rates of 300 mgd (462 cfs) and 400 mgd (462 cfs) and effluent TP loadings of 275 and 334 lbs/day.

[2] M = Mobile. LVB1.85M is mobile and located at a depth of 16 to 18 m (52 to 59 ft) near the confluence of Las Vegas Wash and Lake Mead. All other locations are stationary (See Figure 4.1-1). The position of LVB1.85M for the initial lake level of 1178 ft is the same as LVB2.7 for the entire growing season, but moves away from the Las Vegas Wash later in the year as the lake level drops. Therefore the chlorophyll concentrations (which are averaged over the growing season) are the same at LVB1.85M and LVB2.7, while other parameters (averaged over the entire year) are slightly different.

[3] ND = No Data. No data exists for LVB2.7 because it is located on dry land with a lake level of 1,000 ft.

[4] Hoover Dam discharge data is from the lower intake only.

[5] No data exists for the SNWA 1,000-ft intake.

[6] Total Dissolved Solids (TDS) are not simulated. It is computed from the correlation, TDS (mg/L) = 0.633 Conductivity (µS/cm).

[7] Sampling depth for chlorophyll was averaged over the top 5 m (16 ft), except at SNWA and Hoover Dam, which were sampled at the intake depths.

[8] ND = No Data. No Secchi depth data exists for Hoover Dam Discharge and SNWA Intake because Secchi depth is a property of lake surface.

[9] Total Inorganic Nitrogen is not simulated. It is computed as Nitrate + Total Ammonia Nitrogen. Nitrite is not simulated

[10] Un-ionized ammonia is averaged over the entire depth.

[11] Most Probable Number per 100mL (1 deciliter).

Source: Black & Veatch 2004d.

Table 4.1-9 Lake Mead Chlorophyll Concentrations for Baseline Conditions and the No Action Alternative [1] (1,000-ft Lake level for year 2030 with effluent flows of 300 mgd [462 cfs] and effluent TP = 350 lbs/day).

	Chlorophyll Growing Season Average (µg/L) [2]	
Location [3]	**Baseline Conditions**	**No Action Alternative [4]**
Inner Bay (LVB 1.85M) [5]	12.4	11.4
Inner Bay (LVB 2.7)[6]	12.4	ND
Boulder Basin (CR 346.4)	2.0	5.2
Boulder Beach	2.1	6.1
Hoover Dam [7]	0	0.1
SNWA Intake [8]	0	ND

Notes:

[1] This table is for comparison purposes. Other baseline parameters for Boulder Basin in Lake Mead are shown on Table 3.1-4.

[2] Sampling depth for chlorophyll was averaged over the top 5 m (16 ft), except at SNWA and Hoover Dam, which were sampled at the intake depths. Chlorophyll data is the seasonal average (April 1 to September 30).

[3] Sampling/monitoring locations are shown on Figure 4.1-1.

[4] Year 2030 results were extrapolated from model simulations with effluent flow rates of 300 mgd (462 cfs) and 400 mgd (462 cfs) and effluent TP loadings of 275 and 334 lbs/day.

[5] M = Mobile. LVB1.85M is mobile and located at a depth of 16 to 18 meters (52 to 59 ft) near the confluence of Las Vegas Wash and Lake Mead. All other locations are stationary. The position of LVB1.85M for the initial lake level of 1178 ft is the same as LVB2.7 for the entire growing season, but moves away from the Las Vegas Wash later in the year as the lake level drops. Therefore the chlorophyll concentrations (which are averaged over the growing season) are the same at LVB1.85M and LVB2.7, while other parameters (averaged over the entire year) are slightly different.

[6] ND = No Data. No data exists for LVB2.7 because it is located on dry land with a lake level of 1,000 ft.

[7] Hoover Dam discharge data is from the lower intake only.

[8] No data exists for the SNWA 1,000-ft intake.

Source: Black and Veatch 2004d.

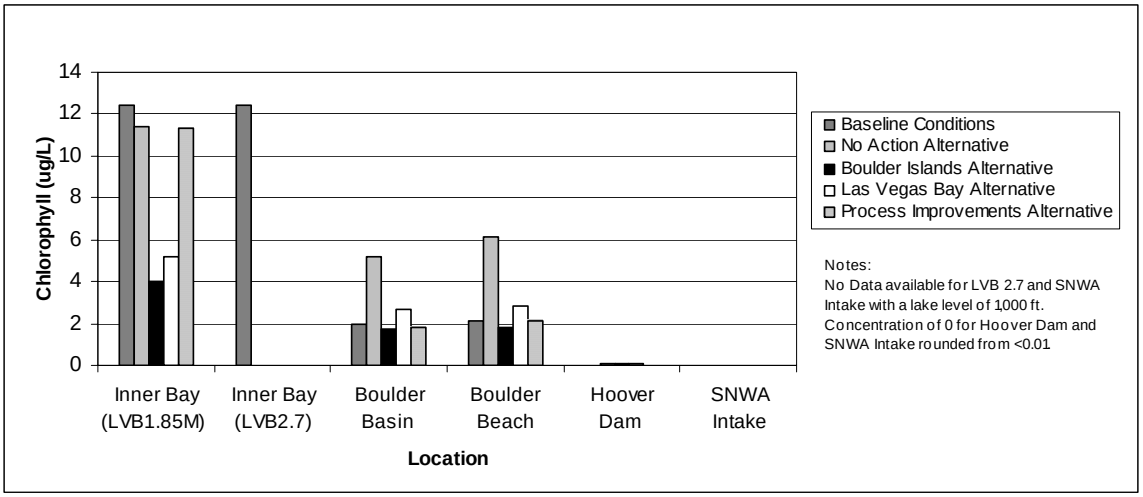


Figure 4.1-5 Chlorophyll Concentrations at a Lake Level of 1,000 ft for year 2030 flows.

Table 4.1-10 Lake Mead Extrapolations for the No Action Alternative [1]
(1,000-ft [305-m] Lake level for year 2050 with effluent flows of 400 mgd [616 cfs] and effluent TP = 467 lbs/day).

Parameter	Inner Bay (LVB1.85M) [2]		Inner Bay (LVB2.7) [3]		Boulder Basin (CR346.4)		Boulder Beach		Hoover Dam Discharge [4]		SNWA Intake [5]	
	Baseline	**2050**	**Baseline**	**2050**	**Baseline**	**2050**	**Baseline**	**2050**	**Baseline**	**2050**	**Baseline**	**2050**
Temperature (°C[°F])	20.3 [68.5]	20.7 [69.2]	20.3 [68.5]	ND	19.6 [67.3]	19.6 [67.3]	19.3 [66.7]	19.5 [67.1]	13.2 [55.8]	14.8 [58.6]	13.0 [55.4]	ND
Perchlorate (µg/L)	45.2	10.5	46.7	ND	12.9	3.5	13.9	4.0	6.6	1.7	5.8	ND
Conductivity (µS/cm)	1,085	1,214	1,094	ND	947	986	952	1,002	901	918	896	ND
Total Dissolved Solids (mg/L) [6]	687	769	693	ND	599	624	603	634	570	581	567	ND
Dissolved Oxygen (mg/L)	8.7	8.4	8.7	ND	8.3	8.1	8.3	8.2	7.7	7.3	7.5	ND
Chlorophyll Growing Season Average (µg/L) [7]	12.4	12.2	12.4	ND	2.0	6.6	2.1	7.5	≤ 0.01	0.1	≤ 0.01	ND
Chlorophyll Annual 95th percentile (µg/L) [7]	23.0	23.8	23.0	ND	3.8	10.1	4.1	12.4	0.2	1.7	0.1	ND
Secchi Depth (m)	3.2	5.0	3.2	ND	8.5	5.9	8.8	5.9	ND [7]	N/A	ND [7]	ND [7]
Total Phosphorus (mg/L)	0.018	0.038	0.018	ND	0.005	0.008	0.005	0.010	0.005	0.007	0.004	ND
Soluble Phosphorus (mg/L)	0.009	0.028	0.009	ND	0.003	0.005	0.003	0.006	0.004	0.006	0.004	ND
Total Nitrogen (mg/L)	1.61	4.61	1.68	ND	0.42	1.18	0.44	1.36	0.34	0.73	0.36	ND
Total Inorganic Nitrogen (mg/L) [9]	1.57	4.45	1.64	ND	0.40	1.13	0.43	1.31	0.32	0.69	0.33	ND
Nitrate (mg/L)	1.56	4.39	1.63	ND	0.39	1.11	0.42	1.28	0.31	0.66	0.31	ND
Total Ammonia Nitrogen (mg/L)	0.012	0.068	0.013	ND	0.010	0.023	0.011	0.025	0.014	0.028	0.019	ND

Table 4.1-10 Lake Mead Extrapolations for the No Action Alternative [1]
(1,000-ft [305-m] Lake level for year 2030 with effluent flows of 300 mgd [462 cfs] and effluent TP = 350 lbs/day) (continued).

Parameter	Inner Bay (LVB1.85M) [2]		Inner Bay (LVB2.7) [3]		Boulder Basin (CR346.4)		Boulder Beach		Hoover Dam Discharge [4]		SNWA Intake [5]	
	Baseline	**2050**	**Baseline**	**2050**	**Baseline**	**2050**	**Baseline**	**2050**	**Baseline**	**2050**	**Baseline**	**2050**
Un-ionized Ammonia (mg/L) [10]	0.0008	< 0.003	0.0008	ND	0.0002	< 0.003	0.0004	< 0.003	0.0002	< 0.003	0.0003	ND
Bromide (mg/L)	0.106	0.125	0.107	ND	0.086	0.092	0.087	0.095	0.080	0.083	0.080	ND
Sulfate (mg/L)	295	295	297	ND	257	258	259	261	243	244	242	ND
Chloride (mg/L)	107	141	108	ND	85	97	85	100	79	85	78	ND
Fecal Coliform (MPN/100mL) [11]	1.0	1.6	1.1	ND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	ND
pH	8.1	8.0	8.1	ND	8.0	8.1	8.0	8.2	7.7	7.8	7.7	ND

Notes:

[1] Unless otherwise specified, sampling depth is surface to 1 m (3.3 ft) except at SNWA and Hoover Dam, which were sampled at the intake depths. All data is the annual average, except for chlorophyll, which includes the growing season average (April 1 to September 30) and the annual 95th percentile, and Secchi depth, which includes the growing season average. Year 2050 results were extrapolated from model simulations with effluent flow rates of 300 mgd (462 cfs) and 400 mgd (462 cfs) and effluent TP loadings of 275 and 334 lbs/day.

[2] M = Mobile. LVB1.85M is mobile and located at a depth of 16 to 18 m (52 to 59 ft) near the confluence of Las Vegas Wash and Lake Mead. All other locations are stationary (See Figure 4.1-1). The position of LVB1.85M for the initial lake level of 1178 ft is the same as LVB2.7 for the entire growing season, but moves away from the Las Vegas Wash later in the year as the lake level drops. Therefore the chlorophyll concentrations (which are averaged over the growing season) are the same at LVB1.85M and LVB2.7, while other parameters (averaged over the entire year) are slightly different.

[3] ND = No Data. No data exists for LVB2.7 because it is located on dry land with a lake level of 1,000 ft.

[4] Hoover Dam discharge data is from the lower intake only.

[5] No data exists for the SNWA 1,000-ft intake.

[6] Total Dissolved Solids (TDS) are not simulated. It is computed from the correlation, TDS (mg/L) = 0.633 Conductivity (µS/cm).

[7] Sampling depth for chlorophyll was averaged over the top 5 m (16 ft), except at SNWA and Hoover Dam, which were sampled at the intake depths.

[8] ND = No Data. No Secchi depth data exists for Hoover Dam Discharge and SNWA Intake because Secchi depth is a property of lake surface.

[9] Total Inorganic Nitrogen is not simulated. It is computed as Nitrate + Total Ammonia Nitrogen. Nitrite is not simulated

[10] Un-ionized ammonia is averaged over the entire depth.

[11] Most Probable Number per 100mL (1 deciliter).

Source: Black & Veatch 2004d.

Table 4.1-11 Lake Mead Chlorophyll Concentrations for Baseline Conditions and the No Action Alternative [1] (1,000-ft Lake level for year 2050 with effluent flows of 400 mgd [616 cfs] and effluent TP = 467 lbs/day).

Location [3]	Chlorophyll Growing Season Average (µg/L) [2]	
	Baseline Conditions	No Action Alternative [4]
Inner Bay (LVB 1.85M) [5]	12.4	12.2
Inner Bay (LVB 2.7) [6]	12.4	ND
Boulder Basin (CR 346.4)	2.0	6.6
Boulder Beach	2.1	7.5
Hoover Dam [7]	0	0.1
SNWA Intake [8]	0	ND

Notes:

[1] This table is for comparison purposes. Other baseline parameters for Boulder Basin in Lake Mead are shown on Table 3.1-4.

[2] Sampling depth for chlorophyll was averaged over the top 5 m (16 ft), except at SNWA and Hoover Dam, which were sampled at the intake depths. Chlorophyll data is the seasonal average (April 1 to September 30).

[3] Sampling/monitoring locations are shown on Figure 4.1-1.

4 Year 2050 results were extrapolated from model simulations with effluent flow rates of 300 mgd (462 cfs) and 400 mgd (462 cfs) and effluent TP loadings of 275 and 334 lbs/day.

[5] M = Mobile. LVB1.85M is mobile and located at a depth of 16 to 18 m (52 to 59 ft) near the confluence of Las Vegas Wash and Lake Mead. All other locations are stationary. The position of LVB1.85M for the initial lake level of 1178 ft is the same as LVB2.7 for the entire growing season, but moves away from the Las Vegas Wash later in the year as the lake level drops. Therefore the chlorophyll concentrations (which are averaged over the growing season) are the same at LVB1.85M and LVB2.7, while other parameters (averaged over the entire year) are slightly different.

[6] ND = No Data. No data exists for LVB2.7 because it is located on dry land with a lake level of 1,000 ft.

[7] Hoover Dam discharge data is from the lower intake only.

[8] No data exists for the SNWA 1,000-ft intake.

Source: Black and Veatch 2004d.

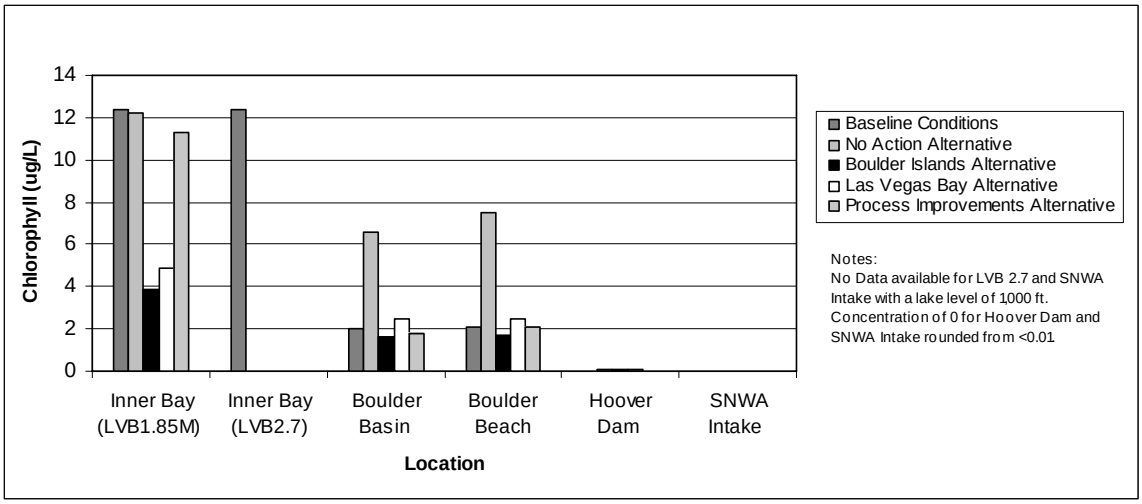


Figure 4.1-6 Chlorophyll Concentrations at a Lake Level of 1,000 ft for year 2050 flows.

4.1.1.3.3 Downstream of Hoover Dam

Under the No Action Alternative, increasing loads of phosphorus would result in a slight increase of phosphorus concentrations below Hoover Dam, compared with baseline conditions. Despite this increase, phosphorus concentrations below Hoover Dam would remain well below historic concentrations (the past three decades), during which no negative consequences would identified in the Colorado River below Hoover Dam. Concentrations would also remain well below Nevada water quality standard and RMHQ criteria. No significant effect is expected.

Treated effluent discharged by the treatment plants contains potential EDCs and PPCPs. Concentrations of these substances generally decrease with increasing distance from the Las Vegas Wash, and drop to non-detectable levels, but the data are limited. It is not clear whether detectable levels are found below Hoover Dam. Even if there are detectable levels, or if detectable levels result from the project, downstream water users are unlikely to be affected by discharges of EDCs and PPCPs attributable to the project, because scientific evaluations have concluded that "no appreciable risk for humans exists at the low levels measured in drinking water" (Appendix K). In the *Colorado River Watershed Sanitary Survey—2000 Update* (MWD 2001), the MWD has reported that non-detectable levels of potential endocrine disrupters have been found at its water intake, although the majority of compounds of interest were not monitored. Pharmaceuticals and personal care products were not identified as one of the four key constituents of concern to MWD. The four key constituents of concern were pathogens (mainly Cryptosporium, Giardia, and enteric viruses), coliforms, MTBE, and perchlorate (MWD 2001).

Some uncertainty exists about the effects on fish. Studies in Lake Mead have suggested that EDCs or PPCPs may have some effect on fish, although the cause of the effect has not been identified, and the magnitude is uncertain. This uncertainty may not be relevant to possible effects below Hoover Dam, however, because the effect appears to be associated with effluent-dominated water of the Las Vegas Wash as it enters the Las Vegas Bay, which is rapidly diluted as it mixes with Lake water. A summary of existing credible scientific evidence is provided in Appendix K. Based on this evidence and the environmental setting, it is reasonable to conclude that potential effects to fish are likely to be focused in the area near the mouth of the Las Vegas Wash, where concentrations are higher and have not had the opportunity to dissipate through mixing and assimilation. Even in the area of higher concentrations, the potential effects appear modest. They are not lethal. No effect has been identified on fish population levels, which are high at the mouth of Las Vegas Wash. Because the effect is uncertain and modest, even at the higher concentration levels, and because of the great dilution and assimilation capacity of Lake Mead, EDCs and PPCPs are not expected to affect fish below Hoover Dam.

Loadings of other wastewater-related constituents may increase because of increases in wastewater flows. Nonconservative substances (decaying or biologically processed substances), however, will be reduced by natural assimilation in Lake Mead or the Colorado River below Hoover Dam. Pathogens, for example, are currently regulated through the use of indicator FC and E. coli bacteria. Because existing discharges are given exceptionally high levels of treatment, the bacterial concentrations in wastewater discharges are very low, well under those required by NDEP permits and those levels established to protect water quality in Lake Mead and the Colorado River. The levels decrease even further as the discharge mixes into the Lake and moves downriver. For these reasons, pathogens, bacteria, and other non-conservative substances are not

likely to have a significant effect on water quality downstream of Hoover Dam. The main conservative substance (non-decaying substance) of concern in wastewater is TDS. The levels attributable to wastewater discharges, however, are very small compared to other sources of TDS in the Colorado River. For these reasons, TDS and other conservative substances attributable to the project are unlikely to have a significant effect on water quality below Hoover Dam.

4.1.2 Boulder Islands North Alternative

The potential impacts to water resources that may result from the construction and operation of the Boulder Islands North Alternative are described in this section.

4.1.2.1 Surface Water & Drainage

The potential impacts to surface water and drainage resulting from the construction and operation of the pipeline are described in this section.

4.1.2.1.1 Effluent Interceptor – Alignment A

The construction of EI-Alignment A primarily involves cut-and-cover with some tunneling segments. The tunneling portions of the construction would have no impact on surface water drainage since this construction is located underground. The tunneling portions of the construction are proposed primarily where the facility crosses the Las Vegas Wash and in the lower portion of the project where a tunnel is to be constructed to convey the combined effluent from all three wastewater treatment plants to Lake Mead. The tunnels beneath the Las Vegas Wash would be at depths sufficient to protect the pipeline from scour. The impacts of EI-Alignment A on surface water are mainly associated with construction activities, and would be temporary. Impacts to surface water that may occur under the Boulder Islands North Alternative are described in the following paragraphs.

Soil Erosion

Disturbance of surface soils by construction activities can increase the potential for erosion and transport of soil (sediment) during rainfall/runoff events where surface water runoff crosses the construction areas. Spills of construction materials and/or erosion of disturbed soils with subsequent transport by surface water runoff to the Las Vegas Wash or other areas outside the construction limits could create adverse impacts to water quality.

Excavation of Reach 1, Reach 2, and the COH Forcemain Pipeline is a combination of cut-and-cover construction and tunneling. Open trenches would require that the easement area be cleared from all vegetation and debris, and a substantial amount of soil be removed or relocated. Construction sites along EI-Alignment A would act as a potential source for non-point source pollution because as land is exposed and disturbed, soil erosion rates are dramatically increased. Erosion and sediment transport would be increased as surface water passes over the areas disturbed by the open trench construction. However, this increase in erosion and sediment transport would be relatively insignificant and similar to surface water passing over unpaved roads that exist throughout the project area.

During tunneling, much of the displaced soil excavated from the working shaft would be hauled by truck to a designated disposal area. The disposal area is located in an area that would prevent sediments from reaching waterways where they can alter the physical and biological characteristics of surface water features.

Cross Drainage

The open trench portions of construction are primarily located adjacent to the Las Vegas Wash in areas where many ephemeral washes cross the alignment. Open trenching, and the associated disturbance of existing desert soil and vegetation, may impact surface-water drainage during construction if a major rainfall/runoff event occurs. The EI-Alignment A would cross perpendicular to several existing ephemeral washes. During a major rainfall runoff event, the open trench could collect runoff from one wash and discharge it to a different wash (act as a diversion channel) instead of allowing the runoff to cross perpendicular to the alignment as it would have prior to construction. Pipelines would be installed below the 100-year flood scour depth and any existing downstream head-cut in order to prevent the pipeline from being washed out during a 100-year flood event. The tunnels along EI-Alignment A are at depths that render them unsusceptible to erosion from a 100-year flood event.

Flow in the Las Vegas Wash

As discussed previously in Sections 3.1.1.1 and 3.1.1.3, the treatment plant effluent is the largest source of flow in the Las Vegas Wash during dry weather. A large reduction in the volume of water conveyed in the Las Vegas Wash during dry weather would not significantly reduce erosion and channel degradation because the construction of the ECSs and bank protection by SNWA (see Section 3.1.1.3) has greatly reduced the potential for erosion in the Las Vegas Wash.

The volume of flows returned to Lake Mead would be the same whether they are discharged via the Las Vegas Wash or the pipeline to the Boulder Islands area. Therefore, the initial presumption is that no impact to return flow credits should be expected.

4.1.2.1.2 Lake Conveyance System, Boulder Islands North

Impacts resulting from accidental spills of construction materials and surface disturbance would be the same as those described for the EI in Section 4.1.2.1.1.

Cross Drainage

The open trench portion of the construction is primarily located from the NRMT3-East working shaft to the shoreline of Lake Mead. One major intermittent stream would cross the open trench alignment in this area. If the trench was left open during a flood event, the flow from the upstream channel would potentially be diverted through the open trench and discharge into the downstream channel.

Dredging Activities in Lake Mead

There would be no change in the operation of Lake Mead from construction or operation of the Boulder Islands North Alternative. Dredging construction techniques would be used to install the pipeline from the shoreline to approximately 1,000 ft (305 m) above msl lakebed elevation. A turbidity curtain, which is described in Section 2.2.2.4, would be installed in the areas that require dredging. The curtain would isolate silt within the screened perimeter and minimize silt spread outside the dredging areas. Therefore, the impacts would be temporary and insignificant. Coordination with SNWA would be implemented regarding the appropriate design and type of turbidity curtain to be used.

Section 404 of the CWA (33 USC 1251-1387; PL 92-500), establishes a program to regulate the discharge of dredged and fill material into waters of the U.S. The basic premise of the program is that no discharge of dredged or fill material can be permitted if a practicable alternative exists that is less damaging to the aquatic environment or if the nation's waters would be significantly degraded. Dredging is a regulated activity controlled by a permit review process administered by the EPA and the USACE (Guidelines for Specification of Disposal Sites for Dredged or Fill Material, 40 CFR 230.3). Sediments in the proposed dredging area have not been analyzed for contaminants. There is no indication that sediments are contaminated.

In addition to a permit under Section 404 of the CWA for the discharge of dredged and fill material in waters of the U.S., a permit under Section 10 of the Rivers and Harbors Act of 1938 as amended (33 USC 540) will be needed for the structures or work in Navigable Waters of the United States (Lake Mead). One or more of the USACE nationwide permits may cover the work subject to its permit authority under both laws. All dredging operations would be conducted in compliance with the stipulations of the SCOP Section 404 and Section 10 permits. Therefore, impacts would not be significant and would not be considered impairment of LMNRA resources.

4.1.2.2 Groundwater

This section discusses the impacts to groundwater that may result from construction of the pipeline and ancillary facilities. Impacts from groundwater on construction activities are also described.

4.1.2.2.1 Effluent Interceptor - Alignment A

Groundwater levels along EI-Alignment A range in depth from 5 to 46 ft (2 to 14 m) below ground surface. These depths correlate to the anticipated depths of the EI pipeline. The depth of the pipeline ranges from a minimum depth of 18 ft (6 m) in Reach 1 to a maximum depth of 178 ft (54 m) in Reach 3. Tunneling would be employed as the construction method for depths exceeding approximately 45 ft (14 m). Therefore, it is likely that groundwater would be encountered and intercepted during excavation, especially along the COH Forcemain. Tunneling for the deeper sections would minimize impacts to the groundwater.

A range of temporary and permanent impacts to the groundwater environment may result from the construction of the EI. The major potential groundwater impacts from construction activities are grouped into five different categories:

- Impacts from removal of groundwater from the shallow groundwater system,
- Impacts from physical disturbance of the shallow groundwater system creating pathways for groundwater flow,
- Impacts from physical disturbance of the shallow groundwater system creating barriers to groundwater flow,
- Impacts from discharges to groundwater, and
- Effects of groundwater on the EI construction.

Removal of Groundwater from the Shallow Groundwater System

The construction activity with the most obvious potential to affect groundwater conditions is construction dewatering. The following scenarios may occur if extensive groundwater pumping is necessary during construction:

- Some domestic water wells would have a lower discharge or would dry up if the water table was lowered below the domestic wells' level of pumping. Derogation of spring sources in the area may also occur.
- Excessive pumping of groundwater may change the Las Vegas Wash from a discharge point of groundwater to a recharge source for the shallow groundwater system in the vicinity of the Las Vegas Wash. The surface water in the Las Vegas Wash contains untreated nuisance flows from urban runoff. Recharging the groundwater system with these flows would contribute to the deterioration of groundwater quality in the shallow groundwater system.

Physical Disturbance of the Shallow Groundwater System Creating Pathways for Groundwater Flow

The construction of tunnels and pipelines inadvertently forms permeable pathways along which groundwater may flow. The consequential impacts of these pathways may include:

- Loss of yield if horizontal pathways act to divert water away from nearby springs or supply wells along the alignment of the EI,
- Increased risk of additional aquifer pollution from land use or near-surface activities,
- Changes in groundwater quality if pathways are formed between aquifer units by deep tunnel excavations, or
- Polluted groundwater in the shallow groundwater system could seep down to deeper aquifers.

Physical Disturbance of the Shallow Groundwater System Creating Barriers for Groundwater Flow

This is more common where structures located underground act as barriers interrupting horizontal groundwater flow through the shallow groundwater system. This may result in a damming effect where groundwater levels may rise on the upstream side of the structure, and lower on the downstream side. This is possible in all locations along the EI where the flow of groundwater intercepts the pipeline alignment. The nature of the impact depends on the backfill used to cover the pipe alignment. A less permeable backfill (as compared to the natural fill in the aquifer) may produce a larger barrier and mounding of groundwater may occur. Mounding of groundwater

without the appropriate seepage may lead to an increase in the hydrostatic pressure that develops below impervious layers and may cause uplift and subsequent foundation or slope instability. Use of a more permeable fill may create preferred horizontal groundwater flow paths along the alignment and thus disrupt the natural groundwater flow.

Discharges to Groundwater

Groundwater in the vicinity of the EI alignment is mainly shallow and susceptible to pollution. Construction activities may create the potential for spills and releases of contaminants to the groundwater. The main sources of discharge to groundwater are associated with:

- Leakages and spills of fuels and lubricants from vehicles and other machinery,
- Runoff from operations such as concrete placement, and
- Runoff of turbid surface water as a result of topsoil removal and excavation.

Effects of Groundwater on the Effluent Interceptor Construction

Groundwater conditions and the adequacy of groundwater-control measures are important factors in excavation, in maintaining a stable foundation, and in backfilling operations. Major areas of concern along the EI alignment are those areas where the alignment intersects the Las Vegas Wash. Tunnel systems, which require deeper excavations, are proposed for these areas. Comparing the tunnel depths in these areas to the depth to groundwater (Figure 3.1-8) provides a good indication that the tunnel construction and excavation would intercept groundwater flow.

If the groundwater level was to rise or if excavation intercepts the groundwater, the presence of groundwater could effect excavation and placement of materials during construction and therefore special engineering measures may be required. Moreover, groundwater in these areas may impact the tunnel system due to the presence of sulfate, which enhances corrosion of the tunnel material. Therefore, a special type of concrete would be used to avoid corrosion.

If dewatering becomes a necessity, a Temporary Discharge Permit from NDEP is required prior to groundwater extraction. In this process, water is pumped out of the aquifer and released to the appropriate location. Important aspects to be considered in this process include:

- Dewatering of groundwater may affect the quality of the water in the Las Vegas Wash. Water pumped from the shallow groundwater system and released into the Las Vegas Wash would likely contain perchlorate, sulfate, and other contaminants. The handling, discharge, or disposal of contaminated groundwater would be conducted in accordance with NDEP requirements and guidance.
- Dewatering may cause subsidence. Subsidence is mainly the settling of layers due to the decrease in hydrostatic pressure as a result of lowering the groundwater table.

Three main tunnels are proposed for EI-Alignment A in Reaches 1 and 3, and the COH Forcemain. Tunnels require deeper excavation and therefore should be given special consideration. The construction of tunnels and other engineering structures may act as barriers to groundwater flow. This process should be monitored carefully. Groundwater without an appropriate seepage would cause an increase in the hydrostatic pressure that develops below

impervious layers and may cause uplift and subsequent foundation or slope instability, which is a problem.

4.1.2.2.2 Lake Conveyance System, Boulder Islands North

Information regarding groundwater in this area is not available. Therefore the potential of tunnel construction to intercept groundwater is not clear.

4.1.2.3 Surface Water Quality

This section addresses the effects of the Boulder Islands North Alternative on water quality in the Las Vegas Wash and Lake Mead including Las Vegas Bay, Boulder Basin, Boulder Beach, the SNWA intake structures, and Hoover Dam. The effects of the Boulder Islands North Alternative on water quality downstream of Hoover Dam are also addressed. The impacts of this alternative are analyzed at projected 2030 and 2050 annual effluent flows, and at the Lake levels of 1,178 ft (359 m) and 1,000 ft (305 m). The 2030 effluent flows would be 300 mgd (462 cfs), which include 270 mgd (416 cfs) to be discharged to Lake Mead near the Boulder Islands, and 30 mgd (46 cfs) to be discharged to the Las Vegas Wash. The 2050 effluent flows would be 400 mgd (616 cfs), which include 370 mgd (570 cfs) to be discharged to Lake Mead near the Boulder Islands, and 30 mgd (46 cfs) to be discharged to the Las Vegas Wash. Increased treatment would be implemented to maintain an annual average TP loading of 334 lbs/day. Tables presenting the water quality data for the projected 2030 and 2050 effluent flows and a TP loading of 334 lbs/day are presented in the following sections.

Water quality in the vicinity of the Boulder Islands discharge would not be noticeably different from water quality elsewhere in Boulder Basin. The effluent would be controlled so that it is broadly dispersed below the thermocline and so that effluent would not enter the epilimnion in a concentrated area.

4.1.2.3.1 Effects Due to Construction Activities

Construction of the BINDP would involve dredging the Lake near the south end of Saddle Island. Dredging activities would result in higher turbidity and increased suspended solids in the construction area. However, a turbidity curtain would be installed around the dredging area to contain the sediments and minimize the impact. The impact would be temporary and minor. No impairment to LMNRA resources would result from construction activities within the Lake. Coordination with SNWA would be implemented regarding the appropriate design and type of turbidity curtain to be used.

4.1.2.3.2 Las Vegas Wash

Under the Boulder Islands North Alternative, a minimum of 30 mgd (46 cfs) of effluent would remain in the Las Vegas Wash. Together with 20 mgd (31 cfs) of base flow, the total flow in the Las Vegas Wash is expected to be at least 50 mgd (77 cfs). This scenario was modeled assuming a total of 50 mgd (77 cfs) of combined base flow and effluent would remain in Las Vegas Wash.

Reducing the flow in the Las Vegas Wash to 50 mgd (77 cfs) (30 mgd [46 cfs] effluent plus 20 mgd [31 cfs] baseflow) would result in higher concentrations of substances associated with groundwater and urban runoff such as perchlorate, TDS, and selenium. The concentrations of these constituents would increase because less effluent flows would provide less dilution of the non-effluent related constituents.

It is estimated that the selenium concentration in the Las Vegas Wash would increase from the baseline level of approximately 2.5 µg/L (COH 2002a) to a value between 5 µg/L and 7 µg/L, depending on the location within the Las Vegas Wash. However, the method used to predict the future concentration was conservative. Therefore, the conservative estimate is likely higher than the actual concentration. Selenium may be present in water in a number of oxidation states depending on conditions such as pH, the presence of other chemicals, and the presence and type of aquatic life. Although the Las Vegas Wash Model (Black & Veatch 2005a) combined these oxidation states, not all oxidation states pose bioaccumulation hazards. The model also did not include two potential removal methods of selenium from the system. Some oxidation states of selenium are volatile and would exit the water to the air. Other oxidation states are accumulated in aquatic vegetation. The only removal method included in the model was the precipitation of selenium into the sediment. Because of these conservative assumptions, the reduction of effluent flows to the Las Vegas Wash may result in a selenium concentration below or perhaps slightly higher than the EPA-recommended criterion for bioaccumulation in aquatic life of 5 µg/L. The impacts of increased selenium concentrations on biological resources are described in Section 4.2.

Table 4.1-12 shows that the reduced flows of effluent in the Las Vegas Wash would result in lower concentrations of substances associated with effluent such as TIN and TP. The Las Vegas Wash WLAs would be attained for all effluent-related parameters.

4.1.2.3.3 Lake Mead

Table 4.1-13 shows the concentrations predicted in the Boulder Basin of Lake Mead from the Boulder Islands North Alternative for the year 2030 when the projected average effluent flow is 300 mgd (462 cfs). This flow includes 270 mgd (416 cfs) to be discharged to Lake Mead near the Boulder Islands and 30 mgd (46 cfs) to be discharged to the Las Vegas Wash. The results are based upon a Lake level of 1,178 ft (359 m) and an effluent TP loading of 334 lbs/day (152 kg/day).

Most of the parameters modeled in Lake Mead and reported in Table 4.1-13 are not significantly affected by the Boulder Islands North Alternative. The concentrations of many inorganic substances at the SNWA intakes, including bromide, sulfate, and chloride, which are relevant to drinking water, are similar in all simulations to the baseline conditions presented in Table 3.1-4 and Table 4.1-13. The same would be true for perchlorate, which is also relevant to drinking water and originates in groundwater discharged into the Las Vegas Wash; however, the concentrations of perchlorate are expected to be lower than baseline due to the groundwater remediation program as discussed in Sections 3.1.3.2 and 4.1.1.3.1. Because these parameters are not significantly affected by the Boulder Islands North Alternative, they receive little discussion in the following sections. However, chlorophyll shows significant differences and is discussed further. Total organic carbon was not modeled. However, because data analysis indicates a direct correlation between algae production and TOC, the Boulder Islands North Alternative

Table 4.1-12 Las Vegas Wash Baseline Conditions and Modeling Results for the Boulder Islands North Alternative [1] (effluent TP = 334 lbs/day).

Parameter	Baseline Conditions [2]	Boulder Islands Alternative [3]
Effluent Flow (mgd [cfs])	150 [231]	30 [46]
Temperature (°C [°F])	23 [73]	20 [68]
TIN (mg/L)	15.0	11.18
TP (mg/L)	0.2	0.14
TDS (mg/L)	1,675	2,416
Selenium (µg/L)	2.5	5.0

Notes:

[1] Location: LW 0.55 (See Figure 4.1-1). This table is for comparison purposes. Other baseline parameters for the Las Vegas Wash are shown on Table 3.1-3. Other Las Vegas Wash Modeling results are included in Appendix D.

[2] *Source: COH 2002d.*

[3] *Source: Black and Veatch 2004d.*

would lower algae production. Therefore, TOC would not increase as a result of implementation of the Boulder Islands North Alternative.

Under the Boulder Islands North Alternative, 50 mgd (77 cfs) of combined effluent and base flows would continue to enter the inner Las Vegas Bay from the Las Vegas Wash (plus up to 270 mgd [416 cfs] effluent discharged to Lake Mead). Therefore, the constituents in effluent that provide a nutrient source for aquatic life would still be present in the inner Las Vegas Bay, but at reduced levels. Similarly, as shown in Table 4.1-14 and Figure 4.1-3, chlorophyll levels would decrease from 12.4 to 5.0 µg/L because less effluent is entering the inner Las Vegas Bay from the Las Vegas Wash. The presence of constituents such as EDCs and other emerging compounds of concern would also be reduced in the inner Las Vegas Bay. Under the Boulder Islands North Alternative, effluent-related constituents would undergo more dilution than under existing conditions.

If more than 30 mgd of effluent is discharged to the Las Vegas Wash, more phosphorus would enter the Lake than shown in Table 4.1-14 and the chlorophyll concentration would be higher, especially in the inner Las Vegas Bay.

The volume of selenium in the Las Vegas Wash would decrease due to the reduction of effluent-based selenium. Although the concentration of selenium in the Las Vegas Wash would increase because there would be less dilution by effluent flows, the decreased volume exiting the Las Vegas Wash would be diluted by the water in the Las Vegas Bay. Therefore, although some uncertaintly exists, it is expected that elevated selenium concentrations in the Las Vegas Wash would not impact selenium levels in the Las Vegas Bay. Sampling and analysis of water quality parameters in the Las Vegas Bay through the Boulder Basin AMP would provide data regarding selenium levels in the Las Vegas Bay.

As shown on Table 4.1-14 and Figure 4.1-3, chlorophyll levels in Boulder Basin and at Boulder Beach would decrease in 2030, with a Lake level of 1,178 ft, compared to baseline conditions. Under the Boulder Islands North Alternative, water quality would remain the same or improve in

Table 4.1-13 Lake Mead Interpolations for the Boulder Islands Alternative [1] (1,178-ft [359-m] Lake level for year 2030 with effluent flows of 300 mgd [462 cfs] and effluent TP = 334 lbs/day).

Parameter	Inner Bay (LVB1.85M) [2]		Inner Bay (LVB2.7)		Boulder Basin (CR346.4)		Boulder Beach		Hoover Dam Discharge [3]		SNWA Intake [4]	
	Baseline	**2030**	**Baseline**	**2030**	**Baseline**	**2030**	**Baseline**	**2030**	**Baseline**	**2030**	**Baseline**	**2030**
Temperature (°C [°F])	20.3 [68.5]	20.0 [68.1]	20.3 [68.5]	20.0 [68.0]	19.6 [67.3]	19.6 [67.3]	19.3 [66.7]	19.3 [66.7]	13.2 [55.8]	13.3 [55.9]	13.0 [55.4]	13.0 [55.4]
Perchlorate (µg/L)	45.2	11.6	46.7	11.9	12.9	3.0	13.9	3.2	6.6	1.6	5.8	1.4
Conductivity (µS/cm)	1,085	1,048	1,094	1,051	947	957	952	961	901	915	896	905
Total Dissolved Solids (mg/L) [5]	687	663	693	665	599	606	603	608	570	579	567	573
Dissolved Oxygen (mg/L)	8.7	8.5	8.7	8.5	8.3	8.3	8.3	8.3	7.7	7.6	7.5	7.5
Chlorophyll Growing Season Average (µg/L) [6]	12.4	5.0	12.4	5.0	2.0	1.7	2.1	1.6	≤ 0.01	≤0.01	≤ 0.01	≤0.01
Chlorophyll Annual 95th percentile (µg/L) [6]	23.0	10.3	23.0	10.3	3.8	4.2	4.1	3.9	0.2	0.3	0.1	0.2
Secchi Depth (m)	3.2	6.6	3.2	6.6	8.5	10.8	8.8	11.0	ND [7]	ND [7]	ND [7]	ND [7]
Total Phosphorus (mg/L)	0.018	0.007	0.018	0.007	0.005	0.005	0.005	0.005	0.005	0.006	0.004	0.005
Soluble Phosphorus (mg/L)	0.009	0.005	0.009	0.005	0.003	0.004	0.003	0.004	0.004	0.006	0.004	0.004
Total Nitrogen (mg/L)	1.61	0.89	1.68	0.90	0.42	0.59	0.44	0.59	0.34	0.53	0.36	0.47
Total Inorganic Nitrogen (mg/L) [8]	1.57	0.86	1.64	0.87	0.40	0.57	0.43	0.57	0.32	0.51	0.33	0.44
Nitrate (mg/L)	1.56	0.85	1.63	0.86	0.39	0.56	0.42	0.56	0.31	0.49	0.31	0.41
Total Ammonia Nitrogen (mg/L)	0.012	0.014	0.013	0.014	0.001	0.012	0.011	0.012	0.014	0.017	0.019	0.021

able 4.1-13 Lake Mead Interpolations for the Boulder Islands Alternative [1] (1,178-ft [359-m] Lake level for year 2030 with effluent flows of 300 mgd [462 cfs] and effluent TP = 334 lbs/day) (continued).

Parameter	Inner Bay (LVB1.85M) [2]		Inner Bay (LVB2.7)		Boulder Basin (CR346.4)		Boulder Beach		Hoover Dam Discharge [3]		SNWA Intake [4]	
	Baseline	2030	Baseline	2030	Baseline	2030	Baseline	2030	Baseline	2030	Baseline	2030
Un-ionized Ammonia (mg/L) [9]	0.0008	<0.003	0.0008	<0.003	0.0002	<0.003	0.0004	<0.003	0.0002	<0.003	0.0003	<0.003
Bromide (mg/L)	0.106	0.098	0.107	0.098	0.086	0.086	0.087	0.087	0.080	0.081	0.080	0.080
Sulfate (mg/L)	295	279	297	280	257	255	259	256	243	244	242	242
Chloride (mg/L)	107	103	108	103	85	89	85	89	79	83	78	81
Fecal Coliform (MPN/100mL) [10]	1.0	0.9	1.1	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
pH	8.1	7.9	8.1	7.9	8.0	7.9	8.0	7.9	7.7	7.7	7.7	7.7

Notes:

[1] Unless otherwise specified, sampling depth is surface to 1 m (3.3 ft) except at SNWA and Hoover Dam, which were sampled at the intake depths. All data is the annual average, except for chlorophyll, which includes the growing season average (April 1 to September 30) and the annual 95th percentile, and Secchi depth, which includes the growing season average. Year 2030 results were interpolated from model simulations with effluent flow rates of 300 mgd (462 cfs) and effluent TP loadings of 275 and 467 lbs/day.

[2] M = Mobile. LVB1.85M is mobile and located at a depth of 16 to 18 m (52 to 59 ft) near the confluence of Las Vegas Wash and Lake Mead. All other locations are stationary (See Figure 4.1-1). The position of LVB1.85M for the initial lake level of 1178 ft is the same as LVB2.7 for the entire growing season, but moves away from the Las Vegas Wash later in the year as the lake level drops. Therefore the chlorophyll concentrations (which are averaged over the growing season) are the same at LVB1.85M and LVB2.7, while other parameters (averaged over the entire year) are slightly different.

[3] Hoover Dam discharge data is from upper and lower intakes combined.

[4] SNWA data is for intake located at 1,000 ft.

[5] Total Dissolved Solids (TDS) are not simulated. It is computed from the correlation, TDS (mg/L) = 0.633 Conductivity (µS/cm).

[6] Sampling depth for chlorophyll was averaged over the top 5 m (16 ft), except at SNWA and Hoover Dam, which were sampled at the intake depths.

[7] ND = No Data. No Secchi depth data exists for Hoover Dam Discharge and SNWA Intake because Secchi depth is a property of lake surface.

[8] Total Inorganic Nitrogen is not simulated. It is computed as Nitrate + Total Ammonia Nitrogen. Nitrite is not simulated.

[9] Un-ionized ammonia is averaged over the entire depth.

[10] Most Probable Number per 100mL (1 deciliter).

Source: Black & Veatch 2004d.

Table 4.1-14 Lake Mead Chlorophyll Concentrations for Baseline Conditions and the Boulder Islands North Alternative [1] (1,178-ft Lake level for year 2030 with effluent flows of 300 mgd [462 cfs] and effluent TP = 334 lbs/day).

Location [3]	Chlorophyll Growing Season Average (µg/L) [2]	
	Baseline Conditions	Boulder Islands Alternative [4]
Inner Bay (LVB 1.85M) [5]	12.4	5.0
Inner Bay (LVB 2.7)	12.4	5.0
Boulder Basin (CR 346.4)	2.0	1.7
Boulder Beach	2.1	1.6
Hoover Dam [6]	0	0
SNWA Intake [7]	0	0

Notes:

[1] This table is for comparison purposes. Other baseline parameters for Boulder Basin in Lake Mead are shown on Table 3.1-4.

[2] Sampling depth for chlorophyll was averaged over the top 5 m (16 ft), except at SNWA and Hoover Dam, which were sampled at the intake depths. Chlorophyll data is the seasonal average (April 1 to September 30).

[3] Sampling/monitoring locations are shown on Figure 4.1-1.

[4] Year 2030 results were interpolated from model simulations with effluent flow rates of 300 mgd (462 cfs) and effluent TP loadings of 275 and 467 lbs/day.

[5] M = Mobile. LVB1.85M is mobile and located at a depth of 16 to 18 m (52 to 59 ft) near the confluence of Las Vegas Wash and Lake Mead. All other locations are stationary. The position of LVB1.85M for the initial lake level of 1178 ft is the same as LVB2.7 for the entire growing season, but moves away from the Las Vegas Wash later in the year as the lake level drops. Therefore the chlorophyll concentrations (which are averaged over the growing season) are the same at LVB1.85M and LVB2.7, while other parameters (averaged over the entire year) are slightly different.

[6] Hoover Dam discharge data is from upper and lower intakes combined.

[7] SNWA data is for intake located at 1,000 ft.

Source: Black and Veatch 2004d.

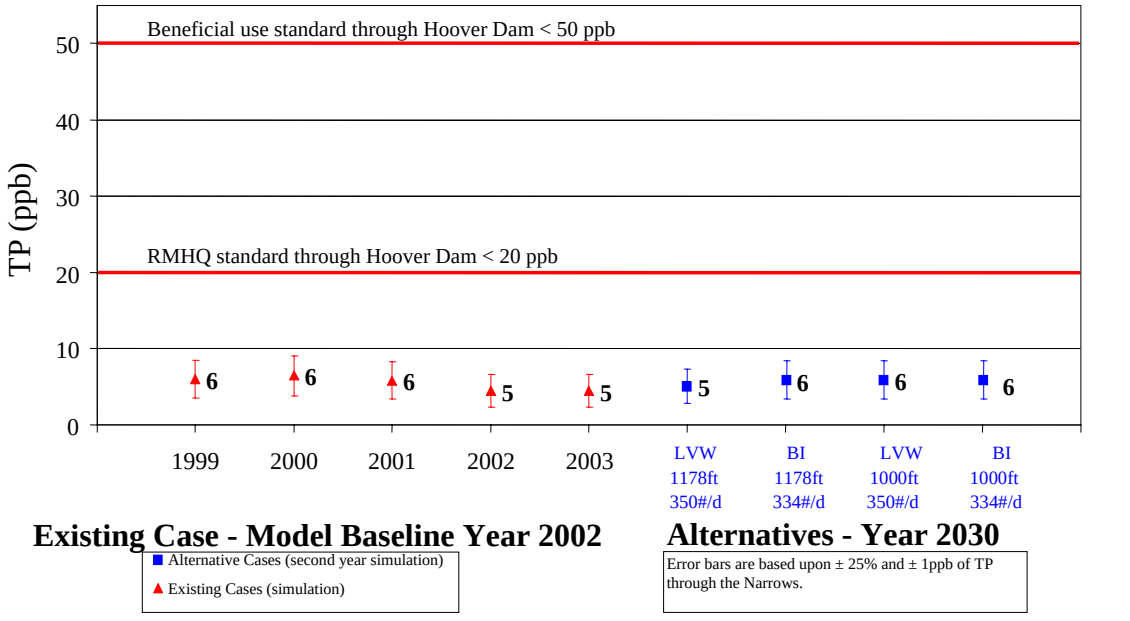
the Las Vegas Bay and Boulder Basin compared to baseline conditions, and water-quality standards for Lake Mead (Table 3.1-2) would continue to be met using current, conventional treatment processes.

Phosphorus concentrations at Hoover Dam would increase from 0.005 to 0.006 mg/L (5 to 6 ppb) as shown on Figure 4.1-7. This increase would not exceed the water-quality standard of 0.050 mg/L (50 ppb) below Hoover Dam (NAC 445A.193). Data from the USGS, UNLV, and Reclamation extending back to 1974 indicates that the TP concentration through Hoover Dam has historically been far higher than in recent years. The predicted TP concentration of 6 ppb through Hoover Dam for the Boulder Islands Alternative is lower than historical levels over an extended period of time. No data have been received identifying impairment of water uses in the Colorado River downstream of Hoover Dam, either in the present or past. Therefore, an increase of 1ppb TP through Hoover Dam would not have a significant impact downstream of Hoover Dam. In addition, monitoring of water-quality parameters through the Boulder Basin AMP, and actions if warranted, would ensure that an increase in effluent-related TP through Hoover Dam would not occur. Phosphorus levels at the SNWA intake structures would increase from

0.004 to 0.005 mg/L (4 to 5 ppb). Impacts from the Boulder Islands North Alternative to Lake Mead (with 2030 annual effluent flows at a Lake level of 1,178 ft [359 m]) would be insignificant and negligible. Impairment of LMNRA water resources would not occur.

When total annual effluent flows increase to 400 mgd (616 cfs) in 2050 with a Lake level of 1,178 ft (359 m) (Tables 4.1-15 and 4.1-16 and Figure 4.1-4), water-quality parameters in the inner Las Vegas Bay would decrease slightly compared to baseline. The water-quality parameters would generally increase slightly in Boulder Basin compared with baseline, but the increases would not result in exceedances of water-quality standards. Overall, impacts from the Boulder Islands North Alternative to Lake Mead (with projected 2050 annual effluent flows at a Lake level of 1,178 ft) would be insignificant and negligible. Therefore, no impairment to LMNRA resources would occur.

Water quality under the Boulder Islands North Alternative at a Lake level of 1,000 ft (305 m) for the year 2030 with annual effluent flows of 300 mgd (462 cfs) are presented in Table 4.1-17. For comparison, water-quality standards are shown on Table 3.1-2 and baseline conditions for Lake Mead on Table 3.1-4.



Notes: Results for the No Action Alternative were extrapolated from model simulations with effluent flow rates of 300 mgd (462 cfs) and 400 mgd (462 cfs) and effluent TP loadings of 275 and 334 lbs/day. Results for the Boulder Islands Alternative were interpolated from model simulations with effluent flow rates of 300 mgd (462 cfs) and effluent TP loadings of 275 and 467 lbs/day. Total phosphorus through Hoover Dam was not simulated or estimated for the Process Improvements Alternative. However, it is assumed that since the TP loading would be 334 lbs/day at a Lake level of 1,178 ft and 165 lbs/day at a Lake level of 1,000 ft, TP through Hoover Dam would be less than the No Action and the Boulder Islands alternatives.

Figure 4.1-7 Annual Average Total Phosphorus Concentrations at Hoover Dam.

Table 4.1-15 Lake Mead Interpolations for the Boulder Islands Alternative [1] (1,178-ft [359-m] Lake level for year 2050 with effluent flows of 400 mgd [616 cfs] and effluent TP = 334 lbs/day).

Parameter	Inner Bay (LVB1.85M) [2]		Inner Bay (LVB2.7)		Boulder Basin (CR346.4)		Boulder Beach		Hoover Dam Discharge [3]		SNWA Intake [4]	
	Baseline	**2050**	**Baseline**	**2050**	**Baseline**	**2050**	**Baseline**	**2050**	**Baseline**	**2050**	**Baseline**	**2050**
Temperature (°C [°F])	20.3 [68.5]	20.0 [68.1]	20.3 [68.5]	20.0 [68.0]	19.6 [67.3]	19.6 [67.3]	19.3 [66.7]	19.3 [66.7]	13.2 [55.8]	13.3 [55.9]	13.0 [55.4]	13.0 [55.4]
Perchlorate (µg/L)	45.2	11.4	46.7	11.6	12.9	3.0	13.9	3.2	6.6	1.6	5.8	1.4
Conductivity (µS/cm)	1,085	1,053	1,094	1,056	947	965	952	969	901	920	896	909
Total Dissolved Solids (mg/L) [5]	687	667	693	668	599	611	603	613	570	582	567	576
Dissolved Oxygen (mg/L)	8.7	8.5	8.7	8.5	8.3	8.3	8.3	8.3	7.7	7.6	7.5	7.5
Chlorophyll Growing Season Average (µg/L) [6]	12.4	4.9	12.4	4.9	2.0	1.7	2.1	1.6	≤ 0.01	≤0.01	≤ 0.01	≤0.01
Chlorophyll Annual 95th percentile (µg/L)[6]	23.0	10.0	23.0	10.0	3.8	4.2	4.1	3.9	0.2	0.3	0.2	0.2
Secchi Depth (m)	3.2	6.8	3.2	6.8	8.5	10.8	8.8	10.7	ND [7]	ND [7]	ND [7]	ND [7]
Total Phosphorus (mg/L)	0.018	0.007	0.018	0.007	0.005	0.005	0.005	0.005	0.005	0.006	0.004	0.005
Soluble Phosphorus (mg/L)	0.009	0.005	0.009	0.005	0.003	0.004	0.003	0.004	0.004	0.006	0.004	0.004
Total Nitrogen (mg/L)	1.61	0.96	1.7	0.96	0.4	0.69	0.4	0.68	0.3	0.60	0.4	0.52
Total Inorganic Nitrogen (mg/L) [8]	1.61	0.93	1.61	0.93	0.41	0.67	0.41	0.66	0.31	0.58	0.32	0.49
Nitrate (mg/L)	1.56	0.91	1.63	0.92	0.39	0.65	0.42	0.65	0.31	0.56	0.31	0.46

Table 4.1-15 Lake Mead Interpolations for the Boulder Islands Alternative [1] (1,178-ft [359-m] Lake level for year 2050 with effluent flows of 400 mgd [616 cfs] and effluent TP = 334 lbs/day) (continued).

Parameter	Inner Bay (LVB1.85M) [2]		Inner Bay (LVB2.7)		Boulder Basin (CR346.4)		Boulder Beach		Hoover Dam Discharge [3]		SNWA Intake [4]	
	Baseline	2050	Baseline	2050	Baseline	2050	Baseline	2050	Baseline	2050	Baseline	2050
Total Ammonia Nitrogen (mg/L)	0.012	0.014	0.013	0.014	0.010	0.012	0.011	0.012	0.014	0.018	0.019	0.022
Un-ionized Ammonia (mg/L) [9]	.0008	<0.003	0.0008	<0.003	0.0002	<0.003	0.0004	<0.003	0.0002	<0.003	0.0003	<0.003
Bromide (mg/L)	0.106	0.099	0.107	0.099	0.086	0.087	0.087	0.088	0.080	0.082	0.080	0.081
Sulfate (mg/L)	295	280	297	280	257	256	259	257	243	245	242	243
Chloride (mg/L)	107	104	108	104	85	90	85	91	79	84	78	82
Fecal Coliform (MPN/100mL) [10]	1.0	0.9	1.1	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
pH	8.1	7.9	8.1	7.9	8.0	7.9	8.0	7.9	7.7	7.7	7.7	7.7

Notes:

[1] Unless otherwise specified, sampling depth is surface to 1 m (3.3 ft) except at SNWA and Hoover Dam, which were sampled at the intake depths. All data is the annual average, except for chlorophyll, which includes the growing season average (April 1 to September 30) and the annual 95th percentile, and Secchi depth, which includes the growing season average. Year 2050 results were interpolated from model simulations with effluent flow rates of 300 mgd (462 cfs) and effluent TP loadings of 275 lbs/day and 467 lbs/day, and model simulations with effluent flow rates of 400 mgd (616 cfs) and effluent TP loadings of 275 lbs/day.

[2] M = Mobile. LVB1.85M is mobile and located at a depth of 16 to 18 m (52 to 59 ft) near the confluence of Las Vegas Wash and Lake Mead. All other locations are stationary (See Figure 4.1-1). The position of LVB1.85M for the initial lake level of 1178 ft is the same as LVB2.7 for the entire growing season, but moves away from the Las Vegas Wash later in the year as the lake level drops. Therefore the chlorophyll concentrations (which are averaged over the growing season) are the same at LVB1.85M and LVB2.7, while other parameters (averaged over the entire year) are slightly different.

[3] Hoover Dam discharge data is from upper and lower intakes combined.

[4] SNWA data is for intake located at 1,000 ft.

[5] Total Dissolved Solids (TDS) are not simulated. It is computed from the correlation, TDS (mg/L) = 0.633 Conductivity (µS/cm).

[6] Sampling depth for chlorophyll was averaged over the top 5 m (16 ft), except at SNWA and Hoover Dam, which were sampled at the intake depths.

[7] ND = No Data. No Secchi depth data exists for Hoover Dam Discharge and SNWA Intake because Secchi depth is a property of lake surface.

[8] Total Inorganic Nitrogen is not simulated. It is computed as Nitrate + Total Ammonia Nitrogen. Nitrite is not simulated.

[9] Un-ionized ammonia is averaged over the entire depth.

[10] Most Probable Number per 100mL (1 deciliter).

Source: Black & Veatch 2004d.

Table 4.1-16 Lake Mead Chlorophyll Concentrations for Baseline Conditions and the Boulder Islands North Alternative [1] (1,178-ft Lake level for year 2050 with effluent flows of 400 mgd [616 cfs] and effluent TP = 334 lbs/day).

Location [3]	Chlorophyll Growing Season Average (µg/L) [2]	
	Baseline Conditions	Boulder Islands Alternative [4]
Inner Bay (LVB 1.85M) [5]	12.4	4.9
Inner Bay (LVB 2.7)	12.4	4.9
Boulder Basin (CR 346.4)	2.0	1.7
Boulder Beach	2.1	1.6
Hoover Dam [6]	0	0
SNWA Intake [7]	0	0

Notes:

[1] This table is for comparison purposes. Other baseline parameters for Boulder Basin in Lake Mead are shown on Table 3.1-4.

[2] Sampling depth for chlorophyll was averaged over the top 5 m (16 ft), except at SNWA and Hoover Dam, which were sampled at the intake depths. Chlorophyll data is the seasonal average (April 1 to September 30).

[3] Sampling/monitoring locations are shown on Figure 4.1-1.

[4] Year 2050 results were interpolated from model simulations with effluent flow rates of 300 mgd (462 cfs) and effluent TP loadings of 275 lbs/day and 467 lbs/day, and model simulations with effluent flow rates of 400 mgd (616 cfs) and effluent TP loadings of 275 lbs/day.

[5] M = Mobile. LVB1.85M is mobile and located at a depth of 16 to 18 m (52 to 59 ft) near the confluence of Las Vegas Wash and Lake Mead. All other locations are stationary. The position of LVB1.85M for the initial lake level of 1178 ft is the same as LVB2.7 for the entire growing season, but moves away from the Las Vegas Wash later in the year as the lake level drops. Therefore the chlorophyll concentrations (which are averaged over the growing season) are the same at LVB1.85M and LVB2.7, while other parameters (averaged over the entire year) are slightly different.

[6] Hoover Dam discharge data is from upper and lower intakes combined.

[7] SNWA data is for intake located at 1,000 ft.

Source: Black and Veatch 2004d.

Table 4.1-18 and Figure 4.1-5 show that at lower Lake levels, chlorophyll concentrations in the inner Las Vegas Bay, the open waters of Boulder Basin, and Boulder Beach are reduced compared to baseline conditions. Chlorophyll concentrations at Hoover Dam increase slightly, but this increase is small and is not expected to cause any impairment to LMNRA resources or exceed water-quality standards. Concentrations of some dissolved substances increase, but the increases would not result in exceedances of water-quality standards (Table 3.1-2).

Under the Boulder Islands North Alternative, with a Lake level of 1,000 ft (305 m) and total effluent flows of 300 mgd (462 cfs), parameter concentrations at the Hoover Dam discharge would generally decrease compared to baseline conditions. If TP loading is 334 lbs/day, water-quality modeling scenarios indicate that phosphorus concentrations at Hoover Dam would increase from 0.005 to 0.006 mg/L (5 to 6 ppb) (Figure 4.1-7), but the water-quality standard of 0.05 mg/L (50 ppb) would not be exceeded below Hoover Dam. Impacts from the Boulder Islands North Alternative to Lake Mead (with 2030 annual effluent flows at a Lake level of 1,000 ft [305 m]) would be insignificant and negligible. Impairment to LMNRA water resources would not occur.

Table 4.1-17 Lake Mead Interpolations for the Boulder Islands Alternative [1] (1,000-ft [305-m] Lake level for year 2030 with effluent flows of 300 mgd [462 cfs] and effluent TP = 334 lbs/day).

Parameter	Inner Bay (LVB1.85M) [2]		Inner Bay (LVB2.7) [3]		Boulder Basin (CR346.4)		Boulder Beach		Hoover Dam Discharge [4]		SNWA Intake [5]	
	Baseline	**2030**	**Baseline**	**2030**	**Baseline**	**2030**	**Baseline**	**2030**	**Baseline**	**2030**	**Baseline**	**2030**
Temperature (°C[°F])	20.3 [68.5]	19.8 [67.7]	20.3 [68.5]	ND	19.6 [67.3]	19.5 [67.0]	19.3 [66.7]	19.3 [66.7]	13.2 [55.8]	14.2 [57.5]	13.0 [55.4]	ND
Perchlorate (µg/L)	45.2	11.2	46.7	ND	12.9	3.4	13.9	4.0	6.6	1.6	5.8	ND
Conductivity (µS/cm)	1,085	1,012	1,094	ND	947	932	952	939	901	909	896	ND
Total Dissolved Solids (mg/L) [6]	687	641	693	ND	599	590	603	595	570	575	567	ND
Dissolved Oxygen (mg/L)	8.7	8.4	8.7	ND	8.3	8.3	8.3	8.3	7.7	7.6	7.5	ND
Chlorophyll Growing Season Average (µg/L) [7]	12.4	4.0	12.4	ND	2.0	1.7	2.1	1.8	≤ 0.01	0.1	≤ 0.01	ND
Chlorophyll Annual 95th percentile (µg/L) [7]	23.0	8.7	23.0	ND	3.8	3.7	4.1	3.9	0.2	0.7	0.2	ND
Secchi Depth (m)	3.2	7.8	3.2	ND	8.5	9.6	8.8	10.6	ND [8]	ND [8]	ND [8]	ND
Total Phosphorus (mg/L)	0.018	0.006	0.018	ND	0.005	0.004	0.005	0.004	0.005	0.006	0.004	ND
Soluble Phosphorus (mg/L)	0.009	0.004	0.009	ND	0.003	0.003	0.003	0.003	0.004	0.006	0.004	ND
Total Nitrogen (mg/L)	1.61	0.88	1.7	ND	0.4	0.59	0.4	0.63	0.3	0.79	0.4	ND
Total Inorganic Nitrogen (mg/L) [9]	1.61	0.86	1.61	ND	0.41	0.57	0.41	0.60	0.31	0.75	0.32	ND
Nitrate (mg/L)	1.56	0.84	1.63	ND	0.39	0.56	0.42	0.59	0.31	0.72	0.31	ND
Total Ammonia Nitrogen (mg/L)	0.012	0.019	0.013	ND	0.010	0.017	0.011	0.017	0.014	0.028	0.019	ND
Un-ionized Ammonia (mg/L) [10]	.0008	<0.003	0.0008	ND	0.0002	<0.003	0.0004	<0.003	0.0002	<0.003	0.0003	ND
Bromide (mg/L)	0.106	0.095	0.107	ND	0.086	0.084	0.087	0.085	0.080	0.082	0.080	ND

Table 4.1-17 Lake Mead Interpolations for the Boulder Islands Alternative [1] (1,000-ft [305-m] Lake level for year 2030 with effluent flows of 300 mgd [462 cfs] and effluent TP = 334 lbs/day) (continued).

Parameter	Inner Bay (LVB1.85M) [2]		Inner Bay (LVB2.7) [3]		Boulder Basin (CR346.4)		Boulder Beach		Hoover Dam Discharge [4]		SNWA Intake [5]	
	Baseline	2030	Baseline	2030	Baseline	2030	Baseline	2030	Baseline	2030	Baseline	2030
Sulfate (mg/L)	295	273	297	ND	257	252	259	254	243	243	242	ND
Chloride (mg/L)	107	98	108	ND	85	85	85	87	79	83	78	ND
Fecal Coliform (MPN/100mL) [11]	1.0	0.6	1.1	ND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	ND
pH	8.1	7.9	8.1	ND	8.0	7.9	8.0	7.9	7.7	7.7	7.7	ND

Notes:

[1] Unless otherwise specified, sampling depth is surface to 1 m (3.3 ft) except at SNWA and Hoover Dam, which were sampled at the intake depths. All data is the annual average, except for chlorophyll, which includes the growing season average (April 1 to September 30) and the annual 95th percentile, and Secchi depth, which includes the growing season average. Year 2030 results were interpolated from model simulations with effluent flow rates of 300 mgd (462 cfs) and effluent TP loadings of 275 and 467 lbs/day.

[2] M = Mobile. LVB1.85M is mobile and located at a depth of 16 to 18 m (52 to 59 ft) near the confluence of Las Vegas Wash and Lake Mead. All other locations are stationary (See Figure 4.1-1). The position of LVB1.85M for the initial lake level of 1178 ft is the same as LVB2.7 for the entire growing season, but moves away from the Las Vegas Wash later in the year as the lake level drops. Therefore the chlorophyll concentrations (which are averaged over the growing season) are the same at LVB1.85M and LVB2.7, while other parameters (averaged over the entire year) are slightly different.

[3] ND = No Data. No data exists for LVB2.7 because it is located on dry land with a lake level of 1,000 ft.

[4] Hoover Dam discharge data is from the lower intake only.

[5] No data exists for the SNWA 1,000-ft intake.

[6] Total Dissolved Solids (TDS) are not simulated. It is computed from the correlation, TDS (mg/L) = 0.633 Conductivity (µS/cm).

[7] Sampling depth for chlorophyll was averaged over the top 5 m (16 ft), except at SNWA and Hoover Dam, which were sampled at the intake depths.

[8] ND = No Data. No Secchi depth data exists for Hoover Dam Discharge and SNWA Intake because Secchi depth is a property of lake surface.

[9] Total Inorganic Nitrogen is not simulated. It is computed as Nitrate + Total Ammonia Nitrogen. Nitrite is not simulated

[10] Un-ionized ammonia is averaged over the entire depth.

[11] Most Probable Number per 100mL (1 deciliter).

Source: Black & Veatch 2004d.

Table 4.1-18 Lake Mead Chlorophyll Concentrations for Baseline Conditions and the Boulder Islands North Alternative [1] (1,000-ft Lake level for year 2030 with effluent flows of 300 mgd [462 cfs] and effluent TP = 334 lbs/day).

Location [3]	Chlorophyll Growing Season Average (µg/L) [2]	
	Baseline Conditions	Boulder Islands Alternative [4]
Inner Bay (LVB 1.85M) [5]	12.4	4.0
Inner Bay (LVB 2.7) [6]	12.4	ND
Boulder Basin (CR 346.4)	2.0	1.7
Boulder Beach	2.1	1.8
Hoover Dam [7]	0	0.1
SNWA Intake [8]	0	ND

Notes:

[1] This table is for comparison purposes. Other baseline parameters for Boulder Basin in Lake Mead are shown on Table 3.1-4.

[2] Sampling depth for chlorophyll was averaged over the top 5 m (16 ft), except at SNWA and Hoover Dam, which were sampled at the intake depths. Chlorophyll data is the seasonal average (April 1 to September 30).

[3] Sampling/monitoring locations are shown on Figure 4.1-1.

[4] Year 2030 results were interpolated from model simulations with effluent flow rates of 300 mgd (462 cfs) and effluent TP loadings of 275 and 467 lbs/day.

[5] M = Mobile. LVB1.85M is mobile and located at a depth of 16 to 18 m (52 to 59 ft) near the confluence of Las Vegas Wash and Lake Mead. All other locations are stationary. The position of LVB1.85M for the initial Lake level of 1,178 ft is the same as LVB2.7 for the entire growing season, but moves away from the Las Vegas Wash later in the year as the lake level drops. Therefore the chlorophyll concentrations (which are averaged over the growing season) are the same at LVB1.85M and LVB2.7, while other parameters (averaged over the entire year) are slightly different.

[6] ND = No Data. No data exists for LVB2.7 because it is located on dry land with a Lake level of 1,000 ft.

[7] Hoover Dam discharge data is from the lower intake only.

[8] No data exists for the SNWA 1,000-ft intake.

Source: Black and Veatch 2004d.

When total annual effluent flows increase to 400 mgd (616 cfs) in 2050 with a Lake level of 1,000 ft (305 m) (Tables 4.1-19 and 4.1-20 and Figure 4.1-6), some water-quality parameters would increase slightly compared with baseline conditions, but the increases would not result in exceedances of water-quality standards. Overall, impacts from the Boulder Islands North Alternative to Lake Mead (with projected 2050 annual effluent flows at a Lake level of 1,000 ft) would be insignificant and negligible. Therefore, no impairment to LMNRA resources would occur.

4.1.2.3.4 Downstream of Hoover Dam

Water quality modeling indicates that the TP concentrations at Hoover Dam would increase from 0.005 to 0.006 mg/L (5 to 6 ppb) (Figure 4.1-7), but the water-quality standard of 0.05 mg/L (50 ppb) below Hoover Dam would not be exceeded. Data from the USGS, UNLV, and Reclamation extending back to 1974 indicates that the TP concentration through Hoover Dam has

Table 4.1-19 Lake Mead Interpolations for the Boulder Islands Alternative [1] (1,000-ft [305-m] Lake level for year 2050 with effluent flows of 400 mgd [616 cfs] and effluent TP = 334 lbs/day).

Parameter	Inner Bay (LVB1.85M) [2]		Inner Bay (LVB2.7) [3]		Boulder Basin (CR346.4)		Boulder Beach		Hoover Dam Discharge [4]		SNWA Intake [5]	
	Baseline	**2050**	**Baseline**	**2050**	**Baseline**	**2050**	**Baseline**	**2050**	**Baseline**	**2050**	**Baseline**	**2050**
Temperature (°C[°F])	20.3 [68.5]	19.8 [67.7]	20.3 [68.5]	ND	19.6 [67.3]	19.5 [67.0]	19.3 [66.7]	19.3 [66.7]	13.2 [55.8]	14.2 [57.5]	13.0 [55.4]	ND
Perchlorate (µg/L)	45.2	10.8	46.7	ND	12.9	3.2	13.9	3.8	6.6	1.3	5.8	ND
Conductivity (µS/cm)	1,085	1,010	1,094	ND	947	934	952	941	901	907	896	ND
Total Dissolved Solids (mg/L) [6]	687	640	693	ND	599	591	603	596	570	574	567	ND
Dissolved Oxygen (mg/L)	8.7	8.5	8.7	ND	8.3	8.3	8.3	8.3	7.7	7.5	7.5	ND
Chlorophyll Growing Season Average (µg/L) [7]	12.4	3.9	12.4	ND	2.0	1.6	2.1	1.7	≤ 0.01	<0.01	≤ 0.01	ND
Chlorophyll Annual 95th percentile (µg/L)	23.0	8.6	23.0	ND	3.8	3.6	4.1	3.8	0.2	0.7	0.1	ND
Secchi Depth (m)	3.2	8.0	3.2	ND	8.5	11.2	8.8	10.0	ND [8]	ND [8]	ND [8]	ND [8]
Total Phosphorus (mg/L)	0.018	0.006	0.018	ND	0.005	0.004	0.005	0.004	0.005	0.006	0.004	ND
Soluble Phosphorus (mg/L)	0.009	0.004	0.009	ND	0.003	0.003	0.003	0.003	0.004	0.005	0.004	ND
Total Nitrogen (mg/L)	1.61	0.91	1.68	ND	0.42	0.65	0.44	0.68	0.34	0.88	0.36	ND
Total Inorganic Nitrogen (mg/L) [9]	1.61	0.88	1.61	ND	0.41	0.63	0.41	0.66	0.31	0.83	0.32	ND
Nitrate (mg/L)	1.56	0.86	1.63	ND	0.39	0.61	0.42	0.64	0.31	0.80	0.31	ND
Total Ammonia Nitrogen (mg/L)	0.012	0.019	0.013	ND	0.010	0.018	0.011	0.018	0.014	0.032	0.019	ND

Table 4.1-19 Lake Mead Interpolations for the Boulder Islands Alternative[1] (1,000-ft [305-m] Lake level for year 2050 with effluent flows of 400 mgd [616 cfs] and effluent TP = 334 lbs/day) (continued).

Parameter	Inner Bay (LVB1.85M) [2]		Inner Bay (LVB2.7) [3]		Boulder Basin (CR346.4)		Boulder Beach		Hoover Dam Discharge [4]		SNWA Intake [5]	
	Baseline	2050	Baseline	2050	Baseline	2050	Baseline	2050	Baseline	2050	Baseline	2050
Un-ionized Ammonia (mg/L)[10]	.0008	<0.003	0.0008	ND	0.0002	<0.003	0.0004	<0.003	0.0002	<0.003	0.0003	ND
Bromide (mg/L)	0.106	0.095	0.107	ND	0.086	0.085	0.087	0.086	0.080	0.082	0.080	ND
Sulfate (mg/L)	295	272	297	ND	257	252	259	253	243	242	242	ND
Chloride (mg/L)	107	98	108	ND	85	86	85	87	79	83	78	ND
Fecal Coliform (MPN/100mL) [11]	1.0	0.5	1.1	ND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	ND
pH	8.1	7.9	8.1	ND	8.0	7.9	8.0	7.9	7.7	7.7	7.7	ND

Notes:

[1] Unless otherwise specified, sampling depth is surface to 1 m (3.3 ft) except at SNWA and Hoover Dam, which were sampled at the intake depths. All data is the annual average, except for chlorophyll, which includes the growing season average (April 1 to September 30) and the annual 95th percentile, and Secchi depth, which includes the growing season average. Year 2050 results were interpolated from model simulations with effluent flow rates of 300 mgd (462 cfs) and effluent TP loadings of 275 lbs/day and 467 lbs/day, and model simulations with effluent flow rates of 400 mgd (616 cfs) and effluent TP loadings of 275 lbs/day.

[2] M = Mobile. LVB1.85M is mobile and located at a depth of 16 to 18 m (52 to 59 ft) near the confluence of Las Vegas Wash and Lake Mead. All other locations are stationary (See Figure 4.1-1). The position of LVB1.85M for the initial lake level of 1178 ft is the same as LVB2.7 for the entire growing season, but moves away from the Las Vegas Wash later in the year as the lake level drops. Therefore the chlorophyll concentrations (which are averaged over the growing season) are the same at LVB1.85M and LVB2.7, while other parameters (averaged over the entire year) are slightly different.

[3] ND = No Data. No data exists for LVB2.7 because it is located on dry land with a lake level of 1,000 ft.

[4] Hoover Dam discharge data is from the lower intake only.

[5] No data exists for the SNWA 1,000-ft intake.

[6] Total Dissolved Solids (TDS) are not simulated. It is computed from the correlation, TDS (mg/L) = 0.633 Conductivity (µS/cm).

[7] Sampling depth for chlorophyll was averaged over the top 5 m (16 ft), except at SNWA and Hoover Dam, which were sampled at the intake depths.

[8] ND = No Data. No Secchi depth data exists for Hoover Dam Discharge and SNWA Intake because Secchi depth is a property of lake surface.

[9] Total Inorganic Nitrogen is not simulated. It is computed as Nitrate + Total Ammonia Nitrogen. Nitrite is not simulated

[10] Un-ionized ammonia is averaged over the entire depth.

[11] Most Probable Number per 100mL (1 deciliter).

Source: Black & Veatch 2004d.

Table 4.1-20 Lake Mead Chlorophyll Concentrations for Baseline Conditions and the Boulder Islands North Alternative [1] (1,000-ft Lake level for year 2050 with effluent flows of 400 mgd [616 cfs] and effluent TP = 334 lbs/day).

Location [3]	Chlorophyll Growing Season Average (µg/L) [2]	
	Baseline Conditions	Boulder Islands Alternative [4]
Inner Bay (LVB 1.85M) [5]	12.4	3.9
Inner Bay (LVB 2.7) [6]	12.4	ND
Boulder Basin (CR 346.4)	2.0	1.6
Boulder Beach	2.1	1.7
Hoover Dam [7]	0	0
SNWA Intake [8]	0	ND

Notes:

[1] This table is for comparison purposes. Other baseline parameters for Boulder Basin in Lake Mead are shown on Table 3.1-4.

[2] Sampling depth for chlorophyll was averaged over the top 5 m (16 ft), except at SNWA and Hoover Dam, which were sampled at the intake depths. Chlorophyll data is the seasonal average (April 1 to September 30).

[3] Sampling/monitoring locations are shown on Figure 4.1-1.

[4] Year 2050 results were interpolated from model simulations with effluent flow rates of 300 mgd (462 cfs) and effluent TP loadings of 275 lbs/day and 467 lbs/day, and model simulations with effluent flow rates of 400 mgd (616 cfs) and effluent TP loadings of 275 lbs/day.

[5] M = Mobile. LVB1.85M is mobile and located at a depth of 16 to 18 m (52 to 59 ft) near the confluence of Las Vegas Wash and Lake Mead. All other locations are stationary. The position of LVB1.85M for the initial Lake level of 1,178 ft is the same as LVB2.7 for the entire growing season, but moves away from the Las Vegas Wash later in the year as the lake level drops. Therefore the chlorophyll concentrations (which are averaged over the growing season) are the same at LVB1.85M and LVB2.7, while other parameters (averaged over the entire year) are slightly different.

[6] ND = No Data. No data exists for LVB2.7 because it is located on dry land with a Lake level of 1,000 ft.

[7] Hoover Dam discharge data is from the lower intake only.

[8] No data exists for the SNWA 1,000-ft intake.

Source: Black and Veatch 2004d.

historically been far higher than in recent years. The predicted TP concentration of 6 ppb through Hoover Dam for the Boulder Islands Alternative is lower than historical levels over an extended period of time. No data have been received identifying impairment of water uses in the Colorado River downstream of Hoover Dam, either in the present or past. Therefore, an increase of 1ppb TP through Hoover Dam would not have a significant impact downstream of Hoover Dam.

The Lake Mohave model, which is discussed in Appendix D, indicates that the Boulder Islands North Alternative would not negatively impact Lake Mohave. Under contract to Reclamation, UNLV investigated water quality in the Colorado River in the early 1980s. The UNLV study reported average TP concentrations of 17 ppb in the canyon downstream of Hoover Dam, and in the 10 to 15 ppb range in Lake Mohave and Lake Havasu. The UNLV study reported that chlorophyll concentrations were in the 2 to 4 ppb range in Lake Mohave, and 3 to 4 ppb in Lake Havasu. These levels were not considered excessive. During ordinary conditions, when phosphorus concentrations resulting from the project would be at baseline levels, there would be no effect. During extraordinary conditions, phosphorus levels through Hoover Dam may increase

by 2 ppb, but they would remain well below historical conditions, and well below concentrations that did not produce excessive algae. Therefore, there would not be a significant effect.

The loading through Hoover Dam would be monitored and regulated through the Boulder Basin AMP monitoring program described in Section 2.2.2.6.

Changing the point of discharge would not be expected to have any effect on downstream users. That is, the annual average mass load of these and other conservative (not destroyed by biochemical reactions) substances through the Hoover Dam outlets would be nearly identical for all of the discharge locations. Future increased discharge volumes may produce additional mass loadings of these substances, but the project would not preclude, or have any effect on, the ability of the dischargers to respond to any issue identified in the future. Text briefly describing NDMA and xenobiotics is provided in Sections 1.4.2.4 and 1.4.2.5. Appendix K provides information about EDCs and PPCPs.

Pathogens are currently regulated through the use of indicator fecal coliform and E. coli bacteria. Because existing discharges are given exceptionally high levels of treatment, their bacterial concentrations are well under those required by their permits, and well under those levels established to protect water quality in Lake Mead and the Colorado River.

The modeling indicates that the Boulder Islands North Alternative would not result in significant changes to TDS concentrations within Lake Mead and the Hoover Dam outlet. Salinity is closely represented by TDS, so it can be concluded that none of the alternatives would have significant impacts on salinity for water users in the Valley and downstream of Hoover Dam.

Total organic carbon concentrations in Lake Mead result from biological productivity, which tends to generate organic carbon, or from biological and physical processes, including ingestion, respiration, and sedimentation, that tend to remove organic carbon. Total organic carbon concentrations at Hoover Dam appear to have decreased since the 1970s. The data show no sign of an increase, despite the substantial increase in wastewater flow. Increasing wastewater flows in the future are not expected to increase TOC concentrations. Total organic carbon is one of the monitoring parameters in the Boulder Basin AMP as indicated in Section 2.2.2.6.

4.1.3 Boulder Islands South Alternative

The potential impacts to water resources that may result from the construction and operation of the Boulder Islands South Alternative are described in this section.

4.1.3.1 Surface Water & Drainage

The potential impacts to surface water and drainage resulting from the construction and operation of the pipeline are described in this section.

4.1.3.1.1 Effluent Interceptor – Alignment B

The impacts from construction and operation of EI-Alignment B would be the same as those described for EI-Alignment A in Section 4.1.2.1.1.

4.1.3.1.2 Lake Conveyance System, Boulder Islands South

Impacts resulting from the construction and operation of the Boulder Islands South LCS would be basically the same as those described for the Boulder Islands North Alternative in Section 4.1.2.1.2. However, under the Boulder Islands South Alternative, the open trench portion of the construction is primarily located from the SRMT3-East working shaft to the shoreline of Lake Mead. Short tunnels would be constructed beneath Lakeshore Drive, the Boulder City Lateral, and the historic railroad grade. Two major intermittent streams would cross the open trench alignment in this area. If the trench was left open during a flood event, the flow from the upstream channel would potentially be diverted through the open trench and discharge into the downstream channel, thus increasing the flows in the downstream channel causing flooding at the Boulder Beach Campground area and the proposed PRS site near the shore.

4.1.3.2 Groundwater

This section discusses the impacts to groundwater that may result from construction of the pipeline and ancillary facilities. Impacts from groundwater on construction activities are also described.

4.1.3.2.1 Effluent Interceptor – Alignment B

Impacts to groundwater resulting from construction and operation of EI-Alignment B would be basically the same as those described for EI-Alignment A under the Boulder Islands North Alternative in Section 4.1.2.2.1. However, EI- Alignment B, which includes the South Lateral Pipeline would have a greater potential to cause interruptions to the horizontal groundwater flow because a larger area would be disturbed. A good example is the area near the Tuscany Hills development where a conduit system was developed south of the C-1 Channel and the Las Vegas Wash to capture groundwater flowing into the site from the south and convey it down gradient. In order to keep the captured groundwater in the system, an infiltration gallery was developed that reintroduces the captured groundwater back into the natural aquifer conditions as it leaves the site. There is a good potential that the construction of the South Lateral Pipeline down gradient from the infiltration gallery may act as a barrier and have adverse impacts on the groundwater system. The nature of the impact depends on the backfill used to cover the pipe alignment. A less permeable backfill (as compared to the natural fill in the aquifer) may produce a larger barrier and mounding of groundwater may occur. Mounding of groundwater without the appropriate seepage may lead to an increase in the hydrostatic pressure that develops below impervious layers and may cause uplift and subsequent foundation or slope instability. Use of a more permeable fill may create preferred horizontal groundwater flow paths along the alignment and thus disrupt the natural groundwater flow.

4.1.3.2.2 Lake Conveyance System, Boulder Islands South

Information regarding groundwater in this area is not available. Therefore, the potential of tunnel construction to intercept groundwater is not clear.

4.1.3.3 Surface Water Quality

The effluent discharge location for the Boulder Islands South Alternative is the same as described for the Boulder Islands North Alternative. Therefore, impacts to surface-water quality would be the same as described in Section 4.1.2.3.

4.1.4 Las Vegas Bay Alternative

The impacts that may result from the construction and operation of the Las Vegas Bay Alternative are described in this section.

4.1.4.1 Surface Water & Drainage

The impacts resulting from the construction and operation of the Las Vegas Bay Alternative would be the same as those described for the Boulder Islands North Alternative (Section 4.1.2).

4.1.4.2 Groundwater

The impacts resulting from the construction and operation of the Las Vegas Bay Alternative would be the same as those described for the Boulder Islands South Alternative (Section 4.1.3).

4.1.4.3 Surface Water Quality

This section addresses the effects of the Las Vegas Bay Alternative on water quality in the Las Vegas Wash and Lake Mead, including Las Vegas Bay, Boulder Basin, Boulder Beach, the SNWA intake structures, and at Hoover Dam. The effects of the Las Vegas Bay Alternative on water quality downstream of Hoover Dam are also addressed. The impacts of this alternative are analyzed at projected 2030 and 2050 annual effluent flows, and at the Lake levels of 1,178 ft (359 m) and 1,000 ft (305 m). The 2030 effluent flows would be 300 mgd (462 cfs), which include 270 mgd (416 cfs) to be discharged to Lake Mead in the Las Vegas Bay, and 30 mgd (46 cfs) to be discharged to the Las Vegas Wash. The 2050 effluent flows would be 400 mgd (616 cfs), which include 370 mgd (570 cfs) to be discharged to Lake Mead in the Las Vegas Bay, and 30 mgd (46 cfs) to be discharged to the Las Vegas Wash. Increased treatment would be implemented as needed to maintain an annual average TP loading of 334 lbs/day. Tables presenting the water quality data for the projected 2030 and 2050 effluent flows of 300 mgd (462 cfs) and 400 mgd (616 cfs), and a TP loading of 334 lbs/day (annual average) are presented in the following sections.

4.1.4.3.1 Effects Due to Construction Activities

The impacts resulting from construction activities would be the same as those described for the Boulder Islands North Alternative in Section 4.1.2.3.

4.1.4.3.2 Las Vegas Wash

The impacts to water quality in the Las Vegas Wash resulting from the Las Vegas Bay Alternative would be the same as those described for the Boulder Islands North Alternative in Section 4.1.2.3.

4.1.4.3.3 Lake Mead

The concentrations predicted from the Las Vegas Bay Alternative for the year 2030 when the projected annual average effluent flow is 300 mgd (462 cfs) are based upon a Lake level of 1,178 ft (359 m) and an effluent TP loading of 334 lbs/day (152 kg/day). Table 4.1-21 presents the parameter concentrations that would result from implementation of the Las Vegas Bay Alternative, and for comparison purposes, baseline conditions are also presented in Table 4.1-21. Water-quality standards are shown on Table 3.1-2.

Most of the parameters modeled in Lake Mead and reported in Table 4.1-21 are not significantly affected by the Las Vegas Bay Alternative compared to baseline conditions. The concentrations of many inorganic substances at the SNWA intakes, including bromide, sulfate, and chloride, which are relevant to drinking water, are almost identical in all scenarios. Because these parameters are not significantly affected by the Las Vegas Bay Alternative, they receive little discussion in the following sections. However, chlorophyll shows differences and is discussed further.

The effect of the Las Vegas Bay Alternative on Lake Mead, with a Lake level of 1,178 ft (359 m) and effluent flows of 300 mgd (462 cfs), would be similar to the Boulder Islands North Alternative. Chlorophyll (Table 4.1-22 and Figure 4.1-3) would be reduced in the inner Las Vegas Bay, in the Boulder Basin, and at Boulder Beach compared to the baseline conditions. Total inorganic nitrogen would increase in the epilimnion, but because algal growth is limited by phosphorus the increase in nitrogen is not expected to produce additional chlorophyll. Under the Las Vegas Bay Alternative, parameter concentrations at the SNWA intake and Hoover Dam discharge would generally increase slightly compared to baseline conditions, but water-quality standards would not be exceeded. With a TP loading of 334 lbs/day, water-quality modeling scenarios indicate that phosphorus concentrations at Hoover Dam would increase from 0.005 to 0.006 mg/L (5 to 6 ppb), but would not exceed the 0.05 mg/L (50 ppb) water-quality standard. Overall, impacts from the Las Vegas Bay Alternative to Lake Mead (with 2030 annual effluent flows at a Lake level of 1,178 ft [359 m]) would be insignificant and negligible. Impairment of LMNRA resources would not occur.

When annual effluent flows increase to 400 mgd (616 cfs) in 2050 with a Lake level of 1,178 ft (359 m) (tables 4.1-23 and 4.1-24 and Figure 4.1-4), some water-quality parameters generally increase slightly in Boulder Basin when compared to baseline conditions, but would not exceed water-quality standards (Table 3.1-2). Therefore, impacts from the Las Vegas Bay Alternative to Lake Mead (with 2050 annual effluent flows at a Lake level of 1,178 ft [359 m]) would be insignificant and negligible. Impairment of LMNRA water resources would not occur.

Table 4.1-21 Lake Mead Interpolations for the Las Vegas Bay Alternative [1] (1,178-ft [359-m] Lake level for year 2030 with effluent flows of 300 mgd [462 cfs] and effluent TP = 334 lbs/day).

Parameter	Inner Bay (LVB1.85M) [2]		Inner Bay (LVB2.7)		Boulder Basin (CR346.4)		Boulder Beach		Hoover Dam Discharge [3]		SNWA Intake [4]	
	Baseline	**2030**	**Baseline**	**2030**	**Baseline**	**2030**	**Baseline**	**2030**	**Baseline**	**2030**	**Baseline**	**2030**
Temperature (°C [°F])	20.3 [68.5]	20.1 [68.1]	20.3 [68.5]	20.0 [68.1]	19.6 [67.3]	19.6 [67.3]	19.3 [66.7]	19.3 [66.7]	13.2 [55.8]	13.3 [55.9]	13.0 [55.4]	13.0 [55.4]
Perchlorate (µg/L)	45.2	11.5	46.7	11.9	3.1	3.0	13.9	3.2	6.6	1.6	5.8	1.4
Conductivity (µS/cm)	1,085	1,057	1,094	1,060	959	959	952	963	901	914	896	906
Total Dissolved Solids (mg/L) [5]	687	669	693	671	607	607	603	610	570	579	567	574
Dissolved Oxygen (mg/L)	8.7	8.5	8.7	8.5	8.3	8.3	8.3	8.3	7.7	7.6	7.5	7.5
Chlorophyll Growing Season Average (µg/L) [6]	12.4	5.3	12.4	5.3	2.0	1.8	2.1	1.7	≤ 0.01	≤0.01	≤ 0.01	≤0.01
Chlorophyll Annual 95th percentile (µg/L) [6]	23.0	11.1	23.0	11.1	3.8	4.4	4.1	4.2	0.2	0.3	0.1	0.2
Secchi Depth (m)	3.2	6.4	3.2	6.4	9.1	10.4	8.8	10.7	ND [7]	ND [7]	ND [7]	ND [7]
Total Phosphorus (mg/L)	0.018	0.008	0.018	0.008	0.007	0.005	0.005	0.005	0.005	0.006	0.004	0.005
Soluble Phosphorus (mg/L)	0.009	0.005	0.009	0.005	0.005	0.004	0.003	0.004	0.004	0.005	0.004	0.005
Total Nitrogen (mg/L)	1.61	1.03	1.68	1.04	0.42	0.58	0.44	0.61	0.34	0.50	0.36	0.48
Total Inorganic Nitrogen (mg/L) [8]	1.57	1.00	1.64	1.01	0.40	0.56	0.43	0.59	0.32	0.48	0.33	0.45
Nitrate (mg/L)	1.56	.098	1.63	0.99	0.39	0.55	0.42	0.58	0.31	0.47	0.31	0.43
Total Ammonia Nitrogen (mg/L)	0.012	0.015	0.013	0.015	0.010	0.011	0.011	0.012	0.014	0.016	0.019	0.021
Un-ionized Ammonia (mg/L) [9]	0.0008	<0.003	0.0008	<0.003	0.0002	<0.003	0.0004	<0.003	0.0002	<0.003	0.0003	≤0.001

Table 4.1-21 Lake Mead Interpolations for the Las Vegas Bay Alternative [1] (1,178-ft [359-m] Lake level for year 2030 with effluent flows of 300 mgd [462 cfs] and effluent TP = 334 lbs/day) (continued).

Parameter	Inner Bay (LVB1.85M) [2]		Inner Bay (LVB2.7)		Boulder Basin (CR346.4)		Boulder Beach		Hoover Dam Discharge [3]		SNWA Intake [4]	
	Baseline	2030	Baseline	2030	Baseline	2030	Baseline	2030	Baseline	2030	Baseline	2030
Bromide (mg/L)	0.106	0.100	0.107	0.100	0.086	0.087	0.087	0.087	0.080	0.081	0.080	0.080
Sulfate (mg/L)	295	280	297	281	255	255	259	256	243	244	242	242
Chloride (mg/L)	107	105	108	105	89	89	85	90	79	83	78	81
Fecal Coliform (MPN/100mL) [10]	1.0	0.9	1.1	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
pH	8.1	7.9	8.1	7.9	7.9	7.9	8.0	7.9	7.7	7.7	7.7	7.7

Notes:

[1] Unless otherwise specified, sampling depth is surface to 1 m (3.3 ft) except at SNWA and Hoover Dam, which were sampled at the intake depths. All data is the annual average, except for chlorophyll, which includes the growing season average (April 1 to September 30) and the annual 95th percentile, and Secchi depth, which includes the growing season average. Year 2030 results were interpolated from model simulations with effluent flow rates of 300 mgd (462 cfs) and effluent TP loadings of 275 and 467 lbs/day.

[2] M = Mobile. LVB1.85M is mobile and located at a depth of 16 to 18 m (52 to 59 ft) near the confluence of Las Vegas Wash and Lake Mead. All other locations are stationary (See Figure 4.1-1). The position of LVB1.85M for the initial lake level of 1178 ft is the same as LVB2.7 for the entire growing season, but moves away from the Las Vegas Wash later in the year as the lake level drops. Therefore the chlorophyll concentrations (which are averaged over the growing season) are the same at LVB1.85M and LVB2.7, while other parameters (averaged over the entire year) are slightly different.

[3] Hoover Dam discharge data is from upper and lower intakes combined.

[4] SNWA data is for intake located at 1,000 ft.

[5] Total Dissolved Solids (TDS) are not simulated. It is computed from the correlation, TDS (mg/L) = 0.633 Conductivity (µS/cm).

[6] Sampling depth for chlorophyll was averaged over the top 5 m (16 ft), except at SNWA and Hoover Dam, which were sampled at the intake depths.

[7] ND = No Data. No Secchi depth data exists for Hoover Dam Discharge and SNWA Intake because Secchi depth is a property of lake surface.

[8] Total Inorganic Nitrogen is not simulated. It is computed as Nitrate + Total Ammonia Nitrogen. Nitrite is not simulated.

[9] Un-ionized ammonia is averaged over the entire depth.

[10] Most Probable Number per 100mL (1 deciliter).

Source: Black & Veatch 2004d.

Table 4.1-22 Lake Mead Chlorophyll Concentrations for Baseline Conditions and the Las Vegas Bay Alternative [1] (1,178-ft Lake level for year 2030 with effluent flows of 300 mgd [462 cfs] and effluent TP=334 lbs/day).

Location [3]	Chlorophyll Growing Season Average (µg/L) [2]	
	Baseline Conditions	Las Vegas Bay Alternative [4]
Inner Bay (LVB 1.85M) [5]	12.4	5.3
Inner Bay (LVB 2.7)	12.4	5.3
Boulder Basin (CR 346.4)	2.0	1.8
Boulder Beach	2.1	1.7
Hoover Dam [6]	0	0
SNWA Intake [7]	0	0

Notes:

1 This table is for comparison purposes. Other baseline parameters for Boulder Basin in Lake Mead are shown on Table 3.1-4.

2 Sampling depth for chlorophyll was averaged over the top 5 m (16 ft), except at SNWA and Hoover Dam, which were sampled at the intake depths. Chlorophyll data is the seasonal average (April 1 to September 30).

3 Sampling/monitoring locations are shown on Figure 4.1-1.

4 Year 2030 results were interpolated from model simulations with effluent flow rates of 300 mgd (462 cfs) and effluent TP loadings of 275 and 467 lbs/day.

5 M = Mobile. LVB1.85M is mobile and located at a depth of 16 to 18 m (52 to 59 ft) near the confluence of Las Vegas Wash and Lake Mead. All other locations are stationary. The position of LVB1.85M for the initial lake level of 1,178 ft is the same as LVB2.7 for the entire growing season, but moves away from the Las Vegas Wash later in the year as the lake level drops. Therefore the chlorophyll concentrations (which are averaged over the growing season) are the same at LVB1.85M and LVB2.7, while other parameters (averaged over the entire year) are slightly different.

6 Hoover Dam discharge data is from upper and lower intakes combined.

7 SNWA data is for intake located at 1,000 ft.

Source: Black and Veatch 2004d.

Table 4.1-25 shows water quality under the Las Vegas Bay Alternative at a Lake level of 1,000 ft for the year 2030 with annual effluent flows of 300 mgd (462 cfs). For comparison, baseline conditions for Lake Mead are also shown on Table 4.1-25, and water-quality standards are shown on Table 3.1-2.

Water-quality modeling for the Las Vegas Bay Alternative at a Lake level of 1,000 ft (305 m) for the year 2030 with effluent flows of 300 mgd (462 cfs) indicates that chlorophyll concentrations within the Las Vegas Bay would decrease greatly compared with baseline conditions (see Table 4.1-26 and Figure 4.1-5). This is due to the fact that station LVB1.85M is mobile and moves away from the Las Vegas Wash into deeper water as the Lake level drops. The deeper water provides more dilution to the effluent. However, chlorophyll concentrations would increase at Boulder Basin, Boulder Beach, and slightly at Hoover Dam. The other water-quality parameters would also increase slightly, but would not exceed water-quality standards (Table 3.1-2). Overall, the impacts from the Las Vegas Bay Alternative to Lake Mead (with 2030 annual effluent flows at a Lake level of 1,000 ft [305 m]) would be insignificant and minor. Impairment of LMNRA resources would not occur.

Table 4.1-23 Lake Mead Interpolations for the Las Vegas Bay Alternative [1] (1,178-ft [359-m] Lake level for year 2050 with effluent flows of 400 mgd [616 cfs] and effluent TP = 334 lbs/day).

Parameter	Inner Bay (LVB1.85M) [2]		Inner Bay (LVB2.7)		Boulder Basin (CR346.4)		Boulder Beach		Hoover Dam Discharge [3]		SNWA Intake [4]	
	Baseline	**2050**	**Baseline**	**2050**	**Baseline**	**2050**	**Baseline**	**2050**	**Baseline**	**2050**	**Baseline**	**2050**
Temperature (°C [°F])	20.3 [68.5]	20.1 [68.1]	20.3 [68.5]	20.0 [68.1]	19.6 [67.3]	19.6 [67.3]	19.3 [66.7]	19.3 [66.7]	13.2 [55.8]	13.3 [55.9]	13.0 [55.4]	13.0 [55.4]
Perchlorate (µg/L)	45.2	11.4	46.7	11.6	3.1	3.0	13.9	3.2	6.6	1.6	5.8	1.4
Conductivity (µS/cm)	1,085	1,065	1,094	1,068	959	967	952	972	901	920	896	911
Total Dissolved Solids (mg/L) [5]	687	674	693	676	607	612	603	615	570	582	567	576
Dissolved Oxygen (mg/L)	8.7	8.4	8.7	8.5	8.3	8.3	8.3	8.3	7.7	7.6	7.5	7.5
Chlorophyll Growing Season Average (µg/L) [6]	12.4	5.2	12.4	5.2	2.0	1.8	2.1	1.8	≤ 0.01	≤0.01	≤ 0.01	≤0.01
Chlorophyll Annual 95th percentile (µg/L) [6]	23.0	11.1	23.0	11.1	3.8	4.6	4.1	4.2	0.2	0.3	0.1	0.2
Secchi Depth (m)	3.2	6.5	3.2	6.5	9.1	6.5	8.8	10.4	ND [7]	ND [7]	ND [7]	ND [7]
Total Phosphorus (mg/L)	0.018	0.008	0.018	0.008	0.007	0.008	0.005	0.005	0.005	0.006	0.004	0.005
Soluble Phosphorus (mg/L)	0.009	0.005	0.009	0.005	0.005	0.005	0.003	0.004	0.004	0.006	0.004	0.005
Total Nitrogen (mg/L)	1.61	1.15	1.68	1.15	0.42	1.15	0.44	0.71	0.34	0.57	0.36	0.53
Total Inorganic Nitrogen (mg/L) [8]	1.61	1.11	1.61	1.12	0.55	1.12	0.41	0.69	0.31	0.55	0.32	0.50
Nitrate (mg/L)	1.56	1.10	1.63	1.10	0.39	1.10	0.42	0.67	0.31	0.53	0.31	0.48
Total Ammonia Nitrogen (mg/L)	0.012	0.016	0.013	0.016	0.01	0.016	0.011	0.012	0.014	0.017	0.019	0.022
Un-ionized Ammonia (mg/L) [9]	0.0008	<0.003	0.0008	<0.003	0.0002	<0.003	0.0004	<0.003	0.0002	<0.003	0.0003	<0.003

Table 4.1-23 Lake Mead Interpolations for the Las Vegas Bay Alternative [1] (1,178-ft [359-m] Lake level for year 2050 with effluent flows of 400 mgd [616 cfs] and effluent TP = 334 lbs/day) (continued).

Parameter	Inner Bay (LVB1.85M) [2]		Inner Bay (LVB2.7)		Boulder Basin (CR346.4)		Boulder Beach		Hoover Dam Discharge [3]		SNWA Intake [4]	
	Baseline	2050	Baseline	2050	Baseline	2050	Baseline	2050	Baseline	2050	Baseline	2050
Bromide (mg/L)	0.11	0.101	0.11	0.101	0.09	0.088	0.087	0.089	0.08	0.082	0.08	0.081
Sulfate (mg/L)	295	281	297	282	257	256	259	257	243	245	242	243
Chloride (mg/L)	107	106	108	107	85	91	85	92	79	84	78	82
Fecal Coliform (MPN/100mL) [10]	1.0	0.9	1.1	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
pH	8.1	7.9	8.1	7.9	8.0	7.9	8.0	7.9	7.7	7.7	7.7	7.7

Notes:

[1] Unless otherwise specified, sampling depth is surface to 1 m (3.3 ft) except at SNWA and Hoover Dam, which were sampled at the intake depths. All data is the annual average, except for chlorophyll, which includes the growing season average (April 1 to September 30) and the annual 95th percentile, and Secchi depth, which includes the growing season average. Year 2050 results were interpolated from model simulations with effluent flow rates of 300 mgd (462 cfs) and effluent TP loadings of 275 lbs/day and 467 lbs/day, and model simulations with effluent flow rates of 400 mgd (616 cfs) and effluent TP loadings of 275 lbs/day.

[2] M = Mobile. LVB1.85M is mobile and located at a depth of 16 to 18 m (52 to 59 ft) near the confluence of Las Vegas Wash and Lake Mead. All other locations are stationary (See Figure 4.1-1). The position of LVB1.85M for the initial lake level of 1178 ft is the same as LVB2.7 for the entire growing season, but moves away from the Las Vegas Wash later in the year as the lake level drops. Therefore the chlorophyll concentrations (which are averaged over the growing season) are the same at LVB1.85M and LVB2.7, while other parameters (averaged over the entire year) are slightly different.

[3] Hoover Dam discharge data is from upper and lower intakes combined.

[4] SNWA data is for intake located at 1,000 ft.

[5] Total Dissolved Solids (TDS) are not simulated. It is computed from the correlation, TDS (mg/L) = 0.633 Conductivity (µS/cm).

[6] Sampling depth for chlorophyll was averaged over the top 5 m (16 ft), except at SNWA and Hoover Dam, which were sampled at the intake depths.

[7] ND = No Data. No Secchi depth data exists for Hoover Dam Discharge and SNWA Intake because Secchi depth is a property of lake surface.

[8] Total Inorganic Nitrogen is not simulated. It is computed as Nitrate + Total Ammonia Nitrogen. Nitrite is not simulated.

[9] Un-ionized ammonia is averaged over the entire depth.

[10] Most Probable Number per 100mL (1 deciliter).

Source: Black & Veatch 2004d.

Table 4.1-24 Lake Mead Chlorophyll Concentrations for Baseline Conditions and the Las Vegas Bay Alternative [1] (1,178-ft Lake level for year 2050 with effluent flows of 400 mgd [616 cfs] and effluent TP=334 lbs/day).

Location [3]	Chlorophyll Growing Season Average (µg/L) [2]	
	Baseline Conditions	Las Vegas Bay Alternative
Inner Bay (LVB 1.85M) [4]	12.4	5.2
Inner Bay (LVB 2.7)	12.4	5.2
Boulder Basin (CR 346.4)	2.0	1.8
Boulder Beach	2.1	1.8
Hoover Dam [5]	0	0
SNWA Intake [6]	0	0

Notes:

[1] This table is for comparison purposes. Other baseline parameters for Boulder Basin in Lake Mead are shown on Table 3.1-4. Year 2050 results were interpolated from model simulations with effluent flow rates of 300 mgd (462 cfs) and effluent TP loadings of 275 lbs/day and 467 lbs/day, and model simulations with effluent flow rates of 400 mgd (616 cfs) and effluent TP loadings of 275 lbs/day.

[2] Sampling depth for chlorophyll was averaged over the top 5 m (16 ft), except at SNWA and Hoover Dam, which were sampled at the intake depths. Chlorophyll data is the seasonal average (April 1 to September 30).

[3] Sampling/monitoring locations are shown on Figure 4.1-1.

[4] M = Mobile. LVB1.85M is mobile and located at a depth of 16 to 18 m (52 to 59 ft) near the confluence of Las Vegas Wash and Lake Mead. All other locations are stationary. The position of LVB1.85M for the initial lake level of 1,178 ft is the same as LVB2.7 for the entire growing season, but moves away from the Las Vegas Wash later in the year as the lake level drops. Therefore the chlorophyll concentrations (which are averaged over the growing season) are the same at LVB1.85M and LVB2.7, while other parameters (averaged over the entire year) are slightly different.

[5] Hoover Dam discharge data is from upper and lower intakes combined.

[6] SNWA data is for intake located at 1,000 ft.

Source: Black and Veatch 2004d.

Under the Las Vegas Bay Alternative (with effluent flows of 300 mgd [462 cfs] at a Lake level of 1,000 ft [305 m]), parameter levels at the Hoover Dam discharge would increase slightly compared to baseline conditions. If TP loading is 334 lbs/day, water-quality modeling scenarios indicate that phosphorus concentrations at Hoover Dam would increase from 0.005 to 0.006 mg/L (5 to 6 ppb), but would not exceed the 0.05 mg/L (50 ppb) water-quality standard.

When effluent flows increase to 400 mgd (616 cfs) in 2050 with a projected lake level of 1,000 ft (305 m) (see Tables 4.1-27 and 4.1-28 and Figure 4.1-6), the Las Vegas Bay Alternative would slightly increase chlorophyll levels in the Boulder Basin, at Boulder Beach, and at Hoover Dam compared to baseline conditions. Total inorganic nitrogen, nitrate, and total ammonium nitrogen would increase slightly in the Las Vegas Bay, at Boulder Beach, and at Hoover Dam, compared to baseline conditions but would not exceed water-quality standards (Table 3.1-2). Overall, impacts from the Las Vegas Bay Alternative to Lake Mead (with 2050 effluent flows at a Lake level of 1,000 ft [305 m]) would be insignificant and minor. Impairment of LMNRA resources would not occur.

Table 4.1-25 Lake Mead Interpolations for the Las Vegas Bay Alternative [1] (1,000-ft [305-m] Lake level for year 2030 with effluent flows of 300 mgd [462 cfs] and effluent TP = 334 lbs/day).

Parameter	Inner Bay (LVB1.85M) [2]		Inner Bay (LVB2.7) [3]		Boulder Basin (CR346.4)		Boulder Beach		Hoover Dam Discharge [4]		SNWA Intake [5]	
	Baseline	2030	Baseline	2030	Baseline	2030	Baseline	2030	Baseline	2030	Baseline	2030
Temperature (°C[°F])	20.3 [68.5]	20.0 [68.1]	20.3 [68.5]	ND	19.6 [67.3]	19.5 [67.1]	19.3 [66.7]	19.3 [66.8]	13.2 [55.8]	14.1 [57.4]	13.0 [55.4]	ND
Perchlorate (µg/L)	45.2	11.0	46.7	ND	3.1	3.3	13.9	3.9	6.6	1.7	5.8	ND
Conductivity (µS/cm)	1,085	1,051	1,094	ND	959	945	952	956	901	908	896	ND
Total Dissolved Solids (mg/L) [6]	687	664	693	ND	607	598	603	605	570	575	567	ND
Dissolved Oxygen (mg/L)	8.7	8.4	8.7	ND	8.3	8.2	8.3	8.2	7.7	7.5	7.5	ND
Chlorophyll Growing Season Average (µg/L) [7]	12.4	5.2	12.4	ND	2.0	2.7	2.1	2.8	≤ 0.01	0.1	≤ 0.01	ND
Chlorophyll Annual 95th percentile (µg/L) [7]	23.0	11.1	23.0	ND	3.8	5.6	4.1	5.9	0.2	1.1	0.1	ND
Secchi Depth (m)	3.2	6.3	3.2	ND	9.1	8.0	8.8	8.0	ND [8]	ND [8]	ND [8]	ND [8]
Total Phosphorus (mg/L)	0.018	0.011	0.018	ND	0.007	0.005	0.005	0.006	0.005	0.006	0.004	ND
Soluble Phosphorus (mg/L)	0.009	0.007	0.009	ND	0.005	0.003	0.003	0.004	0.004	0.005	0.004	ND
Total Nitrogen (mg/L)	1.61	1.55	1.68	ND	0.42	0.76	0.44	0.86	0.34	0.72	0.36	ND
Total Inorganic Nitrogen (mg/L) [9]	1.57	1.50	1.64	ND	0.40	0.74	0.43	0.83	0.32	0.69	0.33	ND
Nitrate (mg/L)	1.56	1.47	1.63	ND	0.39	0.72	0.42	0.80	0.31	0.66	0.31	ND

Table 4.1-25 Lake Mead Interpolations for the Las Vegas Bay Alternative [1] (1,000-ft [305-m] Lake level for year 2030 with effluent flows of 300 mgd [462 cfs] and effluent TP = 334 lbs/day) (continued).

Parameter	Inner Bay (LVB1.85M) [2]		Inner Bay (LVB2.7) [3]		Boulder Basin (CR346.4)		Boulder Beach		Hoover Dam Discharge [4]		SNWA Intake [5]	
	Baseline	2030	Baseline	2030	Baseline	2030	Baseline	2030	Baseline	2030	Baseline	2030
Total Ammonia Nitrogen (mg/L)	0.012	0.028	0.013	ND	0.01	0.020	0.011	0.021	0.014	0.028		ND
Un-ionized Ammonia (mg/L) [10]	0.0008	<0.003	0.0008	ND	0.0002	<0.003	0.0004	<0.003	0.0002	<0.003	0.0003	ND
Bromide (mg/L)	0.11	0.100	0.11	ND	0.09	0.086	0.087	0.088	0.08	0.082	0.08	ND
Sulfate (mg/L)	295	277	297	ND	257	253	259	255	243	243	242	ND
Chloride (mg/L)	107	106	108	ND	85	88	85	90	79	83	78	ND
Fecal Coliform (MPN/100mL) [11]	1.0	0.6	1.1	ND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	ND
pH	8.1	7.9	8.1	ND	8.0	7.9	8.0	8.0	7.7	7.7	7.7	ND

Notes:

[1] Unless otherwise specified, sampling depth is surface to 1 m (3.3 ft) except at SNWA and Hoover Dam, which were sampled at the intake depths. All data is the annual average, except for chlorophyll, which includes the growing season average (April 1 to September 30) and the annual 95th percentile, and Secchi depth, which includes the growing season average. Year 2030 results were interpolated from model simulations with effluent flow rates of 300 mgd (462 cfs) and effluent TP loadings of 275 and 467 lbs/day.

[2] M = Mobile. LVB1.85M is mobile and located at a depth of 16 to 18 m (52 to 59 ft) near the confluence of Las Vegas Wash and Lake Mead. All other locations are stationary (See Figure 4.1-1). The position of LVB1.85M for the initial lake level of 1178 ft is the same as LVB2.7 for the entire growing season, but moves away from the Las Vegas Wash later in the year as the lake level drops. Therefore the chlorophyll concentrations (which are averaged over the growing season) are the same at LVB1.85M and LVB2.7, while other parameters (averaged over the entire year) are slightly different.

[3] ND = No Data. No data exists for LVB2.7 because it is located on dry land with a lake level of 1,000 ft.

[4] Hoover Dam discharge data is from the lower intake only.

[5] No data exists for the SNWA 1,000-ft intake.

[6] Total Dissolved Solids (TDS) are not simulated. It is computed from the correlation, TDS (mg/L) = 0.633 Conductivity (µS/cm).

[7] Sampling depth for chlorophyll was averaged over the top 5 m (16 ft), except at SNWA and Hoover Dam, which were sampled at the intake depths.

[8] ND = No Data. No Secchi depth data exists for Hoover Dam Discharge and SNWA Intake because Secchi depth is a property of lake surface.

[9] Total Inorganic Nitrogen is not simulated. It is computed as Nitrate + Total Ammonia Nitrogen. Nitrite is not simulated

[10] Un-ionized ammonia is averaged over the entire depth.

[11] Most Probable Number per 100mL (1 deciliter).

Source: Black & Veatch 2004d.

Table 4.1-26 Lake Mead Chlorophyll Concentrations for Baseline Conditions and the Las Vegas Bay Alternative [1] (1,000-ft Lake level for year 2030 with effluent flows of 300 mgd [462 cfs] and effluent TP = 334 lbs/day).

Location [3]	Chlorophyll Growing Season Average (µg/L) [2]	
	Baseline Conditions	Las Vegas Bay Alternative [4]
Inner Bay (LVB 1.85M) [5]	12.4	5.2
Inner Bay (LVB 2.7) [6]	12.4	ND
Boulder Basin (CR 346.4)	2.0	2.7
Boulder Beach	2.1	2.8
Hoover Dam [7]	0	0.1
SNWA Intake [8]	0	ND

Notes:

[1] This table is for comparison purposes. Other baseline parameters for Boulder Basin in Lake Mead are shown on Table 3.1-4.

[2] Sampling depth for chlorophyll was averaged over the top 5 m (16 ft), except at SNWA and Hoover Dam, which were sampled at the intake depths. Chlorophyll data is the seasonal average (April 1 to September 30).

[3] Sampling/monitoring locations are shown on Figure 4.1-1.

[4] Year 2030 results were interpolated from model simulations with effluent flow rates of 300 mgd (462 cfs) and effluent TP loadings of 275 and 467 lbs/day.

[5] M = Mobile. LVB1.85M is mobile and located at a depth of 16 to 18 m (52 to 59 ft) near the confluence of Las Vegas Wash and Lake Mead. All other locations are stationary. The position of LVB1.85M for the initial Lake level of 1,178 ft is the same as LVB2.7 for the entire growing season, but moves away from the Las Vegas Wash later in the year as the lake level drops. Therefore the chlorophyll concentrations (which are averaged over the growing season) are the same at LVB1.85M and LVB2.7, while other parameters (averaged over the entire year) are slightly different.

[6] ND = No Data. No data exists for LVB2.7 because it is located on dry land with a Lake level of 1,000 ft.

[7] Hoover Dam discharge data is from the lower intake only.

[8] No data exists for the SNWA 1,000-ft intake.

Source: Black and Veatch 2004d.

4.1.4.3.4 Downstream of Hoover Dam

Impacts downstream of Hoover Dam would be similar to those described for the Boulder Islands alternatives.

4.1.5 Process Improvements Alternative

The potential impacts to water resources that may result from the implementation of the Process Improvements Alternative are described in this section. Under the Process Improvements Alternative, a pipeline would not be constructed. Highly treated effluent would continue to be discharged to the Las Vegas Wash at the existing discharge locations, and effluent flows would continue to enter the Las Vegas Bay for mixing and diffusion in an uncontrolled fashion.

Table 4.1-27 Lake Mead Interpolations for the Las Vegas Bay Alternative [1] (1,000-ft [305-m] Lake level for year 2050 with effluent flows of 400 mgd [616 cfs] and effluent TP = 334 lbs/day).

Parameter	Inner Bay (LVB1.85M) [2]		Inner Bay (LVB2.7) [3]		Boulder Basin (CR346.4)		Boulder Beach		Hoover Dam Discharge [4]		SNWA Intake [5]	
	Baseline	2050	Baseline	2050	Baseline	2050	Baseline	2050	Baseline	2050	Baseline	2050
Temperature (°C[°F])	20.3 [68.5]	20.0 [68.1]	20.3 [68.5]	ND	19.6 [67.3]	19.5 [67.1]	19.3 [66.7]	19.3 [66.8]	13.2 [55.8]	14.1 [57.4]	13.0 [55.4]	ND
Perchlorate (µg/L)	45.2	10.7	46.7	ND	3.1	3.2	13.9	3.7	6.6	1.3	5.8	ND
Conductivity (µS/cm)	1,085	1,062	1,094	ND	959	948	952	959	901	904	896	ND
Total Dissolved Solids (mg/L) [6]	687	672	693	ND	607	600	603	607	570	572	567	ND
Dissolved Oxygen (mg/L)	8.7	8.4	8.7	ND	8.3	8.3	8.3	8.3	7.7	7.5	7.5	ND
Chlorophyll Growing Season Average (µg/L) [7]	12.4	4.9	12.4	ND	2.0	2.5	2.1	2.5	≤ 0.01	0.1	≤ 0.01	ND
Chlorophyll Annual 95th percentile (µg/L) [7]	23.0	10.7	23.0	ND	3.8	5.2	4.1	5.4	0.2	1.1	0.1	ND
Secchi Depth (m)	3.2	7.1	3.2	ND	9.1	9.3	8.8	9.0	ND [8]	ND [8]	ND [8]	ND [8]
Total Phosphorus (mg/L)	0.018	0.010	0.018	ND	0.007	0.005	0.005	0.005	0.005	0.006	0.004	ND
Soluble Phosphorus (mg/L)	0.009	0.007	0.009	ND	0.005	0.003	0.003	0.004	0.004	0.005	0.004	ND
Total Nitrogen (mg/L)	1.61	1.78	1.68	ND	0.42	0.83	0.44	0.93	0.34	0.78	0.36	ND
Total Inorganic Nitrogen (mg/L) [9]	1.61	1.72	1.61	ND	0.55	0.80	0.41	0.90	0.31	0.73	0.32	ND
Nitrate (mg/L)	1.56	1.69	1.63	ND	0.39	0.78	0.42	0.88	0.31	0.70	0.31	ND
Total Ammonia Nitrogen (mg/L)	0.012	0.031	0.013	ND	0.010	0.019	0.011	0.021	0.014	0.030	0.019	ND

Table 4.1-27 Lake Mead Interpolations for the Las Vegas Bay Alternative [1] (1,000-ft [305-m] Lake level for year 2050 with effluent flows of 400 mgd [616 cfs] and effluent TP = 334 lbs/day) (continued).

Parameter	Inner Bay (LVB1.85M) [2]		Inner Bay (LVB2.7) [3]		Boulder Basin (CR346.4)		Boulder Beach		Hoover Dam Discharge [4]		SNWA Intake [5]	
	Baseline	2050	Baseline	2050	Baseline	2050	Baseline	2050	Baseline	2050	Baseline	2050
Un-ionized Ammonia (mg/L) [10]	0.012	<0.003	< 0.003	ND	< 0.003	<0.003	< 0.003	<0.003	< 0.003	<0.003	< 0.003	ND
Bromide (mg/L)	0.0008	0.102	0.107	ND	0.086	0.087	0.087	0.088	0.080	0.081	0.080	ND
Sulfate (mg/L)	295	278	297	ND	255	253	259	255	243	242	242	ND
Chloride (mg/L)	107	109	108	ND	89	89	85	91	79	82	78	ND
Fecal Coliform (MPN/100mL) [11]	1.0	0.5	1.1	ND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	ND
pH	8.1	7.9	8.1	ND	7.9	7.9	8.0	7.9	7.7	7.7	7.7	ND

Notes:

[1] Unless otherwise specified, sampling depth is surface to 1 m (3.3 ft) except at SNWA and Hoover Dam, which were sampled at the intake depths. All data is the annual average, except for chlorophyll, which includes the growing season average (April 1 to September 30) and the annual 95th percentile, and Secchi depth, which includes the growing season average. Year 2050 results were interpolated from model simulations with effluent flow rates of 300 mgd (462 cfs) and effluent TP loadings of 275 lbs/day and 467 lbs/day, and model simulations with effluent flow rates of 400 mgd (616 cfs) and effluent TP loadings of 275 lbs/day.

[2] M = Mobile. LVB1.85M is mobile and located at a depth of 16 to 18 m (52 to 59 ft) near the confluence of Las Vegas Wash and Lake Mead. All other locations are stationary (See Figure 4.1-1). The position of LVB1.85M for the initial lake level of 1178 ft is the same as LVB2.7 for the entire growing season, but moves away from the Las Vegas Wash later in the year as the lake level drops. Therefore the chlorophyll concentrations (which are averaged over the growing season) are the same at LVB1.85M and LVB2.7, while other parameters (averaged over the entire year) are slightly different.

[3] ND = No Data. No data exists for LVB2.7 because it is located on dry land with a lake level of 1,000 ft.

[4] Hoover Dam discharge data is from the lower intake only.

[5] No data exists for the SNWA 1,000-ft intake.

[6] Total Dissolved Solids (TDS) are not simulated. It is computed from the correlation, TDS (mg/L) = 0.633 Conductivity (µS/cm).

[7] Sampling depth for chlorophyll was averaged over the top 5 m (16 ft), except at SNWA and Hoover Dam, which were sampled at the intake depths.

[8] ND = No Data. No Secchi depth data exists for Hoover Dam Discharge and SNWA Intake because Secchi depth is a property of lake surface.

[9] Total Inorganic Nitrogen is not simulated. It is computed as Nitrate + Total Ammonia Nitrogen. Nitrite is not simulated

[10] Un-ionized ammonia is averaged over the entire depth.

[11] Most Probable Number per 100mL (1 deciliter).

Source: Black & Veatch 2004d.

Table 4.1-28 Lake Mead Chlorophyll Concentrations for Baseline Conditions and the Las Vegas Bay Alternative [1] (1,000-ft Lake level for year 2050 with effluent flows of 400 mgd [616 cfs] and effluent TP = 334 lbs/day).

Location [3]	Chlorophyll Growing Season Average (µg/L) [2]	
	Baseline Conditions	Las Vegas Bay Alternative [4]
Inner Bay (LVB 1.85M) [5]	12.4	4.9
Inner Bay (LVB 2.7) [5]	12.4	ND
Boulder Basin (CR 346.4)	2.0	2.5
Boulder Beach	2.1	2.5
Hoover Dam [7]	0	0.1
SNWA Intake [8]	0	ND

Notes:

[1] This table is for comparison purposes. Other baseline parameters for Boulder Basin in Lake Mead are shown on Table 3.1-4.

[2] Sampling depth for chlorophyll was averaged over the top 5 m (16 ft), except at SNWA and Hoover Dam, which were sampled at the intake depths. Chlorophyll data is the seasonal average (April 1 to September 30).

[3] Sampling/monitoring locations are shown on Figure 4.1-1.

[4] Year 2050 results were interpolated from model simulations with effluent flow rates of 300 mgd (462 cfs) and effluent TP loadings of 275 lbs/day and 467 lbs/day, and model simulations with effluent flow rates of 400 mgd (616 cfs) and effluent TP loadings of 275 lbs/day.

[5] M = Mobile. LVB1.85M is mobile and located at a depth of 16 to 18 m (52 to 59 ft) near the confluence of Las Vegas Wash and Lake Mead. All other locations are stationary. The position of LVB1.85M for the initial Lake level of 1,178 ft is the same as LVB2.7 for the entire growing season, but moves away from the Las Vegas Wash later in the year as the lake level drops. Therefore the chlorophyll concentrations (which are averaged over the growing season) are the same at LVB1.85M and LVB2.7, while other parameters (averaged over the entire year) are slightly different.

[6] ND = No Data. No data exists for LVB2.7 because it is located on dry land with a Lake level of 1,000 ft.

[7] Hoover Dam discharge data is from the lower intake only.

[8] No data exists for the SNWA 1,000-ft intake.

Source: Black and Veatch 2004d.

In addition to current, conventional treatment processes and plant optimization, best available technologies would be implemented to maintain an acceptable TP loading.

Microfiltration/ultrafiltration membranes are described in the following sections as an example of the type of technology that may be implemented to achieve the target TP levels. However, as technologies change and improve, other technologies may be implemented.

4.1.5.1 Surface Water and Drainage

The effluent discharged from the treatment plants is the largest source of flow in the Las Vegas Wash during dry weather. Erosion and degradation that has occurred over the last 50 years is in part due to the effluent flows, and in part due to storm events. An increase in the volume of water conveyed in the Las Vegas Wash during dry-weather flows would not significantly increase erosion and channel degradation. The SNWA's ongoing construction of ECSs and bank protection reduces the potential for future erosion in the Las Vegas Wash.

Wastewater flows would continue to be discharged to the Las Vegas Wash under the Process Improvements Alternative. The process used to account for return flow credits would continue to be used. No loss of return flow credits is expected from the use of MF/UF membranes.

4.1.5.2 Groundwater

Construction of the EI and LCS pipelines would not occur under the Process Improvements Alternative. No impacts to the existing groundwater system would result from implementation of this alternative.

4.1.5.3 Surface Water Quality

This section addresses the effects of the Process Improvements Alternative on surface water quality in the Las Vegas Wash, Lake Mead, and downstream of Hoover Dam.

4.1.5.3.1 Las Vegas Wash

The Process Improvements Alternative requires the implementation of MF/UF membranes. These membranes are expected to reduce the concentrations of many parameters found in wastewater to baseline levels within the Las Vegas Wash. The interpolated effluent concentrations for the Process Improvements Alternative are presented in Table 4.1-29. The addition of the treated effluent to the Las Vegas Wash would reduce the concentrations of non-effluent related parameters because of dilution.

Under the Process Improvements Alternative, there would be an increase in effluent flows, but no expected increase in groundwater/urban runoff base flows in the Las Vegas Wash. Despite the increased population of the Valley, surfacing groundwater and urban over-watering are not expected to increase because of water conservation measures, which are described in Section 1.4.1.3.

Non-point source base flows would remain the same under the Process Improvements Alternative but there would be increased dilution of groundwater constituents because effluent flows would increase. These changes are not likely to have significant environmental effects.

The decrease in perchlorate concentrations is the result of the groundwater remediation program, and levels are expected to be much lower in the future. Additional effluent flows in the Las Vegas Wash would provide additional dilution, which would lower perchlorate concentrations in the Las Vegas Wash, but not affect total loading to Lake Mead.

Additional SNWA ECSs are being installed in the Las Vegas Wash, thereby reducing velocities and settling out sediments. Because of these ECSs, TSS concentrations are not expected to increase above current conditions. Other parameters are not expected to change significantly. For example, the increase in effluent flow is not expected to cause a significant deviation in pH from the existing level, because effluent pH is not expected to change. The DO concentration is not expected to change because the level of oxygen-demanding substances would remain low.

In the year 2030, all the parameters in the effluent are expected to stay the same as baseline conditions except for phosphorus, which would be reduced to 0.05 mg/L. In 2050, some

Table 4.1-29 Baseline and Interpolated Effluent Concentrations for the Process Improvements Alternative.[1]

Parameter	Baseline	2030	2050
Flows (mgd [cfs])	165 [254]	300 [462]	400 [616]
Perchlorate (µg/L)	0	0	0
Conductivity (µS/cm)	1,700	1,700	1,700
Total Dissolved Solids (mg/L)	1,140	1,140	1,140
Total Phosphorus (mg/L) [2]	0.2	0.05	0.05
Soluble Phosphorus (mg/L) [2]	0.15	0.05	0.05
Total Nitrogen (mg/L) [3]	17	17	23
Total Inorganic Nitrogen (mg/L) [3]	17	17	23
Nitrate (mg/L)	16	16	21
Total Ammonia Nitrogen (mg/L)	0.26	0.26	0.35
Bromide (mg/L)	0.2	0.2	0.27
Sulfate (mg/L)	330	330	440
Chloride (mg/L)	250	250	440
Selenium (µg/L)	2.5	2.5	2.5

Notes:

[1] Year 2030 and 2050 numbers interpolated based upon an assumed 90 to 99 percent rejection (membrane efficiency) of feed concentration. Additional chemicals would be used to precipitate phosphorus.

[2] Assumed all as orthophosphate, however, the speciation will greatly affect the results. Baseline TP is based upon 125 to 467 lbs/day loading.

[3] Assumed as nitrate.

Source: Black and Veatch 2004d, 2006.

parameters in the effluent would increase slightly but phosphorus would still be less than the baseline conditions.

4.1.5.3.2 Lake Mead

As discussed in Section 4.1.5.3, the Process Improvements Alternative requires the implementation of MF/UF membranes, which would reduce the concentration of many of the parameters in the effluent beyond conventional treatment processes.

Lake Mead chlorophyll concentrations for the Process Improvements Alternative in 2030 and 2050 for a Lake level of 1,178 ft were interpolated from model simulations using a 300 mgd (462 cfs) effluent flow rate with effluent TP loadings of 275 and 467 lbs/day (125 and 212 kg/day) and using a 400 mgd (616 cfs) effluent flow rate with an effluent TP loading of 275 lbs/day (125 lbs/day). The Lake Mead chlorophyll concentrations for 2030 and 2050 at a Lake level of 1,000 ft were extrapolated from the same modeling simulations used to interpolate concentrations for a Lake level of 1,178 ft. The interpolated and extrapolated Lake Mead chlorophyll concentrations for the Process Improvements Alternative are shown on Table 4.1-30.

Table 4.1-30 shows that the Process Improvements Alternative does not improve, and actually increases existing elevated chlorophyll concentrations in the inner Las Vegas Bay, Boulder Basin,

Table 4.1-30 Lake Mead Chlorophyll Concentrations for Baseline Conditions and the Process Improvements Alternative.

Location [3]	Chlorophyll Growing Season Average (µg/L) [2]				
	Baseline	1,178-ft Lake level and effluent TP = 334 lbs/day		1,000-ft Lake level and effluent TP = 165 lbs/day	
		Year 2030 [4]	Year 2050 [5]	Year 2030 [4]	Year 2050 [5]
Inner Bay (LVB1.85M) [6]	12.4	12.9	12.9	11.3	11.3
Inner Bay (LVB2.7) [7]	12.4	12.9	12.9	ND	ND
Boulder Basin (CR346.4)	2.0	3.0	3.0	1.8	1.8
Boulder Beach	2.1	3.2	3.2	2.1	2.1
Hoover Dam [8]	0	0	0	0	0
SNWA Intake [9]	0	0	0	ND	ND

Notes:

[1] This table is for comparison purposes. Other baseline parameters for Boulder Basin in Lake Mead are shown on Table 3.1-4.

[2] Sampling depth for chlorophyll was averaged over the top 5 m (16 ft), except at SNWA and Hoover Dam, which were sampled at the intake depths. Chlorophyll data is the seasonal average (April 1 to September 30). Concentrations are rounded.

[3] Sampling/monitoring locations are shown on Figure 4.1-1.

[4] Year 2030 and 2050 results for 1,178 ft Lake level were interpolated from model simulations using a 300 mgd (462 cfs) effluent flow rate with effluent TP loadings of 275 and 467 lbs/day and using a 400 mgd (616 cfs) effluent flow rate with an effluent TP loading of 275 lbs/day.

[5] Year 2030 and 2050 results at a Lake level of 1,000 ft were extrapolated from model simulations using a 300 mgd (462 cfs) effluent flow rate with effluent TP loadings of 275 and 467 lbs/day and using a 400 mgd (616 cfs) effluent flow rate with an effluent TP loading of 275 lbs/day.

[6] M = Mobile. LVB1.85M is mobile and located at a depth of 16 to 18 m (52 to 59 ft) near the confluence of Las Vegas Wash and Lake Mead. All other locations are stationary. The position of LVB1.85M for the initial lake level of 1178 ft is the same as LVB2.7 for the entire growing season, but moves away from the Las Vegas Wash later in the year as the lake level drops. Therefore the chlorophyll concentrations (which are averaged over the growing season) are the same at LVB1.85M and LVB2.7, while other parameters (averaged over the entire year) are slightly different.

[7] ND = No Data. No data exists for LVB2.7 with a lake level of 1,000 ft because it is located on dry land.

[8] Hoover Dam discharge data is from upper and lower intakes combined. Concentration of 0 is rounded from <0.01.

[9] SNWA 2030 data is for intake located at 1,000 ft. Concentration of 0 is rounded from <0.01. ND = No Data. No data exists for the SNWA 1,000-ft intake with a lake level of 1,000 ft.

Source: Baseline: Black and Veatch 2004d. Process Improvements Alternative data: Black and Veatch 2006.

and Boulder Beach with a Lake level of 1,178 ft. Baseline chlorophyll levels are shown on Figure 3.1-11. Phosphorus loadings entering the Lake through the Las Vegas Wash would continue to be mixed into the epilimnion, as they are under baseline conditions, and would continue to produce elevated chlorophyll concentrations in the inner Las Vegas Bay. In the inner Las Vegas Bay, phosphorus is mixed into the epilimnion where there is sufficient light for algae to grow. However, chlorophyll concentrations in the inner Las Vegas Bay, in the Boulder Basin, and at Boulder Beach would decrease with 2030 and 2050 flows and a Lake level of 1,000 ft

because the TP loading would need to be reduced to 165 lbs/day (75 kg/day) to meet water quality standards.

This alternative would not cause a significant increase to other water-quality parameter concentrations within Lake Mead. Therefore, the Process Improvements Alternative would not significantly impact the water quality in Lake Mead and impairment of LMNRA resources would not occur.

4.1.5.3.4 Downstream of Hoover Dam

Under the Process Improvements Alternative, TP loading would b 334 lbs/day (151 kg/day) at a Lake level of 1,178 ft compared to the baseline TP loading of 292 lbs/day (132 kg/day). The increasing loads of phosphorus would result in a slight increase of phosphorus concentrations below Hoover Dam, compared with baseline conditions. Despite this increase, phosphorus concentrations below Hoover Dam would remain well below historic concentrations (the past three decades), during which no negative consequences were identified in the Colorado River below Hoover Dam. Concentrations would also remain well below Nevada water quality standard and RMHQ criteria. No significant effect is expected.

The implementation of the MF/UF process would not remove additional EDCs and PPCPs from the effluent beyond what current treatment processes remove. Therefore, the Process Improvements Alternative is expected to have the same impacts downstream of Hoover Dam from EDCs and PPCPs as the No Action Alternative.

The Process Improvement Alternative is also expected to have the same impacts to other conservative and non-conservative substances as the No Action Alternative. Nonconservative substances (decaying or biologically processed substances) would be reduced by natural assimilation in Lake Mead or the Colorado River below Hoover Dam. The bacterial concentrations in the effluent would still be well under those required by NDEP permits and those levels established to protect water quality in Lake Mead and the Colorado River. For these reasons, pathogens, bacteria, and other non-conservative substances are not likely to have a significant effect on water quality downstream of Hoover Dam. In addition, TDS and other conservative substances attributable to the project are unlikely to have a significant effect on water quality below Hoover Dam.

4.1.6 Mitigation

The mitigation measures that would be implemented during construction and operation of the SCOP are described in this section. The measures described apply to the three pipeline alternatives unless specified otherwise. Although mitigation measures are typically implemented to minimize or eliminate significant impacts, this section also includes actions that would be taken to minimize or eliminate insignificant impacts.

4.1.6.1 Surface Water

During a major rainfall runoff event, the open trench could collect runoff from one wash and discharge it to a different wash (acting as a diversion channel) instead of allowing the runoff to cross perpendicular to the alignment as it would have prior to construction. Open-trench excavation will be conducted with caution and attention to any major ephemeral washes that are crossed to ensure that the open trench does not cross two major ephemeral washes at any one time. In addition, the sequencing of excavation would minimize the amount of time the trench will remain open. This is especially critical during the monsoon season in the summer months when the risk of major rainfall runoff events is highest.

4.1.6.2 Groundwater

Dewatering operations and discharges will be conducted in compliance with the applicable dewatering and discharge permits. The discharge of pollutants to the groundwater system from dewatering operations will be prevented or reduced by using sediment controls and by testing the groundwater for pollutants. High sediment content in dewatering discharges is common because of the nature of the operation. The use of a sediment trap or basin in conjunction with a filtration system to remove sediment from the trap or basin will minimize the chances of sediment entering the groundwater system.

Dewatering activities in the vicinity of the COH Forcemain and South Lateral Pipeline are likely. The groundwater will be analyzed for suspected pollutants and be properly disposed of as directed in the discharge permit. The handling, discharge, and disposal of contaminated groundwater would be conducted in accordance with NDEP requirements and guidance.

Monitoring of groundwater levels in the vicinity of the dewatering operations will be conducted to detect harmful groundwater lowering, which could cause the surrounding layers to settle and therefore impose hazards to structures in the area. In addition, structures will be monitored for possible movement.

Impacts from disturbance to the shallow groundwater system may create pathways for groundwater flow. The nature of the impact depends on the backfill used to cover the pipe alignment for the South Lateral Pipeline. The permeability of the backfill material may influence the type and extent of impact to the groundwater system. Therefore, backfill of suitable permeability would be used to avoid the potential impact to the groundwater system. Additional mitigation measures as specified by NDEP may be implemented to reduce the potential for contaminant migration.

Groundwater may be encountered during construction activities, and affect excavation and placement of materials. In addition, the sulfate in the groundwater may enhance corrosion of the pipe material. Therefore, the potential for corrosion will be considered during selection of pipe material.

4.1.6.3 Surface Water Quality

Under the No Action Alternative, current conventional treatment processes and plant optimization would be used to attempt to meet the requirements set by the NDEP through the NPDES

permitting program. Phosphorus loadings entering the Lake through the Las Vegas Wash would continue to be released to the inner Las Vegas Bay, as they are under baseline conditions, and would continue to produce elevated chlorophyll concentrations in the inner Las Vegas Bay

Concentrations of TIN would continue to exceed water-quality standards in the Las Vegas Bay near the Las Vegas Wash, in particular the RMHQ 95th percentile limit of 4.5 mg/L at station LVB 1.85M (Table 3.1-2). Under the No Action Alternative, the TIN concentration at station LVB 1.85M would be 9.0 mg/L. To eliminate any impacts, the three wastewater treatment agencies would implement advanced filtration using MF/UF membranes and/or RO. Implementation of these membranes and processes are the Process Improvements Alternative. The potential impacts of the Process Improvements Alternative to water quality are described in Section 4.1.5.

Under the Boulder Islands North, Boulder Islands South, and Las Vegas Bay alternatives, the reduction in flows through the Las Vegas Wash would result in less dilution of non-effluent related parameters such as selenium. Local agencies are reviewing mitigation measures for the selenium concentrations in the Las Vegas Wash as this EIS is being prepared.

Under the Boulder Islands North, Boulder Islands South, and Las Vegas Bay alternatives, adverse impacts to water quality in Lake Mead are not expected. However, the Boulder Basin AMP, which is part of the proposed alternatives and not a mitigation measure, would be implemented to address concerns about the effects that may result from the discharge of highly treated effluent into Lake Mead in the vicinity of the Boulder Islands or Las Vegas Bay. A description of the Boulder Basin AMP is provided in Section 2.2.2.6.

The results of the monitoring implemented through the Boulder Basin AMP may indicate the need to alter the way the SCOP is managed or operated to meet changing Lake or regulatory conditions in order to maintain the desired results. The NDEP has statutory authority to issue NPDES permits and regulate wastewater discharges. As such, the Boulder Basin AMP, including monitoring, sampling, and requirements to meet water-quality requirements and NPS guidelines for non-impairment, would be subject to the approval of the NDEP and NPS, respectively.

4.2 Biological Resources

This section contains a discussion of potential impacts that would result from the construction, operation, and maintenance of the No Action, Boulder Islands North, Boulder Islands South, Las Vegas Bay, and Process Improvements alternatives related to vegetation, wildlife, and aquatic resources. The methodology used during field surveys, and baseline data summarized in this section are presented in Appendix E. In addition, the regulatory framework established for management and protection of special status species is presented in Appendix E.

Impacts would be considered significant if construction, operation, or maintenance of a project alternative would:

- Adversely affect a federally listed or state protected species of plant, wildlife, or fish;
- Significantly change the existing abundance, diversity, or habitat value of plants, wildlife, or fish, or the distribution of existing plant communities; or

- Substantially interfere with the movement of native resident or migratory wildlife species, established native resident or migratory corridors, or the use of native wildlife nursery/spawning sites.

The impairment analysis conducted for biological resources uses the following criteria for vegetation, wildlife, and threatened and endangered species.

Vegetation

- *Negligible impacts:* Impacts have no measurable or perceptible changes in plant community size, integrity, or continuity.
- *Minor impacts:* Impacts are measurable or perceptible and localized within a relatively small area. The overall viability of the plant community would not be affected and, if left alone, would recover.
- *Moderate impacts:* Impacts would cause a change in the plant community (e.g. abundance, distribution, quantity, or quality), however, the impact would remain localized.
- *Major impacts:* Impacts to the plant community would be substantial, highly noticeable, and permanent.
- *Impairment:* For this analysis, impairment is considered a permanent change in a large portion of the overall acreage of the LMNRA, affecting the resource to the point that the park's purpose could not be fulfilled and the resource would be degraded precluding the enjoyment of future generations. The impact would contribute substantially to the deterioration of LMNRA's native vegetation.

Wildlife

- *Negligible impacts:* No species of concern is present; no impacts or impacts with only temporary effects are expected.
- *Minor impacts:* Non-breeding animals of concern are present, but only in low numbers. Habitat is not critical for survival; other habitat is available nearby. Occasional flight responses by wildlife are expected, but without interference with feeding, reproduction, or other activities necessary for survival.
- *Moderate impacts:* Breeding animals of concern are present during particularly vulnerable life-stages, such as migration or winter; mortality or interference with activities necessary for survival expected on an occasional basis, but not expected to threaten the continued existence of the species in the LMNRA.
- *Major impacts:* Breeding animals are present in relatively high numbers, and/or wildlife is present during particularly vulnerable life stages. Habitat targeted by actions has a history of use by wildlife during critical periods, but there is suitable habitat for use nearby. Few incidents of mortality could occur, but the continued survival of the species is not at risk.
- *Impairment:* The impact would contribute substantially to the deterioration of natural resources to the extent that the LMNRA's wildlife and habitat would no longer function as a natural system. Wildlife and its habitat would be affected over the long-term to the point that the LMNRA's purpose (*Enabling Legislation* [PL 88-639], *General Management Plan* [NPS 1986], *Strategic Plan* [NPS 2001c]) could not be fulfilled and the resource could not be experienced and enjoyed by future generations.

Threatened and Endangered Species

- *No effect:* The appropriate conclusion when the action agency determines that its proposed action would not affect a listed species or designated critical habitat.
- *Not likely to adversely affect:* The appropriate conclusion when effects on listed species are expected to be discountable, insignificant, or completely beneficial. Beneficial effects are contemporaneous positive effects without any adverse effects to the species. Insignificant effects relate to the size of the impact and should never reach the scale where take occurs. Discountable effects are those extremely unlikely to occur. Based on the best judgment, a person would not: (1) be able to meaningfully measure, detect, or evaluate insignificant effects; or (2) expect discountable effects to occur.
- *Likely to adversely affect:* The appropriate finding if any adverse effect to listed species may occur as a direct or indirect result of the proposed action or its interrelated or interdependent actions, and the effect is not: discountable, insignificant, or beneficial. If the overall effect of the proposed action is beneficial to the listed species, but is also likely to cause some adverse effects, then the proposed action "is likely to adversely affect" the listed species. If incidental take is anticipated to occur as a result of the proposed action, an "is likely to adversely affect" determination should be made.
- *Is likely to imperil proposed species existence and/or adversely modify proposed critical habitat – (impairment).* The appropriate conclusion when the action agency or the USFWS identify situations in which the proposed action is likely to jeopardize the continued existence of a proposed species or adversely modify the proposed critical habitat.

4.2.1 No Action Alternative

A discussion of the impacts that may result from implementation of the No Action Alternative related to vegetation, wildlife, and aquatic resources is provided in this section.

4.2.1.1 Vegetation

The EI facilities would not be constructed under the No Action Alternative. Increased effluent flows would likely widen the saturated substrate zone in the Las Vegas Wash because ongoing construction of ECSs that serve to arrest headcutting would also cause the low-flow channel to become wider at some locations. A larger saturated area would encourage the expansion of riparian plant and wetlands communities. It is likely that these communities would steadily expand in area as effluent flows to the Las Vegas Wash increase. An increase in water surface area correspondingly would increase habitat for birds and bats along the Las Vegas Wash.

No special status plant species would be impacted by the No Action Alternative because surface disturbance would not occur.

4.2.1.2 Wildlife

Four federally listed threatened or endangered species have potential to occur in the project area. The No Action Alternative would not affect the desert tortoise or bald eagle.

The impacts to two federally listed endangered birds that have the potential to occur in the area, the southwestern willow flycatcher and Yuma clapper rail, are associated with the increased flows in the Las Vegas Wash. A larger saturated area would encourage the expansion of riparian plant and wetlands communities, which would increase the habitat for these species. In addition, anticipated natural and human-assisted development of wetland and riparian vegetation behind the existing and proposed ECSs in the Las Vegas Wash would increase habitat for these species. This would be a beneficial impact to these species. No impacts to the least tern, an incidental migrant, are anticipated to occur.

The impacts to special status birds, including the black tern (*Chlidonias niger*), western yellow-billed cuckoo, American peregrine falcon (*Falco peregrinus anatum*), blue grosbeak (*Guiraca caerulea*), western least bittern (*Ixobrychus elixis hesperis*), summer tanager (*Piranga rubra*), white-faced ibis (*Plegadis chihi*), Vermilion flycatcher (*Pyrocephalus rubinus*), Lucy's warbler (*Vermivora luciae*), and Arizona Bell's vireo (*Vireo bellii arizonae*) are associated with the increased flows in the Las Vegas Wash. Impacts would be similar to those described for the southwestern willow flycatcher and the Yuma clapper rail.

The impacts to special status bats are similar to those described for the birds. An increase in water surface area would increase foraging habitat for bats, which would be beneficial.

Shallow groundwater and tributaries to the Las Vegas Wash contain high levels of selenium that may bioaccumulate in wildlife species. Although these non-effluent related flows of selenium would continue to enter the Las Vegas Wash under the No Action Alternative, there would be increased dilution due to an increase in effluent flows. The reduction of selenium concentrations in the Las Vegas Wash, from the current concentration of 2.5 µg/L to 2.0 µg/L in the year 2030, would benefit wildlife species by reducing the potential for bioaccumulation.

4.2.1.3 Aquatic Resources

Black and Veatch (2004d) indicated in 2002, that the Las Vegas Wash and Las Vegas Bay had the highest level of chlorophyll production lakewide (Figure 3.1-11). Productivity in Lake Mead is limited by the availability of phosphorus. Other areas of the Lake have nutrient inputs via ground and storm water contributions though none display the elevated phosphorus levels observed in Las Vegas Bay. Therefore, the quality sport fishery that is now established in Lake Mead is likely dependant upon this nutrient input.

Although non-point source base flows would remain the same under the No Action Alternative, there would be increased dilution of groundwater and runoff constituents because effluent flows would increase. The daily flow rates for 2030 are predicted to be 300 mgd (462 cfs), which would represent a 49 percent increase in effluent flows in the Las Vegas Wash relative to 2002 conditions. This increase of effluent discharge causes a dilution of the natural selenium concentrations contained in the groundwater and runoff. This would equate to a reduction in groundwater and runoff contribution from 22 percent in 2002 to 6 percent in 2030 due to the increased quantity of effluent flow in the Las Vegas Wash. The Las Vegas Wash Baseline Conditions and Modeling Results for the No Action Alternative shows a decrease in selenium levels in the Las Vegas Wash from 2.5 µg/L of selenium at 150 mgd (231 cfs) in 2002 to 2.0 µg/L of selenium at 300 mgd (462 cfs) in 2030. Though this level does not exceed EPA standards, it could potentially cause food-chain bioaccumulation and reproductive failure in fish and wildlife

as indicated by Lemly (1 to 2 µg/L) (1996). However, this level does not exceed the toxic thresholds for waterborne selenium concentrations of less than 3.0 µg/L indicated by Maier and Knight (1994).

The impacts of the projected increase in the Las Vegas Bay effluent discharge to the loading of other harmful contaminants may offset the benefit of selenium dilution. Tuttle and Orsak (2002) examined two razorback sucker specimens from Las Vegas and Echo bays for contaminants. They concluded concentrations of other contaminants (including organochlorine [OC] compounds and pesticide residues) occurred in elevated levels in the fish from the Las Vegas Wash. Bevans et al. (1996) indicated the presence of a variety of EDCs and pesticide residues in carp sampled from the Las Vegas Wash. The toxicity levels of many of these components, however, remain uncertain and EPA standards have yet to be formalized for many of them. Furthermore, the impacts of wind and water currents, biological metabolism and transport, wetland absorption, and other complicated processes that likely affect the bioaccumulation of such contaminants are unknown.

The toxicological relevance of the occurrence of EDCs and PPCPs in Lake Mead is under study at this time to determine whether these chemicals are capable of producing adverse effects in the aquatic environment at environmentally relevant concentrations. There is little evidence to suggest that EDCs and PPCPs in wastewater are having an effect on human populations anywhere. However, substantial evidence from laboratory studies and from field studies in other locations indicates that EDCs and at least one PPCP (EE2) at concentrations that occur in some municipal effluents can adversely affect fish. While recent research suggests that common carp in the Las Vegas Wash and Las Vegas Bay of Lake Mead might be affected by EDCs and PPCPs, there is no evidence that these substances affect survival or reproduction of carp, which are plentiful in the Las Vegas Bay and Lake Mead. If EDCs or PPCPs are responsible for the reported effects, they might have arisen from effluent, contaminated groundwater seeps, urban runoff, stormwater flow, or a combination of these. More information would be needed to determine whether the SCOP project is likely to alter potential exposure and effects of EDCs or PPCPs. Appendix K provides additional information regarding EDCs and PPCPs.

The No Action Alternative would not directly affect the aquatic faunal communities currently occupying the Las Vegas Wash and Las Vegas Bay. The anticipated increase of effluent into the Las Vegas Wash may be beneficial to the aquatic faunal communities already present by supporting additional habitat for residency, forage, and cover. The No Action Alternative would have similar direct impacts to the aquatic fauna occupying the Las Vegas Bay. No adverse direct impacts from this action are anticipated. Therefore, impacts would be insignificant and negligible. Impairment of aquatic resources in the Las Vegas Bay would not occur.

The No Action Alternative would have indirect effects on the aquatic fauna currently occupying the inner Las Vegas Bay. In the spring, the sun promotes algal blooms that could “choke out” other organisms and alter water chemistry. The algal growth could over-saturate DO during daylight (photosynthesis) and at night, deplete DO (respiration), creating less than favorable DO conditions for aquatic life. Additionally, the eutrophic conditions would promote population outbreaks of scavenger and predator species like crayfish. Competition by these species for prey on eggs, larvae, and benthic invertebrates could have negative impacts to other aquatic fauna populations.

Water-quality monitoring in the Las Vegas Bay concludes that the current rate of nutrient loading has not caused adverse environmental conditions. However, the nutrient loading in conjunction with the lowering water levels in Lake Mead may create less than favorable conditions for aquatic fauna because dilution of effluent-related constituents would be reduced.

Las Vegas Bay is a current and historic spawning area for the razorback sucker populations occurring in Lake Mead. Populations of razorback suckers migrate to this area once a year for spawning. Although the exact location of the spawning site in the Las Vegas Bay is unknown, it is believed to be located off the west shore of Blackbird point, on the north shore of the Las Vegas Bay. This conclusion is based on the yearly razorback sucker larval captures in the area (Holden and Welker 2003). Under this alternative, flows from the Las Vegas Wash may create eutrophic conditions in the Las Vegas Bay, as previously described. These water quality conditions would not be ideal conditions for spawning razorback suckers or larvae, because eutrophic conditions promote population outbreaks of scavenger and predator species that prey on razorback suckers and their larvae. In addition, increased quantities of effluent in the Las Vegas Bay would increase the presence of constituents such as EDCs and other emerging compounds of concern that may impact the razorback sucker.

The No Action Alternative is not likely to adversely affect the razorback sucker or any other special status aquatic species present in the Las Vegas Bay.

4.2.2 Boulder Islands North Alternative

A discussion of the potential impacts of construction, operation, and maintenance of the Boulder Islands North Alternative related to vegetation, wildlife, and aquatic resources is provided in this section.

4.2.2.1 Effluent Interceptor – Alignment A

Impacts to biological resources from the construction and implementation of EI-Alignment A are primarily associated with surface disturbance during construction activities and flow quantity changes in the Las Vegas Wash.

4.2.2.1.1 Vegetation

Construction activities would affect vegetation communities. Impacts to vegetation communities include loss of or damage to individual plants and the seed bank, grading and compacting native soil, and permanent loss of habitat. Ground-clearing activities could introduce or spread non-native, invasive weeds that would compete with native plant species for resources.

The methodology for determining the acres of impact were determined using the estimated acreage required for staging areas and the temporary and permanent easement widths described in Chapter 2. All reaches of the EI requiring a cut-and-cover construction technique would disturb a width of up to 175 ft (53 m) of temporary easement and the COH Forcemain would require up to 125 ft (38 m) of temporary disturbance.

Proposed EI-Alignment A construction activities would result in 202 acres (82 hectares) of temporary land disturbance and 53 acres (21 hectares) of permanent land disturbance. However, much of this area is already disturbed from previous construction activities related to public use or unrelated to the proposed action. The Mojave creosote bush scrub community is the majority of the vegetation cover within the area of impact and would therefore experience the greatest amount of disturbance. A minimal amount of disturbance would occur in Mojave wash scrub and desert saltbush scrub communities. No disturbance would occur in the desert riparian or wetland communities associated with the Las Vegas Wash. The construction corridor would parallel the Las Vegas Wash and tunnel underneath it at the two proposed Las Vegas Wash crossings, thereby avoiding both community types.

Maintenance activities would affect vegetation during periodic access to the project area for routine inspection, repairs, structure replacement, and other activities. However, maintenance activities would occur infrequently and predominantly in areas of existing disturbance, therefore impacts from these activities would be insignificant.

The reduced effluent flow, approximately 30 mgd (46 cfs), to the Las Vegas Wash would result in a reduction in surface flow into Lake Mead. By maintaining a base flow of 50 mgd (77 cfs) in the Las Vegas Wash, sufficient water would be available to sustain existing riparian plant communities as a whole. However, the saturated substrate would likely decrease in area. This may result in the transition of emergent wetland communities to drier riparian communities, such as alkali scrub and tamarisk. Although the extent to which this would occur cannot be accurately predicted with the available information, a review of the estimated water budget for the Las Vegas Wash indicates that riparian and wetlands vegetation communities can be supported at their current level, but the composition and diversity of those communities would likely change.

In addition, ongoing construction of ECSs may serve to enhance the vegetation communities along the Las Vegas Wash. The SNWA plans to construct a total of 22 ECSs in the Las Vegas Wash. Currently, 11 ECSs are completed or under construction. These structures help stabilize sections of the channel by slowing the flow of water. Ponds are created behind the structures allowing for establishment of wetland and riparian vegetation.

Significant reduction of wetland and riparian communities in the Las Vegas Wash would also be addressed by the implementation of the Boulder Basin AMP. The effects of reduced flows through the Las Vegas Wash would be analyzed and monitored regularly through the Boulder Basin AMP to ensure that no significant loss of valuable riparian or wetland habitat is occurring. Should loss of riparian or wetland habitat become apparent, the Boulder Basin AMP CMT, in coordination with associated committees and workgroups, would direct the treatment facilities to increase effluent delivery to the Las Vegas Wash. The increase in flows would help sustain the existing wetland and riparian habitat types.

Habitat likely to support the Las Vegas bearpoppy, rosy twotone beardtongue, and cacti and yucca species was observed during field surveys. However, no Las Vegas bearpoppy or rosy twotone beardtongue were observed in the project area during spring 2003, 2004, and 2005 surveys. Occurrences of Las Vegas bearpoppy have been documented adjacent to the proposed project corridor east of Reach 1 and also at a location west of the Magic Way access road (Figure 3.2-1).

Potential habitat for the rosy twotone beardtongue in ephemeral drainages is traversed by the proposed project facilities. Construction in these ephemeral drainages would affect potential habitat. Potential habitat for cacti and yucca species occurs throughout the project area in association with upland vegetation communities. Low population densities of cacti species (approximately one to three plants per acre) and no yucca species were observed in the study area during spring 2003, 2004, and 2005.

All temporary surface disturbances associated with construction and maintenance of the project may result in the introduction or spreading of noxious weed species. Plant seeds may be transported to the project area by construction vehicles and equipment that have been operated in areas where noxious weeds are present. In areas where ground disturbance is substantial, aggressive non-native weed species may become established. Once established, aggressive weed species can invade adjacent habitats and degrade the condition of the surrounding area. Mitigation measures to reduce the spread of noxious weeds are discussed in Section 4.2.6.

4.2.2.1.2 Wildlife

Construction activities associated with this alternative would cause temporary and permanent disturbance to wildlife and wildlife habitat in the area. Clearing and grading activities would result in the destruction of wildlife habitat and injury, mortality, or temporary displacement of wildlife, particularly to small mammals and reptiles that are not mobile enough to avoid construction operations. Larger, more mobile wildlife species would avoid the initial clearing activity and move into adjacent areas.

Some animals would be dispersed outside the construction limits and would be susceptible to predators or competitive stress. Displacement would result in a slight population depression adjacent to the corridor, but following project completion and successful restoration, wildlife would reoccupy restored portions of the project area. Implementation of this alternative would not eliminate wildlife populations or substantially reduce wildlife population densities or habitat in the region. Therefore, impacts would be temporary and minor.

Increased noise, dust levels, and human activity during construction would potentially disrupt normal foraging and breeding behavior of wildlife species adjacent to the construction area. However, these impacts would be localized and temporary. Existing sources of noise in the proposed project area include recreational activities such as OHV use, automobile traffic, operation of heavy machinery, and other construction-related activities. Project-related noise would not substantially differ from the existing conditions. Therefore, noise impacts to wildlife would be insignificant.

Impacts to the Mojave desert tortoise resulting from project construction and maintenance activities would include removal of habitat, loss of habitat features such as cover and forage, and injury or loss of animals. Desert tortoises may be harassed by removal or displacement from the construction area. Construction activities may result in injury or loss of desert tortoises that enter the access roads or construction areas. Equipment and vehicles operated outside of the designated construction area may injure or kill tortoises above ground or in their burrows. Construction of the facilities would potentially result in degradation of desert tortoise habitat due to soil and vegetation disturbance, introduction of non-native plant species, habitat fragmentation,

and increased noise, traffic, equipment movement, and human presence. Water application to unpaved access roads for dust suppression during construction activities may attract tortoises and subsequently increase potential for injury or mortality from vehicle collision.

Maintenance activities would affect the desert tortoise during access to the project area for routine inspection, repairs, structure replacement, and other activities. Tortoises may be injured or killed by equipment or vehicles during these activities and the tortoise habitat may be disturbed. However, maintenance would occur infrequently and predominantly in areas of existing disturbance, therefore impacts from these activities would be minimal.

Construction of EI-Alignment A would result in the temporary disturbance of approximately 202 acres (82 hectares) of desert tortoise habitat. Approximately 53 acres (21 hectares) of the 202 acres (82 hectares) would be permanent disturbance. However, much of this area is already disturbed from previous unrelated construction activities or public use. Following project construction and site restoration, desert tortoises would likely reoccupy restored portions of the project area.

The riparian vegetation in the Las Vegas Wash is potential habitat for the southwestern willow flycatcher and Yuma clapper rail. Construction-related noise, traffic, or other human activities would potentially deter the southwestern willow flycatcher and Yuma clapper rail from breeding, nesting, and foraging near the project corridor. These impacts would be localized and temporary.

The breeding and nesting seasons for the southwestern willow flycatcher and Yuma clapper rail are May through September and March through August, respectively. Disturbance near the Las Vegas Wash during these periods may result in impacts to nesting or foraging birds. Operation of the proposed pipelines would substantially reduce flows through the Las Vegas Wash. The reduction in flows may alter the composition and diversity of the vegetation communities along the Las Vegas Wash. Existing emergent wetland communities may transition to drier riparian communities. Existing drier riparian communities may transition to upland communities. The potential net loss of riparian communities may adversely impact the flycatcher, clapper rail, or other species utilizing these vegetation communities.

As described in Section 4.2.2.1.1, ongoing construction of ECSs may serve to enhance the vegetation communities along the Las Vegas Wash. These structures help stabilize sections of the channel by slowing the flow of water. Ponds are created behind the structures allowing for establishment of wetland and riparian vegetation. Recruitment and establishment of additional wetland and riparian vegetation would sustain or increase flycatcher habitat.

The effects of reduced flows through the Las Vegas Wash would be analyzed and monitored regularly through the Boulder Basin AMP to ensure that no significant loss of valuable riparian or wetland habitat is occurring. Should loss of riparian or wetland habitat become apparent, the Boulder Basin AMP CMT, in coordination with associated committees and workgroups, may direct the treatment facilities to increase effluent delivery to the Las Vegas Wash. The increase in flows would help sustain the existing wetland and riparian habitat types.

The reduction of effluent flows through the Las Vegas Wash would increase the concentration of selenium in the water, thus potentially impacting wildlife species in the Las Vegas Wash. Selenium enters the Las Vegas Wash through tributaries, shallow groundwater, and treated

wastewater effluent. The EPA-recommended water quality criterion for bioaccumulation (accumulation in the tissues of organisms) in aquatic life is 5 µg/L. However, the appropriate concentration for protecting birds is complex and outside the scope of their recommended aquatic life criterion (EPA 2006). Although not included in the EPA-recommended standards, the southwestern willow flycatcher and Yuma clapper rail may be adversely impacted by the bioaccumulation of selenium.

It is estimated that the selenium concentration in the Las Vegas Wash would increase from the baseline level of approximately 2.5 µg/L (COH 2002a) to a value between 5 µg/L and 7 µg/L, depending on the location within the Las Vegas Wash. However, the method used to predict the future concentration was conservative. Therefore, the conservative estimate is likely higher than the actual concentration. Selenium may be present in water in a number of oxidation states depending on conditions such as pH, the presence of other chemicals, and the presence and type of aquatic life. Although the Las Vegas Wash Model (Black & Veatch 2005a) combined these oxidation states, not all oxidation states pose bioaccumulation hazards. The model also did not include two potential removal methods of selenium from the system. Some oxidation states of selenium are volatile and would exit the water to the air. Other oxidation states are accumulated in aquatic vegetation. The only removal method included in the model was the precipitation of selenium into the sediment. Because of these conservative assumptions, the reduction of effluent flows to the Las Vegas Wash may result in a selenium concentration below or perhaps slightly higher than the EPA-recommended water quality criterion for bioaccumulation in aquatic life of 5 µg/L.

Impacts to the chuckwalla (*Sauromalus obesus*) and banded Gila monster (*Heloderma suspectum cinctum*) would include injury to or loss of animals and habitat during construction activities. Impacts to the chuckwalla may occur in the project area where rocky outcrops occur. Potential impacts to the Gila monster would be limited to the ephemeral washes in the project area. Following construction and site restoration, chuckwallas and Gila monsters would likely reoccupy restored portions of the project area. Implementation of this alternative would not substantially reduce chuckwalla or Gila monster population densities or habitat in the region.

Western burrowing owl (*Athene cunicularia hypugea*) habitat requirements largely overlap those of the Mojave desert tortoise. Therefore, potential project-related impacts to burrowing owls and their habitat are the same as those described for the desert tortoise.

Impacts to the black tern, western yellow-billed cuckoo, American peregrine falcon, blue grosbeak, western least bittern, summer tanager, white-faced ibis, vermilion flycatcher, Lucy's warbler, Arizona Bell's vireo, and other native migratory bird species, are similar to those described for the southwestern willow flycatcher and Yuma clapper rail.

The impacts to special status bats are similar to those described in Section 4.2.1.2. Normal foraging behavior patterns of bats may be disrupted by noise, night-time illumination, and other disturbance associated with construction activity.

4.2.2.1.3 Aquatic Resources

Construction of EI-Alignment A including the COH Forcemain would not impact aquatic resources along the Las Vegas Wash. Once the EI becomes operational, it would directly affect

aquatic resources by diverting effluent flows normally discharged into the Las Vegas Wash. This diversion would remove a portion of the effluent discharge and lower the normal base flows in the Las Vegas Wash. This action would reduce the extent of habitat for aquatic fauna such as fish, amphibians, and invertebrates in the Las Vegas Wash and downstream to Las Vegas Bay.

The reduction of effluent flows to the Las Vegas Wash would reduce the dilution of non-effluent related constituents such as TDS, selenium, and perchlorate. The daily flow rate for 2030 in the Las Vegas Wash under the Boulder Islands North Alternative is predicted to be 30 mgd (46 cfs), which would represent an 81 percent reduction in effluent flows in the Las Vegas Wash relative to 2002 conditions. This would equate to an increase in groundwater and runoff contribution from 22 percent in 2002 to 36 percent in 2030 due to the decreased quantity of effluent flows in the Las Vegas Wash. The Las Vegas Wash Baseline Conditions and Modeling Results for the pipeline alternatives show an increase in selenium levels from 2.5 μg/L at 150 mgd (231 cfs) in 2002 to 5.0 μg/L of selenium at 300 mgd (462 cfs) in 2030. Though this level meets EPA standards, it could potentially cause food-chain bioaccumulation and reproductive failure in fish and wildlife as indicated by Lemly (1 to 2 μg/L) (1996). This level also exceeds the toxic thresholds for waterborne selenium concentrations of less than 3.0 μg/L indicated by Maier and Knight (1994). However, the contribution of other contaminants to the Las Vegas Bay through increased effluent discharge may offset the benefit of selenium dilution.

The impacts to aquatic species in the Las Vegas Wash, from exposure to these constituents, is not known. It is expected that the abundance of some species may be slightly reduced, but the populations would continue to inhabit the Las Vegas Wash. Agencies responsible for management of the Las Vegas Wash are monitoring the concentrations of substances associated with groundwater and urban runoff in the Las Vegas Wash, and will address the issue as needed.

No direct or indirect impacts to the razorback sucker would result from construction of the EI because the razorback sucker is not present in the Las Vegas Wash. Operation of the EI in which all but 30 mgd (46 cfs) of effluent are diverted to the vicinity of the Boulder Islands, would affect the razorback sucker environment in the inner Las Vegas Bay. Approximately 50 mgd (77cfs) of effluent and base flows would continue to enter the inner Las Vegas Bay from the Las Vegas Wash, and subsequently the TP loading would be reduced. This would likely reduce turbidity, aquatic vegetation cover, and phytoplankton abundance in the inner Las Vegas Bay. Similarly, because less effluent is entering the inner Las Vegas Bay, the presence of constituents such as EDCs and other emerging compounds of concern would also be reduced. The new discharge location is unlikely to adversely affect the razorback sucker.

There would be no direct effects to the southwestern toad from the operation of the EI. However, during construction of the EI, ground-disturbing activities have the potential to directly affect the southwestern toad through direct mortality or displacement. Potentially suitable habitat may occur within the construction easement along the Las Vegas Wash and would be disturbed, degraded, or removed. Being primarily nocturnal, the southwestern toad may be in burrows, dens, or crevices during the day and may not be able to avoid disturbance from construction activities resulting in direct loss of life.

4.2.2.2 Lake Conveyance System, Boulder Islands North

Impacts to vegetation, wildlife, and aquatic resources that may result from construction, operation, and maintenance of the Boulder Islands North LCS are discussed in this section.

4.2.2.2.1 Vegetation

The types of impacts to vegetation communities that may result from construction, maintenance, and operation of the LCS would be similar to those discussed for the EI in Section 4.2.2.1.1. The estimated acreage of temporary and permanent surface disturbance for this project was determined using the land requirements described in Chapter 2.

The Mojave creosote bush scrub community would experience the greatest amount of disturbance. The Boulder Islands North LCS would cause temporary impacts to approximately 155 acres (63 hectares) and approximately 25 of these acres (10 hectares) would be permanently disturbed. Portions of those acres have been previously disturbed from construction activities unrelated to the proposed project. No desert saltbush scrub, desert riparian scrub, or wetland communities would be impacted by the LCS. Impacts to vegetation would be insignificant and minor. Therefore, there would be no impairment to vegetation in the LMNRA.

Potential habitat for the rosy twotone beardtongue in ephemeral drainages is traversed by the proposed project facilities. Construction in these ephemeral drainages would affect potential habitat. Potential habitat for cacti and yucca species occurs throughout the project area in association with upland vegetation communities. Low population densities of cacti species (approximately one to three plants per acre) and no yucca species were observed in the study area during spring 2003, 2004, and 2005.

Potential project impacts related to noxious weeds would be the same as those described for the EI in Section 4.2.2.1.1.

4.2.2.2.2 Wildlife

Impacts to wildlife and wildlife habitat that may result from construction, maintenance, and operation of the LCS would be similar to those described for the EI in Section 4.2.2.1.2. Construction and implementation of the Boulder Islands North LCS would result in an estimated 155 acres (63 hectares) of temporary surface disturbance to potential wildlife habitat and 25 acres (10 hectares) of permanent surface disturbance. However, much of this area is already disturbed from previous unrelated construction activities or public use. Following project construction and site restoration, wildlife would likely reoccupy restored portions of the project area. Therefore, impacts to wildlife would be insignificant and minor.

Potential project-related impacts to the Mojave desert tortoise would be similar to those described for the EI in Section 4.2.2.1.2. No tortoise sign was observed within the proposed project construction corridor during field surveys conducted in 2005. However, a Reclamation biologist confirmed the presence of Mojave desert tortoise within the footprint of the EI Terminus site on April 25, 2005 (Reclamation 2005) and again on April 11, 2006 (Reclamation 2006).

Construction of the Boulder Islands North LCS would result in the temporary disturbance of approximately 155 acres (63 hectares) of desert tortoise habitat. Approximately 25 acres (10 hectares) of the 155 acres (63 hectares) would result in permanent disturbance.

No habitat for the federally listed Yuma clapper rail or southwestern willow flycatcher occurs in the LCS segment.

Roosting and nesting habitat for the bald eagle is not present in the project area. However, bald eagles may traverse the area during foraging or travel from roosts or nests to water sources such as Lake Mead. Impacts from construction activities on the bald eagle include temporary disturbance of a small amount of foraging habitat along the shores and on the open water of Lake Mead. Construction-related noise, traffic, or other human activities would potentially keep the eagles from foraging near the project corridor while these actions are taking place. These temporary impacts would be localized and minimal. Existing sources of noise in the proposed project area include recreational activities such as OHV use and motor craft within LMNRA, automobile traffic, operation of heavy machinery, and other construction activities. Therefore, project-related noise is not expected to substantially differ from the existing conditions. Impacts to the bald eagle would be insignificant.

Potential project-related impacts to reptile, bird, and bat species would be similar to those described for the EI in Section 4.2.2.1.2.

Degradation or loss of desert bighorn sheep habitat may occur during construction activities, but it is unlikely. Disturbance to bighorn sheep habitat would not occur during construction of the tunnel through the River Mountains. Bighorn sheep are highly mobile and would likely avoid any construction area. Therefore, injury to or mortality of bighorn sheep is not expected and the impacts to habitat would be localized and temporary.

Impacts to the banded Gila monster, chuckwalla, peregrine falcon, and migratory birds during construction are not expected. No surface disturbance would occur in the River Mountains during construction of the LCS tunnel. Peregrine falcons select nest sites in early spring and in areas with high cliffs that have protected holes or ledges. Construction is not expected to occur in such areas. Therefore, no impairment would occur to migratory birds or nesting habitat in the River Mountains.

Impacts to wildlife resulting from the LCS portion of the Boulder Islands North Alternative would be insignificant. Therefore, no impairment would occur to wildlife in the LMNRA.

4.2.2.2.3 Aquatic Resources

The land-based segments of the LCS would not directly impact aquatic fauna. Construction of the BINDP would directly impact aquatic habitat and fauna starting with the riparian corridor on the edges of Lake Mead. The LCS pipeline would be dredged into place, disturbing the benthic and littoral habitat in the Lake. Aquatic vegetation and habitat would be destroyed in the construction areas. Invertebrate species with limited home ranges, such as crayfish, would be lost due to direct mortality. Common fish and amphibian species are not likely to be impacted through direct mortality because of their ability to move away from the dredging operations. Dredging activities would result in short-term negative impacts to benthic organisms in the

immediate area. The area would recolonize with organisms that move in once construction activities cease. The effect of redistribution of benthic contaminants is unknown for this area of the Lake. Similar impacts to aquatic fauna would occur from the installation of the turbidity curtain, which would surround the dredging operation. Construction activities would directly affect aquatic fauna associated with this section of the LCS, but these impacts would be temporary and would not be significant because the fauna would return once construction activities cease.

Construction of the LCS would have indirect affects on the aquatic resources in Lake Mead. Indirect mortality resulting from temporary relocations and the reduced fitness created by stress associated with these activities may occur to aquatic species located in this portion of the Lake. The construction activities would create temporary barriers, which would interrupt normal foraging patterns and disrupt normal community behavior patterns. These interruptions to normal behavior patterns and stress associated with these disruptions may reduce fitness of the aquatic species in the immediate area. In turn, reduced fitness may decrease the survival of these species. Although these impacts may indirectly affect the aquatic species associated with the construction of the LCS, these impacts would be temporary, minimizing the possibility of species mortality. Therefore, the associated indirect impacts would be insignificant and negligible. No impairment to aquatic species would result from construction activities in Lake Mead.

Once constructed, operation of the LCS would impact aquatic resources when the effluent is diffused into Lake Mead. Highly treated effluent would be dispersed below the thermocline from the diffuser, and mixed with the waters of Lake Mead. The Boulder Islands discharge location provides more dilution of effluent-related constituents than the release of effluent to the inner Las Vegas Bay via the Las Vegas Wash. Water-quality modeling indicates that parameters such as conductivity, density, DO content, and temperature of the waters near the diffuser would be within the ranges preferred by the aquatic life that inhabits this area of Lake Mead. Therefore, aquatic resources would not be adversely impacted by the discharge of effluent in the proposed vicinity. Impairment of aquatic resources in the LMNRA would not occur.

The reduction of effluent flows to the Las Vegas Wash would reduce the TP loading to the inner Las Vegas Bay. This would potentially impact the quality of the sport fishery in Boulder Basin by reducing the algae and forage fish abundance upon which sport fish depend. The likelihood of the sport fishery adapting to new locations of effluent discharge, the availability and contribution of the discharge to primary production and the time required to attain full utilization of the nutrients by sport fish is uncertain, but not expected to be significant because the total productivity of Boulder Basin would not be greatly reduced.

Razorback sucker. Construction of the LCS would directly impact aquatic habitat and fauna starting with the riparian corridor on the edges of Lake Mead. Fish species are not likely to be impacted through direct mortality because of their ability to move away from the dredging operations. Construction impacts would be temporary. However, the physical disturbance associated with pipe installation activities in Lake Mead may directly impact the razorback sucker population's dispersal, migration, and ability to forage. The razorback sucker may be displaced from its normal forage range, and normal community behavior may be disrupted. These construction activities may interrupt dispersal corridors with physical barriers and may block seasonal migration to known breeding locations.

Although known to occur throughout Lake Mead, little is known about the razorback suckers distribution outside of the known breeding areas such as Las Vegas Bay and Echo Bay. Several attempts to use sonic location transmitters have been implemented but with limited success. It appears that razorback suckers use the areas around known breeding locations before and after seasonal breeding activities. However, yearly activity, migratory corridors, and dispersal patterns in Lake Mead have not been well documented because of the limits of sonic telemetry. The exact location of razorback suckers and community populations outside the normal breeding season is relatively unknown (Holden and Welker 2003).

The construction activities associated with the installation of the LCS pipeline and barriers would be short-term in nature thus reducing the likelihood of direct impacts significance. Although these activities may impact the razorback suckers normal behavior and dispersal patterns, the razorback's ability to avoid these activities along with the short-term nature of these disruptions would reduce the degree of impact to the species.

Impacts from construction activities of the LCS may indirectly affect the razorback sucker populations in the area. Indirect mortality to the razorback suckers created by stress-induced fitness reduction may occur. Abnormal stress may be created by the temporary relocations of razorback populations, the interruptions of dispersal patterns, or barriers to forage areas associated with construction activities. In turn, stress may reduce the fitness of the razorback suckers that occupy this area of the Lake. This reduced fitness condition may decrease the razorback sucker's natural immune system and invite secondary infections such as columnaris, fungus, and parasites. Under abnormal immunity conditions, the razorback sucker's ability to combat these infections may be reduced, thus lowering the ability for its survival.

Although indirect impacts associated with the installation of the LCS may occur, the short-term nature of these impacts and the ability of the razorback sucker to avoid this area minimizes the level of the impacts. Thus, the likelihood of these impacts to be significant and affect the razorback sucker population is low.

Operation of the LCS and discharge of highly treated effluent into Lake Mead near the Boulder Islands may directly affect the razorback sucker populations by changing the water quality in the dispersal area and in the inner Las Vegas Bay. The area of the inner Las Vegas Wash would receive less effluent that may contain EDCs. Modeling of conductivity and other parameters within Boulder Basin indicated that the water would be mixed within the basin. Concentrations of EDCs in Boulder Basin are not expected to be greater than under the No Action Alternative. Highly treated effluent would be dispersed below the thermocline from the diffuser, and mix with the waters of Lake Mead. The Boulder Islands discharge location provides more dilution of effluent-related constituents than the release of effluent to the inner Las Vegas Bay via the Las Vegas Wash. Water-quality modeling indicates that parameters such as conductivity, density, DO content, and temperature of the waters near the diffuser would be within the ranges preferred by razorback suckers. However, it is uncertain if the razorback sucker inhabits the waters surrounding the proposed diffuser location near the Boulder Islands. It is also uncertain if the razorback sucker uses the water column at the diffuser level. Although the discharge may affect the water-quality parameters surrounding the diffuser, it is unlikely that these conditions would adversely affect the razorback sucker.

The removal of all but 50 mgd (77 cfs) of flows from the Las Vegas Wash would affect the razorback sucker environment in the inner Las Vegas Bay. The reduction in flows to the Las Vegas Bay would result in less TP loading. This would likely reduce turbidity, aquatic vegetation cover, and phytoplankton abundance in the inner Las Vegas Bay. The constituents in effluent that provide a nutrient source for the razorback sucker would be present in the inner Las Vegas Bay, but at reduced levels. Similarly, because less effluent is entering the inner Las Vegas Bay, the presence of constituents such as EDCs and other emerging compounds of concern would also be reduced. The mass of selenium in the Las Vegas Wash would decrease due to the reduction of effluent-based selenium. Although, the concentration of selenium in the Las Vegas Wash and inner Las Vegas Bay would increase, the decreased mass exiting the Las Vegas Wash is expected to be diluted by the water in the Las Vegas Bay. However, based on preliminary consultation with the USFWS as required under Section 7 of the ESA, adverse impacts to the endangered razorback sucker may occur under the Boulder Islands North Alternative. Minimization measures, and mitigation and monitoring plans are being developed through consultation to alleviate potential impacts to the razorback sucker.

Water-quality modeling indicates that during operation of the LCS, parameters such as conductivity, density, DO content, and temperature of the waters in the Las Vegas Bay would remain within the ranges preferred by razorback suckers. The razorback sucker would not likely be adversely impacted by changes in these parameters alone. Temporary impacts to the razorback sucker would likely occur during construction of the LCS.

Total phosphorus levels going through Hoover Dam, based on the Lake Mead model, are predicted to increase slightly from 5 ppb to 6 ppb under the Boulder Islands alternatives. This level is comparable to the baseline period, and lower than historical levels over an extended period of time. Given that Lake Mead and Lake Mohave are phosphorus limited, the effect of this increase would be a slight to negligible increase in phytoplankton production in Lake Mohave. The level below Hoover Dam will be substantially less than the elevated levels of phosphorus and chlorophyll occurring in the Las Vegas Bay, where an aggregation of spawning razorbacks is known to occur. Therefore, there would be no impact to aquatic species downstream of Hoover Dam and no impacts to the implementation of the LCR MSCP.

Some uncertainty exists about the effects of EDCs or PPCPs on fish. Studies in Lake Mead have suggested that EDCs or PPCPs may have some effect on fish, although the cause of the effect has not been identified, and the magnitude is uncertain. This uncertainty appears not to be relevant to the effects on downstream users, however, because the effect appears to be associated with discharges from the Las Vegas Wash, which are highly concentrated as they enter Las Vegas Bay, but are rapidly diluted as they mix with Lake waters. Lake Mead is a considerable distance upstream from the water intakes of downstream users, and the Lake provides considerable dilution and buffering capacity. A summary of existing credible scientific evidence is provided in Appendix K. Based on this evidence and the environmental setting, it is reasonable to conclude that potential effects are likely to be limited to the area near the mouth of Las Vegas Wash, where concentrations are high, and to dissipate as the elevated concentrations decrease through mixing and assimilation. Even in the area of higher concentrations, the potential effects appear modest at most. They are not lethal, and appear not to be sufficient to decrease fish population levels, which are high at the mouth of the Las Vegas Wash. Because the effect is uncertain and modest,

even at the higher concentration levels, and because of the great dilution and assimilation capacity of Lake Mead, EDCs and PPCPs are not expected to affect fish below Hoover Dam.

Organochlorines were found in Lake Mead using a semi-permeable membrane device but were not below Hoover Dam (Tuttle and Orsak 2002). However, OCs have been found in carp tissues sampled from Lake Mead and Lake Mohave. The highest concentration of OCs in Lake Mohave was found in fish sampled from Willow Beach located approximately 11 miles downstream of Hoover Dam. Other trace metals including selenium were also found in carp samples taken from Lake Mohave at concentrations that could impact reproductive function (Tuttle and Orsak 2002). These results suggest the transport of OCs and trace metals through Hoover Dam via organisms that had accumulated the contaminants (not detectable using the semi-permeable membrane device) or the presence of local contaminant sources in Lake Mohave. However, there is no evidence of any effect on fish or other organisms.

Water quality modeling indicates that during operation of the LCS, water parameters in Lake Mead and downstream of Hoover Dam would remain within the range preferred by razorback suckers. Therefore, no impairment of the razorback sucker would occur.

4.2.3 Boulder Islands South Alternative

A discussion of the potential impacts of construction, operation, and maintenance of the Boulder Islands North Alternative related to vegetation, wildlife, and aquatic resources is provided in this section.

4.2.3.1 Effluent Interceptor – Alignment B

Impacts to biological resources from the construction and implementation of EI-Alignment B are similar to those described for EI-Alignment A in Section 4.2.2.1. Any different or additional impacts resulting from EI-Alignment B are presented in the following subsections.

4.2.3.1.1 Vegetation

Proposed EI-Alignment B construction activities would affect approximately 224 acres (91 hectares) of land surface. However, much of this area is already disturbed from previous, unrelated construction activities or public use. The Mojave creosote bush scrub community would experience the greatest amount of disturbance. The least impacted plant communities would be the desert saltbush scrub and Mojave wash scrub. Development of the chat trail would channel existing recreational activities into the trail system and away from sensitive habitat, thereby minimizing further degradation and allowing habitat rehabilitation to occur.

4.2.3.1.2 Wildlife

Construction of EI-Alignment B would result in the temporary disturbance of approximately 224 acres of desert tortoise habitat. Approximately 82 acres (33 hectares) of the 224 acres (91 hectares) would be permanent disturbance. However, much of this area is already disturbed

from previous unrelated construction activities or public use. Following project construction and site restoration, desert tortoises would likely reoccupy restored portions of the project area.

4.2.3.1.3 Aquatic Resources

Impacts to aquatic resources resulting from the construction and operation of EI-Alignment B would be the same as those described for EI-Alignment A in Section 4.2.2.1.3.

4.2.3.2 Lake Conveyance System, Boulder Islands South

Impacts to vegetation, wildlife, and aquatic resources that may result from construction, operation, and maintenance of the Boulder Islands South LCS would be the same as those described for the Boulder Islands North LCS in Section 4.2.2.2. Any different or additional impacts resulting from the Boulder Islands South LCS are presented in the following subsections.

4.2.3.2.1 Vegetation

The Mojave creosote bush scrub community would experience the greatest amount of disturbance. The Boulder Islands South LCS would cause temporary impacts to approximately 36 acres (15 hectares) of the Mojave creosote bush scrub community, and approximately 9 of these acres (4 hectares) would be permanently disturbed. No desert saltbush scrub, desert riparian scrub, or wetland communities would be impacted by the LCS. Impacts to vegetation would be insignificant and minor. Therefore, there would be no impairment to vegetation in the LMNRA.

4.2.3.2.2 Wildlife

The impacts to wildlife would be the same as those described for the Boulder Islands North Alternative in Section 4.2.2.2.2, except for the impacts to desert tortoise habitat.

Construction of the Boulder Islands South LCS would result in the temporary disturbance of approximately 65 acres (26 hectares) of desert tortoise habitat. Approximately 22 of the 65 acres (9 of the 26 hectares) would result in permanent disturbance.

4.2.3.2.3 Aquatic Resources

Impacts to aquatic resources resulting from the Boulder Islands South LCS would be the same as those described for the Boulder Islands North LCS in Section 4.2.2.2.3.

4.2.4 Las Vegas Bay Alternative

A discussion of potential impacts of the construction, operation, and maintenance of the Las Vegas Bay Alternative related to vegetation, wildlife, and aquatic resources is provided in this section.

4.2.4.1 Effluent Interceptor – Alignment B

Impacts for EI-Alignment B of this alternative would be the same as those described for EI-Alignment B in Section 4.2.3.1.

4.2.4.2 Lake Conveyance System, Las Vegas Bay

Impacts to vegetation, wildlife, and aquatic resources that may result from construction, operation, and maintenance of the Las Vegas Bay alternative are discussed in this section.

4.2.4.2.1 Vegetation

The types of impacts to vegetation resulting from the construction, operation, and maintenance of the Las Vegas Bay LCS are the same as those described for the Boulder Islands North Alternative in Section 4.2.2.2.1.

Proposed construction activities would temporarily impact approximately 26 acres (10 hectares) of land surface under this alternative. Approximately 6 acres (2 hectares) of permanent disturbance would occur. However, much of this area is already disturbed from previous, unrelated construction activities or public use. The greatest amount of temporary disturbance under this alternative would be 14 acres (6 hectares) to the Mojave creosote bush scrub community. No desert saltbush scrub, desert riparian scrub, or wetland communities would be impacted. The LCS would not directly affect wetlands and riparian vegetation within the vicinity of the proposed project. Therefore, there would be no impairment to vegetation in the LMNRA.

Potential habitat for the rosy twotone beardtongue in ephemeral drainages is traversed by the proposed project facilities. Construction in these ephemeral drainages would affect potential habitat. Potential habitat for cacti and yucca species occurs throughout the project area in association with upland vegetation communities. Low population densities of cacti species (approximately one to three plants per acre) and no yucca species were observed in the study area during spring 2003, 2004, and 2005.

Potential project impacts related to noxious weeds would be the same as those described for the EI in Section 4.2.3.1.1.

4.2.4.2.2 Wildlife

The impacts to wildlife would be the same as those described for the Boulder Islands North Alternative in Section 4.2.2.2.2, except for the impacts to desert tortoise habitat.

Construction of the Las Vegas Bay LCS would result in the temporary disturbance of approximately 26 acres of desert tortoise habitat. Approximately 6 of the 26 acres (2 of the 10 hectares) would be permanent disturbance.

4.2.4.2.3 Aquatic Resources

Construction of the LCS under this alternative would have direct and indirect impacts similar to those described for the Boulder Islands North Alternative in Section 4.2.2.2.3. The terrestrial portion of the LCS would not directly impact aquatic fauna. Once constructed, operation of the LCS would directly impact aquatic resources when the effluent is diffused into the Lake. The direct impacts of the LCS to aquatic fauna are similar to those described for the Boulder Islands North Alternative in Section 4.2.2.2.3. The release of nutrient-rich effluent in the Las Vegas Bay may increase the number of fish in that area of Lake Mead and may have a beneficial impact on sport fishing.

Although operation of the LCS possesses the ability to directly affect aquatic species associated with the Las Vegas Bay, long-term and significant impacts are not anticipated. Therefore, impairment would not occur.

Razorback sucker. Impacts to aquatic habitat and fauna from construction of the LCS in the Las Vegas Bay would be similar to those described for the Boulder Islands North Alternative in Section 4.2.2.2.3. However, the Las Vegas Bay Alternative would be most likely to effect the known spawning aggregation of razorback suckers located near Blackbird Point in Las Vegas Bay.

The impacts of the construction of the LCS pipeline on razorback suckers outside of the spawning season is unknown due to the lack of information regarding razorback dispersal patterns in the Lake during this time. Razorback spawning in Las Vegas Bay occurs from February through May in the vicinity of Blackbird Point though this location is expected to shift further into the Bay with lowered Lake elevations. Locations of sonic-tagged razorbacks extend throughout Las Vegas Bay and into Boulder Basin. One adult fish tagged in the Las Vegas Bay was found among the spawning aggregation in Echo Bay several years later (Holden and Welker 2003) suggesting extensive movement of razorbacks can occur.

Although indirect impacts associated with the installation of the LCS may occur, the short-term nature of these impacts and the ability of the razorback sucker to avoid this area decreases the level of the impacts. Thus, the likelihood of these impacts to be significant and affect the razorback sucker population is low. Therefore, construction activities would not likely affect the razorback sucker.

Operation of the LCS and discharge of highly treated effluent into the Las Vegas Bay may directly affect the razorback sucker populations by changing the water quality in the dispersal area. The area of the inner Las Vegas Bay and Las Vegas Wash would receive less effluent that may contain EDCs. Modeling of conductivity and other parameters within Boulder Basin indicated that the water would be mixed within the basin. Concentrations of EDCs in Boulder Basin are not expected to be greater than under the No Action Alternative. Highly treated effluent would be dispersed below the thermocline from the diffuser, and mixed with the waters of Lake Mead. At a Lake elevation of 1,178 ft (359 m), the Las Vegas Bay would provide more dilution of effluent-related constituents than the release of effluent to the inner Las Vegas Bay via the Las Vegas Wash. Appendix K contains a summary of scientific literature pertaining to the potential effects of EDCs and PPCPs on fish.

Total phosphorus levels going through Hoover Dam, based on the Lake Mead model, are predicted to increase slightly from 5 ppb to 6 ppb under the Las Vegas Bay Alternative. This level is comparable to the baseline period, and lower than historical levels over an extended period of time. Given that Lake Mead and Lake Mohave are phosphorus limited, the effect of this increase would be a slight to negligible increase in phytoplankton production in Lake Mohave. The level below Hoover Dam would be substantially less than the elevated levels of phosphorus and chlorophyll occurring in the Las Vegas Bay, where an aggregation of spawning razorbacks is known to occur. Therefore, there would be no impact to aquatic species downstream of Hoover Dam and no impacts to the implementation of the LCR MSCP.

Some uncertainty exists about the effects of EDCs or PPCPs on fish. Studies in Lake Mead have suggested that EDCs or PPCPs may have some effect on fish, although the cause of the effect has not been identified, and the magnitude is uncertain. This uncertainty appears not to be relevant to the effects on downstream users, however, because the effect appears to be associated with discharges from the Las Vegas Wash, which are highly concentrated as they enter Las Vegas Bay, but are rapidly diluted as they mix with Lake waters. Lake Mead is a considerable distance upstream from the water intakes of downstream users, and the Lake provides considerable dilution and buffering capacity. A summary of existing credible scientific evidence is provided in Appendix K. Based on this evidence and the environmental setting, it is reasonable to conclude that potential effects are likely to be limited to the area near the mouth of Las Vegas Wash, where concentrations are high, and to dissipate as the elevated concentrations decrease through mixing and assimilation. Even in the area of higher concentrations, the potential effects appear modest at most. They are not lethal, and appear not to be sufficient to decrease fish population levels, which are high at the mouth of the Las Vegas Wash. Because the effect is uncertain and modest, even at the higher concentration levels, and because of the great dilution and assimilation capacity of Lake Mead, EDCs and PPCPs are not expected to affect fish below Hoover Dam.

Organochlorines were found in Lake Mead using a semi-permeable membrane device but were not below Hoover Dam (Tuttle and Orsak 2002). However, OCs have been found in carp tissues sampled from Lake Mead and Lake Mohave. The highest concentration of OCs in Lake Mohave was found in fish sampled from Willow Beach located approximately 11 miles downstream of Hoover Dam. Other trace metals including selenium were also found in carp samples taken from Lake Mohave at concentrations that could impact reproductive function (Tuttle and Orsak 2002). These results suggest the transport of OCs and trace metals through Hoover Dam via organisms that had accumulated the contaminants (not detectable using the semi-permeable membrane device) or the presence of local contaminant sources in Lake Mohave. However, there is no evidence of any effect on fish or other organisms. Water-quality modeling indicates that parameters such as conductivity, density, DO content, and temperature of the waters near the diffuser would be within the ranges preferred by razorback suckers. At Lake elevations of 1,178 ft (359 m) and 1,000 ft (305 m), water-quality standards would not be exceeded. Relatively rapid, thorough dilution of the effluent reduces the concentrations of constituents such as endocrine-disrupting compounds and other emerging compounds of concern that may affect the razorback sucker. Temporary impacts to the razorback sucker would likely occur during construction of the LCS. Water-quality modeling indicates that during operation of the LCS, water parameters would remain within the range preferred by razorback suckers. Therefore, no impairment of the razorback sucker would occur.

Under this alternative, no direct or indirect effects to the southwestern toad are anticipated from the operation of the Las Vegas Bay LCS.

4.2.5 Process Improvements Alternative

A description of the impacts that may result from implementation of the Process Improvements Alternative related to vegetation, wildlife, and aquatic resources is provided in this section.

4.2.5.1 Vegetation

The EI facilities would not be constructed under the Process Improvements Alternative. Increased effluent flows would likely widen the saturated substrate zone in the Las Vegas Wash because ongoing construction of ECSs that serve to arrest headcutting would also cause the low-flow channel to become wider at some locations. A larger saturated area would encourage the expansion of riparian plant and wetlands communities. It is likely that these communities would steadily expand in area as effluent flows to the Las Vegas Wash increase. An increase in water surface area correspondingly would increase habitat for birds and bats along the Las Vegas Wash.

No special status plant species would be impacted by the Process Improvements Alternative because surface disturbance would not occur.

4.2.5.2 Wildlife

Four federally listed threatened or endangered species have potential to occur in the project area. The Process Improvements Alternative would not affect the desert tortoise or bald eagle because no surface disturbance would occur.

The impacts to two federally listed endangered birds that have the potential to occur in the area, the southwestern willow flycatcher and Yuma clapper rail, are associated with the increased flows in the Las Vegas Wash. A larger saturated area would encourage the expansion of riparian plant and wetlands communities, which would increase the habitat for these species. In addition, anticipated natural and human-assisted development of wetland and riparian vegetation behind the existing and proposed ECSs in the Las Vegas Wash would increase habitat for these species. This would be a beneficial impact to these species. No impacts to the least tern, an incidental migrant, are anticipated to occur.

The impacts to special status birds, including the black tern, western yellow-billed cuckoo, American peregrine falcon, blue grosbeak, western least bittern, summer tanager, white-faced ibis, Vermilion flycatcher, Lucy's warbler, and Arizona Bell's vireo are associated with the increased flows in the Las Vegas Wash. Impacts would be similar to those described for the southwestern willow flycatcher and the Yuma clapper rail.

The impacts to special status bats are similar to those described for the birds. An increase in water surface area would increase foraging habitat for bats, which would be beneficial.

4.2.5.3 Aquatic Resources

The impacts of the Process Improvements Alternative to aquatic resources would be similar to the impacts of the No Action Alternative. The volume of effluent and effluent-related nutrients discharged through the Las Vegas Wash would vary only slightly from the anticipated volumes resulting from the No Action Alternative. Specifically, the abundance of nutrients responsible for phytoplankton production (measured as chlorophyll) entering Lake Mead is expected to be similar to the No Action Alternative for all projected years and Lake levels (Figures 4.1-3 through 4.1-6).

The increased effluent flow through the Las Vegas Wash may benefit the existing aquatic faunal communities by increasing habitat for residency, forage, and cover. No adverse impacts to these aquatic wash communities are anticipated. Shallow groundwater and tributaries to the Las Vegas Wash contain high levels of selenium that may bioaccumulate in wildlife species. Although these non-effluent related flows of selenium would continue to enter the Las Vegas Wash under the Process Improvements Alternative, there would be increased dilution due to an increase in effluent flows. The reduction of selenium concentrations in the Las Vegas Wash would benefit wildlife species by reducing the potential for bioaccumulation.

The Process Improvements Alternative would not directly affect the aquatic faunal communities occupying the Las Vegas Bay. Nutrients essential to support the sport fishery industry would continue to enter the Las Vegas Bay at levels similar to the No Action Alternative (Figures 4.1-3 through 4.1-6). However, the nutrient loading in conjunction with the lowering water levels in Lake Mead may create less than favorable conditions for the aquatic fauna in the Las Vegas Bay. Algal blooms may create eutrophic conditions that promote population outbreaks of scavenger and predator species. Competition by these species for prey on eggs, larvae, and benthic invertebrates could have negative impacts to other aquatic fauna populations including the razorback sucker.

It is expected that the use of MF/UF membranes would slightly reduce the amount of EDCs and PPCPs entering Lake Mead. Recent research suggests that common carp in the Las Vegas Wash and Las Vegas Bay may be affected by endocrine disruption, although no causative chemical agents or specific sources have been identified. If EDCs or PPCPs are responsible for the reported effects, they may have arisen from effluent, contaminated groundwater seeps, urban runoff, stormwater flow or a combination of these. The slight reduction of these chemicals in the effluent via process improvements would likely not benefit the sport fishes and the razorback sucker in the Las Vegas Bay.

4.2.6 Mitigation

The mitigation measures that would be implemented during construction and operation of the SCOP are described in this section.

Under the No Action Alternative, no mitigation measures to protect vegetation, wildlife, or aquatic resources are necessary. Future additions of treatment facilities will be constructed on lands owned by the CLV, Clark County, and the COH. Construction impacts from the facility modifications will be minimized by implementing BMPs regarding erosion and water quality protection.

Under the Boulder Islands North, Boulder Islands South, and Las Vegas Bay alternatives, an approved restoration plan would be developed as part of the temporary and permanent ROW easement grant. The restoration plan will describe the reclamation of disturbed areas to a preconstruction condition. This plan will outline revegetation, wildlife habitat reclamation, and soil stabilization measures. Reclamation of the disturbed vegetation will restore wildlife habitat that was temporarily disturbed during construction. Due to the regionally arid climate, vegetation recovers slowly over several years. Therefore, implementation, monitoring, and success criteria will be established to ensure the successful reclamation of the project area. Implementation of these mitigation measures will reduce any adverse impacts on vegetation communities to less than significant.

Erosion and sediment control devices will be used to prevent impacts to the riparian areas and Lake Mead. Once on Lake Mead, the construction activities will implement Zero Tolerance Management Practices for hazardous material spills and contamination directly into the Lake.

Several measures will be taken to avoid, minimize, monitor, and mitigate adverse impacts to the desert tortoise, including:

- Restricting surface disturbance to the minimum amount needed for construction,
- Educating construction personnel about listed species,
- Construction monitoring by qualified biologists,
- Placement of tortoise fencing in areas of known tortoise habitat,
- Restoring habitat in areas temporarily disturbed during project construction, and
- Payment of mitigation fees for habitat compensation.

A pre-construction survey will be conducted for migratory birds including the southwestern willow flycatcher and Yuma clapper rail during the nesting and breeding season. The breeding and nesting seasons for the southwestern willow flycatcher and Yuma clapper rail are May through September and March through August, respectively. If active nests are located, construction activities will not be allowed to occur within 100 ft (30 m) of the Las Vegas Wash during this time, as mitigation for potential impacts to the species.

The chances of spreading noxious weeds into the project area will be greatly reduced by implementing the following mitigation measures. These measures include mechanical or herbicidal methods to control and remove noxious weeds prior to construction from all areas to be disturbed.

- The undercarriages of construction vehicles will be washed prior to working on the project at designated wash stations located off the project site.
- The disturbed areas will be restored according to the applicable land management agency. Restoration within the LMNRA would be in accordance with LMNRA requirements and concurrence, including weed treatment as may be prescribed. The area will be monitored for restoration success according to success criteria established by the federal land owner, and for noxious weeds and exotic plants to ensure that establishment of these species does not occur.

Pre-construction surveys for the southwestern toad will identify possible populations along the Las Vegas Wash and allow for the removal of species that may be affected by the construction activities associated with this project.

To minimize impacts to sport fish, construction of the LCS pipeline and dredging activities within the aquatic environment will be conducted after the absence of sport fish in the location of the dredging location is confirmed with netting and electro-fishing efforts. These efforts will be utilized to salvage and relocate any fish species in the area before the installation of the turbidity curtain. Once the turbidity curtain is in place, other salvage efforts could be conducted to remove the remaining fish.

To minimize the potential impacts to razorback suckers, construction activities within 100 yards (91 m) of known razorback sucker spawning areas will not be allowed between December 1 and May 1.

A mitigation and monitoring plan must be prepared and approved by the USACE prior to issuance of the Individual CWA Section 404 permit and the Section 10 of the Rivers and Harbors Act permit. The applicant may also purchase credits from the Clark County In-Lieu Fee Wetlands Mitigation Program as part of or for the entire amount of mitigation.

Mitigation to lessen the potential impact to waters of the U.S. may include habitat preservation, restoration, and/or creation to achieve the "no net loss" policy. The mitigation will be based on the functions and values of wetlands and waterways that are affected. Focusing on the replacement of the functions provided by the wetlands within the Las Vegas Wash, rather than calculation of acreage impacted or restored, will provide a more accurate and effective way to achieve the environmental performance objectives of the no net loss policy.

4.3 Cultural Resources

This section describes environmental impacts to cultural resources of the No Action, Boulder Islands North, Boulder Islands South, Las Vegas Bay, and Process Improvements alternatives.

Various federal laws and regulations, including the NHPA, ensure consideration of cultural resources. For the purposes of this EIS, impacts to cultural resources would be considered significant if the preferred alternative resulted in an adverse effect to any characteristic of a resource eligible for listing on the NRHP including relevant features of its environment or use. Impacts to cultural resources are assessed through various measures. Four criteria were used in identifying the potential impacts to cultural resources.

- Identifying the nature and location of all elements of the alternatives,
- Comparing those locations with identified cultural resources,
- Determining the known or potential significance of cultural resources that may be affected, and
- Assessing the extent and intensity of the effects.

The impairment analysis for cultural resources used the following criteria:

- *Negligible impacts:* No potentially eligible or listed properties are present; no direct or indirect impacts.
- *Minor impacts:* Potentially eligible or listed properties are present; no direct impacts or impacts with only temporary effects are expected.
- *Moderate impacts:* Potentially eligible or listed properties are present; indirect impacts or, in the case of structures, where activity is limited to rehabilitation conducted in a manner that preserves the historical and architectural value of the property.
- *Major impacts:* Potentially eligible or listed properties present; direct impacts including physical destruction, damage, or alternation of all or part of a property. Isolation of a property from or alteration of the character of a property's setting when that character contributes to its eligibility, including removal from its historic location. Introduction of visual, audible, or atmospheric elements that are out of character with the property or alter its setting. Neglect of a property resulting in its deterioration or destruction (36 CFR 800.5).
- *Impairment:* Loss, destruction, or degradation of a cultural property, resource, or value to the point that it negatively affects the park's purpose and visitor experience.

Six cultural resources sites are located along the proposed EI pipeline alignments as discussed in Section 3.3.2. Five of these sites are located in the EI portion of the proposed project (26CK1300, 26CK1301, 26CK1303, 26CK4877, and 26CK6150). Five of the sites in the vicinity of the EI have been previously evaluated with respect to their eligibility for listing on the NRHP. Sites 26CK1300, 26CK1301, and 26CK1303 have been determined eligible for the listing on the NRHP as contributing elements to the Las Vegas Wash Archaeological District. Site 26CK6150 has been determined eligible on its own. Site 26CK4877, which has been destroyed, was considered not eligible for nomination to the NRHP.

Previous surveys within the proposed LCS areas have identified 17 previously recorded sites. Thirteen of the 17 sites are located in areas that would not experience surface disturbance because the LCS would be installed in a tunnel more than 56-ft (17-m) deep. Boring activities at such depths would have no potential impact to shelters or structures located on the surface. Therefore, the 13 sites are not described further. The four previously recorded NRHP sites located within or near proposed LCS areas where surface disturbance would occur include 26CK4046A, 26CK4046B, 26CK6247, and 26CK6249. In addition, one newly recorded archaeological site (26CK7115) and one previously recorded site (26CK6247) were investigated.

4.3.1 No Action Alternative

Under the No Action Alternative, no direct or indirect disturbance to any cultural resources would occur. There would be no impacts to identified NRHP sites. Therefore, no impairment of cultural resources would occur in the LMNRA.

4.3.2 Boulder Islands North Alternative

The impacts to cultural resources that may result from the construction and operation of the Boulder Islands North Alternative are described in this section.

4.3.2.1 Effluent Interceptor – Alignment A

Portions of the proposed EI alignment would follow the southern edge of the road that is part of Site 26CK6150 for approximately 12,000 linear ft (3,658 m). Site 26CK6150 is the Hoover Dam to Pioche Powerline. Telephone Line Road has been determined to be a non-contributing element to the overall NRHP eligibility of the site. The existing powerline and associated poles are considered contributing elements. Construction of the EI would not occur close enough to the powerline or associated poles to affect the integrity of location or setting for the eligible powerline and associated pole elements of the site. No alteration of the poles or conductors would occur (HRA 2004). In addition, the powerline would be protected from impacts during construction as a result of standard safety procedures that are in effect when work is conducted near features of that kind.

Indirect impacts to Site 26CK6150 are expected to be minimal. Parts of the powerline retain integrity of location, design, setting, and materials. Most of the powerline within and adjacent to the EI project area consists of original poles in their original configuration. Telephone Line Road would provide access to the area. The historic value of the powerline would not be diminished by EI construction activities. Excavation of a trench for the EI at the south edge of Telephone Line Road would result in a temporary visual impact to the setting of the Hoover Dam to Pioche Powerline (26CK6150) that would be reversible with the backfilling and recontouring of the trench.

The proposed pipeline would be located within 100 ft (30 m) of three identified sites:

- Site 26CK1300 (southern edge): This site does not contain features that may be susceptible to vibration damage. Direct and indirect impacts to the site are not expected to occur as a result of the proposed EI construction.
- Site 26CK1301: There is a slight possibility that vibration from the tunneling operation could have an effect on the structural integrity of the rock shelter (HRA 2004). However, the SNWA pipeline was recently tunneled through the area and did not result in impacts to the site.
- Site 26CK1303: This site does not contain features that may be susceptible to vibration damage. Direct and indirect impacts to the site are not expected to occur as a result of the proposed EI construction.

However, these sites are located along the portion of the EI alignment where the pipeline would be placed in a tunnel. As a result, there would be no direct effect to these sites. The only potential indirect effect would be vibration damage from the boring.

Additionally, since HRA completed the Cultural Resources Inventory for the EI, numerous buried cultural features were discovered at two sites in areas not far to the west of the proposed cut-and-cover segment of Reach 2. These discoveries indicate that although surface artifacts were not observed in the vicinity of the EI, subsurface artifacts may be present and may be affected by construction activities.

4.3.2.2 Lake Conveyance System, Boulder Islands North

The potential impacts of the Boulder Islands North LCS are presented based on whether the effects would occur on the land above the high-water level of Lake Mead (terrestrial), or within Lake Mead (underwater). Impacts to cultural resources downstream of Hoover Dam would not occur.

4.3.2.2.1 Impacts on Terrestrial Cultural Resource Sites

The HPRS site and the cut-and-cover portion of the BINDP were surveyed by HRA. No cultural resources were located within the proposed HPRS site or the cut-and-cover portion of the BINDP (HRA 2005).

4.3.2.2.2 Impacts on Underwater Cultural Resource Sites

The submerged sections of the BINDP would cross the SCIRR within areas not previously evaluated for their eligibility to NRHP (HRA 2005). Three contributing elements of Site 26CK4046B are located within the BINDP APE. The BINDP would intersect with the Gravel Pit Line, service road, and aggregate storage pile.

Approximately 1,476 ft (450 m) of the Gravel Pit Line is within the Boulder Islands North LCS APE. The Gravel Pit Line has an elevation range of 975 to 935 ft (297 to 285 m), placing it outside the proposed dredging corridor. However, the BINDP would intersect the Gravel Pit Line. Therefore, damage to the segment of the Gravel Pit Line within the Boulder Islands North LCS APE may occur during placement of the BINDP on the Lake bottom.

Approximately 1,250 ft (381 m) of the unpaved service road is located with the Boulder Islands North LCS APE. The elevation of the service road is 943 to 924 ft (287 to 281 m), placing it outside the proposed dredging corridor. However, the BINDP would intersect the road, leaving it vulnerable to negative impacts from pipeline construction.

The aggregate storage pile within the Boulder Islands North LCS APE spans a non-contiguous area with a total width of 2,133 ft (650 m). The aggregate storage pile is located south of the BINDP centerline and may not come into direct contact with the pipeline. However, the storage pile is within the APE and may be affected by indirect impacts such as sediment redistribution from dredging and anchor-dragging scars.

A non-historic pipeline is located east of the Lake Mead Resort Marina entrance channel. The BINDP would cross the pipeline. This feature does not have any cultural resource value. However, it may pose a hazard to dredging and pipe-laying operations.

4.3.3 Boulder Islands South Alternative

The impacts to cultural resources that may result from the construction and operation of the Boulder Islands South Alternative are described in this section. Impacts to cultural resources downstream of Hoover Dam would not occur.

4.3.3.1 Effluent Interceptor – Alignment B

The potential impacts resulting from EI-Alignment B would be the same as those described for EI-Alignment A in Section 4.3.2.1.

4.3.3.2 Lake Conveyance System, Boulder Islands South

The potential impacts of the Boulder Islands South LCS are presented based on whether the effects would occur on the land above the high-water level of Lake Mead (terrestrial), or within Lake Mead (underwater).

4.3.3.2.1 Impacts on Terrestrial Cultural Resource Sites

Terrestrial surveys were conducted in areas of potential surface disturbance. The areas investigated include the SRMT3-east working shaft site, BISOP alignment, BISDP alignment between the PRS and high-water line of Lake Mead, and access roads.

In the vicinity of the SRMT3-East working shaft, there are 7,500 ft (2,286 m) of the underground water line (Site 26CK7115) within the APE of the Boulder Islands South LCS. Site 26CK7115 is recommended to be eligible for the NRHP under Criterion A, association with events or broad patterns important in history (HRA 2005). Three potential cultural resource elements were identified in the vicinity of the proposed SRMT3-East working shaft: Locus A, large earthen-covered concrete cistern; Locus B, two concrete vaults; and Locus C, two small valve boxes with a buried tank. Impacts to the above-ground features may occur during construction activities in the vicinity of the SRMT3-East working shaft. Mitigation measures to avoid impacts to these sites are described in Section 4.3.6.

The proposed access roads to the SRMT3-East working shaft would cross or are located on portions of Site 26CK6247, the remains of Hemenway Wash Road (or Old Lake Highway). The NPS recommended that the site is not eligible for the NRHP due to lack of integrity. The Nevada State Historic Preservation Office (SHPO) concurs with the NPS recommendations.

The use of the alternate access route to the SRMT3-East working shaft would have significant impacts to Site 26CK6247. The western portions of the alternative access road have been highly damaged from stream action. Any use of this segment of the road would require extensive grading and would damage the remains of the road at the edges of the main channel of Hemenway Wash. However, Since the site is not eligible for the NRHP, the impacts are considered insignificant.

The proposed access roads to the SRMT3-East working shaft would pass underneath Site 26CK6249, the Southern California Edison North Transmission Line. No modifications to the line or towers would occur, and once construction is completed there would be no visual impact to the site's integrity. No impacts to Site 26CK6249 would occur.

The BISOP APE crosses Site 26CK4046A, the remains of the USCRR, at two locations near Hemenway Wash. Proposed access roads would cross sections of the USCRR that have previously been determined as non-contributing elements to the overall line because of damage from natural disturbances.

The BISOP would cross beneath a portion of Site 26CK4046B, the remains of the SCIRR, within an existing breach of the railroad grade that has been previously determined to be a non-contributing element to the overall railroad line due to previous damage from natural and man-made disturbances. Impacts to this section of Site 26CK4046B are not expected because the BISOP would be installed in a tunnel beneath the railroad grade to avoid surface disturbance.

4.3.3.2.2 Impacts on Underwater Cultural Resources Sites

The submerged sections of the BISDP would cross the SCIRR within areas not previously evaluated for their eligibility to NRHP (HRA 2005). Three contributing elements of Site 26CK4046B are located within the BISDP APE. The BISDP would intersect with the USCRR Junction Line, track siding, and Gravel Pit Line. Additionally, the BISDP would intersect with the service road (Site 26CK7254) and the aggregate storage pile (Site 26CK7285).

The USCRR Junction Line, an element of Site 26CK4046B, runs perpendicular to the proposed BISDP and is located within the 1,000 ft (305 m) elevation corridor for dredging. Therefore, the USCRR Junction Line would be impacted by dredging activities.

The isolated track siding lies within the 1,000 ft (305 m) APE corridor proposed for dredging of the pipeline trench, and the historical integrity would be severely damaged by the proposed activities (HRA 2005).

Approximately 1,526 ft (465 m) of the Gravel Pit Line is within the Boulder Islands South LCS APE. The Gravel Pit Line has an elevation range of 975 to 935 ft (297 to 285 m), placing it outside the proposed dredging corridor. However, the BISDP would intersect the Gravel Pit Line. Therefore, damage to the segment of the Gravel Pit Line within the Boulder Islands South LCS APE may occur during placement of the BISDP on the Lake bottom.

Approximately 1,086 ft (331 m) of the unpaved service road (Site 26CK7254) is located within the Boulder Islands South LCS APE. The elevation of the service road is 943 to 924 ft (287 to 281 m), placing it outside the proposed dredging corridor. However, the BISDP would intersect the road, leaving it vulnerable to negative impacts from pipeline construction.

The aggregate storage pile (Site 26CK7285) within the Boulder Islands South LCS APE spans a non-contiguous area with a total width of 2,133 ft (650 m). The aggregate storage pile crosses the BISDP centerline. The elevation of the aggregate storage pile is 999 to 968 ft (304 to 295 m), placing it outside the proposed dredging corridor. However, the BISDP would intersect the aggregate storage pile, leaving it vulnerable to negative impacts from pipeline construction.

Although every effort would be made to avoid the underwater features described in previous paragraphs, some of these features may be impacted during installation of the turbidity curtain.

4.3.4 Las Vegas Bay Alternative

The impacts to cultural resources that may result from the construction and operation of the Las Vegas Bay Alternative are described in this section. Impacts to cultural resources downstream of Hoover Dam would not occur.

4.3.4.1 Effluent Interceptor – Alignment B

Impacts to the EI portion of this alternative would be the same as described for the Boulder Islands North Alternative in Section 4.3.2.1.

4.3.4.2 Lake Conveyance System, Las Vegas Bay

No sites were identified during the terrestrial survey of this alternative. Underwater surveys were not conducted for this alignment because sites associated with Hoover Dam construction did not extend into Las Vegas Bay. Therefore, no impacts to cultural resources would occur.

4.3.5 Process Improvements Alternative

Under the Process Improvements Alternative the impacts to cultural resources would be the same as those described for the No Action Alternative.

4.3.6 Mitigation

Although impacts to sites 26CK1300, 26CK1301, and 26CK1303 are not expected to occur as a result of the proposed project, construction crews will be advised of their presence, and directed to use existing roads for access to project construction sites. In addition, pre- and post-construction conditions assessments will be conducted for these sites. Although not expected to be used, blasting would be prohibited in the vicinity of Site 26CK1301. If damage to these sites has occurred as a result of the EI construction, consultation will be reopened with the Nevada SHPO to determine appropriate mitigation measures.

The discovery of numerous buried cultural features in areas not far from the proposed cut-and-cover segment of Reach 2 indicate that although surface artifacts were not observed in the vicinity of the EI, subsurface artifacts may be present and may be affected by construction activities. Therefore, a qualified monitor will be present during cut-and-cover construction activities.

The above-ground features associated with Site 26CK7115 would be avoided by project activities. Avoidance of Locus A would be achieved by not using the proposed alternative access road to the SRMT3-East working shaft. Avoidance of Locus B would be achieved by fencing the area during construction to ensure that encroachment and possible disturbance will not occur. Possible disturbance to Locus C will be avoided by using only the existing road, with no widening that may cut into the area near the locus. Routine maintenance of the utility access road would not damage the site if the loci are avoided and the road is not widened.

The submerged sections of the Boulder Islands North and the Boulder Islands South alternatives would cross submerged portions of the SCIRR sites 26CK4046B, the service road site 26CK7254, and portions of the aggregate storage piles which are part of site 26CK7285. These sites may also be affected by the installation of the turbidity curtain. These activities would have adverse impacts on the integrity of the sites. If the sites cannot be avoided, the NPS would consult with the Nevada SHPO and the Advisory Council on Historic Preservation to determine appropriate mitigation measures.

There is the potential for encountering previously unknown cultural resources during ground-disturbing activities associated with construction. A qualified construction monitor will be present during construction activities. If cultural resources are found during construction, all work shall cease and the appropriate federal agency (Reclamation or NPS) shall be contacted immediately to coordinate assessment of the find.

The non-historic pipeline, located east of the Lake Mead Resort Marina entrance channel, may pose a safety hazard during construction. To minimize this potential, the exact location of the pipeline will be determined and the pipeline will be avoided during dredging and pipe-laying activities.

4.4 Recreation

Potential impacts to recreational resources, visitor use and experience, or values, and recreational operations that could result from implementation of the Boulder Islands North, Boulder Islands South, and Las Vegas Bay alternatives; the Process Improvements Alternative; and the No Action Alternative are analyzed in this section.

A project alternative would have a significant adverse impact to recreation resources, values, or operations if it would:

- Result in substantial loss, destruction, or degradation of federal, state, local, or private recreational resources;
- Restrict access to federal, state, local, or private recreational sites or restrict access to public land;
- Substantially reduce the aesthetic values of federal, state, local, or private recreational sites; or
- Substantially conflict with approved, adopted, or officially stated policies, goals, or operations of communities or governmental agencies specific to recreational resource plans or activities.

The impairment analysis for recreation used the following criteria.

- *Negligible impacts:* The impact is at the lower level of detection; there would be no measurable change.
- *Minor impacts:* The impact is slight but detectable; there would be a small change.
- *Moderate impacts*: The impact is readily apparent; there would be a measurable change that could result in a small but permanent change.
- *Major impacts:* The impact is severe; there would be a highly noticeable, permanent measurable change.

4.4.1 No Action Alternative

It is likely that riparian and wetlands communities would steadily expand in area as effluent flows to the Las Vegas Wash increase. An increase in water surface area correspondingly would increase habitat for birds and bats along the Las Vegas Wash. This would have a beneficial effect

on recreation because there would be increased opportunities for nature observation, such as bird watching, which is a primary recreational activity in the Wetlands Park.

Water-quality modeling indicates that under the No Action Alternative, using current conventional treatment processes and plant optimization, effluent flows of 200 mgd (308 cfs) or more, with a Lake elevation of 1,000 ft (305 m), would result in exceedances of the WLAs for the Las Vegas Wash and water-quality standard exceedances in the Las Vegas Bay. Increased chlorophyll concentrations in the Las Vegas Bay may result in increased production of algae blooms and macro invertebrates (zooplankton). Nutrients for fish would be plentiful. Therefore, sport fishing would seemingly be unaffected. However, algae have the potential to change the apparent color of water when excessive amounts are present, and they may create undesirable surface scum that can affect recreational use and create taste and odor problems. If the algae blooms should spread throughout Lake Mead and/or downstream of Hoover Dam, it would be considered a major but temporary impact. Impairment to LMNRA resources would not occur.

4.4.2 Boulder Islands North Alternative

Impacts to recreational resources, values, and operations that may occur from implementation of the Boulder Islands North Alternative are presented in the following two subsections.

4.4.2.1 Effluent Interceptor – Alignment A

Recreational activities, including OHV use, mountain bicycling, hiking, horseback riding, and nature observation, would be displaced temporarily from the lands occupied by the EI project construction area. However, measures such as retaining access to adjacent sites with comparable recreational resources and values, would be implemented to reduce these temporary impacts. Visitors to the area may also experience inconveniences during construction activities such as increased noise, dust, localized traffic, and altered scenic or aesthetic values of the landscape. Expanded discussions about potential project-induced impacts to these resources and related mitigation measures are addressed in Section 4.6, Noise; Section 4.7, Air Quality; Section 4.10, Visual Resources; and Section 4.13, Traffic.

The project is located in a relatively urban setting that is experiencing frequent ongoing construction activities associated with various residential developments, golf courses, utility lines, flood control facilities, and ECSs in the Las Vegas Wash. Therefore, impacts to recreational resources, values, and operations that may occur during construction activities are not uncommon to the area and would be short in duration.

Ongoing maintenance activities, such as authorized road grading or vegetation clearing may result in minor adverse impacts to recreational resources since the activities would be confined to an existing disturbed corridor.

By maintaining a base flow in the Las Vegas Wash, sufficient water would be available to sustain existing riparian plant communities as a whole. However, the saturated substrate would likely decrease in area. This may result in the transition of emergent wetland communities to drier riparian communities. Habitat for wildlife would remain.

4.4.2.2 Lake Conveyance System, Boulder Islands North

The Boulder Islands North LCS would involve tunneling through the River Mountains from the EI Terminus to the NRMT3-East working shaft located within the LMNRA. The tunnel would be located in bedrock and the working shafts would be in areas of existing disturbance on private or federal lands that do not support recreational resources. Therefore, no impacts to recreational activities, values, and operations would occur in the tunnel segment of the LCS. No impairment to LMNRA recreational resources would occur from construction of the NRMT3.

The BINDP segment of the LCS would traverse easterly across NPS land, from the HPRS location and continue in an easterly direction to the Boulder Islands diffuser location. The BINDP segment and the diffuser would be located to the north and east of the Boulder Islands in the general area of the underwater screening plant, a popular SCUBA diving attraction that exists to the south and west of the Boulder Islands. Portions of the BINDP segment would be constructed using the open trench and dredging technique. The dredged section of the BINDP would occur in close proximity to the Lake Mead Resort Marina. Access to the Marina may be impacted during construction of the BINDP. However, construction would occur during the winter (October through March) when marina use is low. Measures that will be implemented to eliminate or minimize the impacts to the Marina are presented in Section 4.4.6.

Construction traffic may create minor temporary traffic delays for LMNRA visitors, staff, and concessionaires. However, construction would occur during the winter (October through March) when LMNRA visitation is low and construction vehicles would avoid Lakeshore Drive as much as possible. Therefore, traffic delays would be minimal. Traffic impacts are discussed further in Section 4.13.

Recreational resources and activities, including hiking, mountain bicycling, nature observation, boating, PWC use, waterskiing, windsurfing, swimming, SCUBA diving, and fishing, would be temporarily unavailable on lands and in waters that are within the project construction area. Additionally, LMNRA visitors may experience inconveniences during construction activities, such as increased noise, dust, localized traffic, travel times and distances, and altered scenic or aesthetic values of the landscape and underwater environs. However, construction of the BINDP would be limited to October through March, which is considered the slow season for tourism. Therefore, the impacts would be temporary and minor. No impairment would occur to recreational resources within the LMNRA from construction of the BINDP.

The HPRS would be a permanent below-grade structure located near the AMSWTF. The HPRS would be enclosed by a 6-ft (2-m) tall concrete block wall with a wrought iron gate and a keypad entry security system. An earthen berm would be constructed around the proposed HPRS. Therefore, the facility would not be visible to visitors on the Lake, the impact would be negligible, and no impairment to recreation would occur.

Underwater portions of the BINDP would be permanently installed at depths not conducive for diving or other recreational activities. Therefore, no long-term adverse impacts to recreational resources, values, and operations would occur. Ongoing O&M activities, such as facility inspection, would result in negligible impacts to recreational resources since the activities would be confined to existing disturbed areas and would require minimal equipment.

Implementation of the Boulder Islands North Alternative would not conflict with approved, adopted, or official policies, goals, or operations of communities or governmental agencies specific to recreational resource plans or activities.

The reduction of effluent flows to the Las Vegas Wash would reduce the TP loading to the inner Las Vegas Bay. This would potentially impact the quality of the sport fishery in Boulder Basin by reducing the algae and forage fish abundance upon which sport fish depend. Impacts to recreational resources, values, and operations within LMNRA and downstream of Hoover Dam that may occur from construction, operation, or maintenance of this alternative are expected to be minor.

Under the Boulder Islands North Alternative, water-quality standards would not be exceeded for flows up to 400 mgd (616 cfs). Therefore, no impacts to recreation would result from water-quality issues.

4.4.3 Boulder Islands South Alternative

Impacts to recreational resources, values, and operations that may occur from implementation of the Boulder Islands South Alternative are presented in the following two subsections.

4.4.3.1 Effluent Interceptor – Alignment B

Potential impacts to recreation from EI-Alignment B would be basically the same as described for the Boulder Islands North Alternative in Section 4.4.2.1. Any differences and additional impacts are presented in the following paragraphs.

Under the Boulder Islands South Alternative, a 16-ft (5-m) wide chat trail would be constructed along the cross-country segment of EI-Alignment B Reach 2 for maintenance access and public recreational use. Trail improvements to match existing grade (to the extent possible) would be completed along the South Lateral Pipeline within the Wetlands Park. A pedestrian bridge would be built as part of the trail across the C-1 Channel to connect the Wetlands Park areas west and east of the C-1 Channel. These proposed facilities are anticipated to attract visitor use and improve visitor experience in the Wetlands Park and adjacent residential communities.

Completion of the trails would help organize existing uncontrolled recreational use in the Wetlands Park by channeling existing recreational activities into the trail system and away from sensitive plant and wildlife habitat. Additionally, it would help minimize dust emissions by confining motorized recreational vehicle activities to authorized segments of the trail system.

Construction and improvement of the trails and pedestrian bridge are part of the *Wetlands Park Master Plan and Trail Corridor and Guidelines Plan* (Clark County Parks and Community Services 2002), and would be implemented in cooperation with and approval of Clark County Parks and Community Services. Ongoing maintenance activities, such as authorized road grading, trail maintenance, or vegetation clearing may result in minor adverse impacts to recreational resources since the activities would be confined to an existing disturbed corridor. Construction of the trails and pedestrian bridge would result in long-term beneficial effects to recreational resources, values, and operations in the immediate and surrounding areas.

4.4.3.2 Lake Conveyance System, Boulder Islands South

The potential impacts resulting from the Boulder Islands South LCS would be similar to those described for the Boulder Islands North LCS. Any different or additional impacts are described in the following paragraphs.

The PRS would be a permanent below-grade structure located in the Boulder Beach area. The PRS would be enclosed by a 6-ft (2-m) tall concrete block wall with a wrought iron gate and a keypad entry security system. The proposed fencing would result in a long-term impact to the viewshed but would be considered a minor impact on recreational aesthetics because it would be located in a highly developed area of the LMNRA. The fencing would incorporate colors that are visually compatible with the surrounding landscape, as approved by the NPS. Therefore, the impact would be negligible, and no impairment to recreation would occur.

Implementation of the Boulder Islands South Alternative would not conflict with approved, adopted, or official policies, goals, or operations of communities or governmental agencies specific to recreational resource plans or activities.

Under the Boulder Islands South Alternative, impacts to recreational resources, values, and operations that may occur from construction, operation, or maintenance of this alternative would be minor. Water-quality standards would not be exceeded for flows up to 400 mgd (616 cfs). Therefore, no impacts to recreation would result from water-quality issues.

4.4.4 Las Vegas Bay Alternative

Impacts to recreational resources, values, and operations that may occur from implementation of the Las Vegas Bay Alternative are presented in this section.

4.4.4.1 Effluent Interceptor – Alignment B

Impacts to recreational resources, values, and operations that may result from construction, maintenance, and operation of the EI would be identical to those described for the Boulder Islands South Alternative in Section 4.4.3.1.

4.4.4.2 Lake Conveyance System, Las Vegas Bay

The Las Vegas Bay LCS would involve tunneling through the River Mountains from the LVBT1 working shaft, located at the EI Terminus, to the PRS shaft located within the LMNRA. The tunnel would be located 70 to 515 ft (21 to 157 m) below surface in bedrock. Therefore no impacts to recreational activities, values, and operations would occur in this segment of the LCS, except in the vicinity of the PRS shaft and Las Vegas Bay Diffuser segment.

The LMNRA visitors in the area may experience inconveniences during construction activities such as increased noise, dust, localized traffic, and altered scenic or aesthetic values of the landscape. The project is located in a relatively urban setting that is experiencing frequent ongoing construction activities; therefore, impacts to recreational resources, values, and

operations that may occur during construction are not uncommon to the area and would be short in duration.

Construction equipment and excess soil cuttings from trenching, tunneling, and dredging activities would be transported to and from the project area via US 93, Lake Mead Parkway, and Lakeshore Drive. Temporary traffic delays for LMNRA visitors, staff, and concessionaires may result from the increased construction traffic.

Recreational resources and activities, including hiking, mountain bicycling, nature observation, boating, PWC use, swimming, and fishing, would be temporarily unavailable on lands and in waters that are within the project construction area. Additionally, LMNRA visitors may experience inconveniences during construction activities, such as increased noise, dust, localized traffic, travel times and distances, and altered scenic or aesthetic values of the landscape and underwater environs. However, construction of the PRS shaft and diffuser segment would be limited to October through March, which is considered the low-tourist season. Therefore, the impacts would be temporary and minor.

The PRS would be a permanent below-grade structure located adjacent to the Sunset Scenic Overlook. The PRS would be enclosed by a 6-ft (2-m) tall concrete block wall with a wrought iron gate and a keypad entry security system. The proposed fencing would result in a long-term impact to the viewshed but would be considered a minor impact on recreational aesthetics because it would be located in a highly developed area of the LMNRA and the fencing would incorporate colors that are visually compatible with the surrounding landscape, as approved by the NPS. Access to the scenic overlook and associated parking lot would be limited during construction of the PRS. However, other scenic overlooks are located in relatively close proximity and would provide alternate viewing locations. In addition, construction would occur during the low-tourist season. Therefore, the impacts would be temporary and insignificant.

The Las Vegas Bay pipelines and diffuser would be permanently installed at an elevation of 880 ft (268 m) in areas not conducive for underwater diving or other recreational activities; therefore, no long-term impacts to recreational resources, values, and operations would occur. Ongoing maintenance activities, such as facility inspection, would result in negligible impacts to recreational resources since the activities would be confined to existing disturbed areas and would require minimal equipment.

Once constructed, operation of the LCS would directly impact aquatic resources when the effluent is diffused into the Lake. The direct impacts of the LCS to aquatic fauna are similar to those described for the Boulder Islands North Alternative in Section 4.2.2.2.3. The release of nutrient-rich effluent in the Las Vegas Bay may increase the number of fish in that area of Lake Mead and may have a beneficial impact on sport fishing.

Implementation of the Las Vegas Bay LCS alternative would not conflict with approved, adopted, or official policies, goals, or operations of communities or governmental agencies specific to recreational resource plans or activities.

Impacts to recreational resources, values, and operations that may occur from construction, operation, or maintenance of this alternative would be negligible to minor and would not result in impairment of the resource.

Water-quality modeling indicates that under the Las Vegas Bay Alternative (at a Lake level of 1,000 ft [305 m]), using current conventional treatment processes, water-quality standards for chlorophyll in the Las Vegas Bay would not be exceeded. Therefore, impacts to recreation resulting from water-quality issues are not expected. Impairment to recreational resources of the LMNRA is unlikely.

4.4.5 Process Improvements Alternative

It is likely that riparian and wetlands communities would steadily expand in area as effluent flows to the Las Vegas Wash increase. An increase in water surface area correspondingly would increase habitat for birds and bats along the Las Vegas Wash. This would have a beneficial effect on recreation because there would be increased opportunities for nature observation, such as bird watching, which is a primary recreational activity in the Wetlands Park.

4.4.6 Mitigation

Land surfaces disturbed by construction activities under the pipeline alternatives would be rehabilitated and restored, as applicable, to lessen or eliminate potential adverse effects. Restoration of the project site would be completed in accordance with a project-specific Reclamation- or NPS-approved restoration plan. The restoration plan will address salvage of topsoil for reseeding purposes, recontouring the natural land surface, blending colors and textures, treating weeds, and revegetating the disturbed areas. Coordination with Clark County Parks and Community Services would occur, to the extent required by Reclamation, during restoration activities within the Wetlands Park. In addition, coordination with Clark County Parks and Community Services would occur to ensure that SCOP activities do not conflict with the Clark County Wetlands Park Master Plan.

During construction, the public would be routed around or away from construction areas. Barricades and temporary construction fencing would be used on land, and buoys would be used in the water to temporarily exclude the public from the construction area for safety purposes.

Water activities in the vicinity of the Lake Mead Resort Marina and Boulder Islands would be restricted during construction of the pipeline and diffuser. To minimize the impacts to Marina and Lake users, Notices to Mariners will be published and posted prior to construction activities. Aids to Navigation for Inland Waterways will be implemented, and a minimum-width construction corridor will be used to ensure that at least one-way boat traffic is maintained throughout the construction period.

4.5 Hazardous Materials

This section provides an analysis of the impacts that the proposed project would encounter from hazardous materials and items of concern as well as the potential impacts relating to hazardous materials that may result from the proposed project. For the purposes of this EIS, impacts from hazardous materials would be significant if they resulted in:

- Creation of a potential health hazard or the use, production, or disposal of materials that pose a hazard to people or animal populations in the area affected;
- Interference with emergency response plans or emergency evacuation plans; or
- Activation of requirements under the *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA)(42 USC 103)/*Superfund Amendments & Reauthorization Act* (SARA) PL 99-499) and materials are not properly contained, stored, used, or transported.

4.5.1 No Action Alternative

The CWC would not construct pipelines to transport effluent from the treatment facilities under the No Action Alternative. Highly treated effluent would continue to be discharged to the Las Vegas Wash at the existing discharge locations. The treatment plants would continue to use conventional treatment processes. Hazardous materials would continue to be stored, handled, and disposed of appropriately at the three treatment facilities. Therefore, no impact would result.

4.5.2 Boulder Islands North Alternative

The impacts relating to hazardous materials and items of concern that may result from the construction and operation of the Boulder Islands North Alternative are described in this section. The discussion of potential impacts is separated into two subsections: EI-Alignment A and LCS.

4.5.2.1 Effluent Interceptor – Alignment A

Depending on the depth of excavation and groundwater elevations in a given area, the existing perchlorate plume in the groundwater may be encountered during construction of the EI, including the COH Forcemain. The handling, discharge, and disposal of contaminated groundwater would be conducted in accordance with NDEP requirements and guidance. Requirements for release of perchlorate-contaminated groundwater may include treatment, onsite filtration of groundwater prior to discharge, or construction of temporary infiltration ponds in the vicinity of the proposed project (Croft 2004b). Site-specific requirements would be determined during the permitting process.

Effluent Interceptor – Alignment A would not be located near enough to the Henderson Landfill to encounter metal contamination. However, soil sampling and analyses would be conducted as directed by NDEP in accordance with NDEP requirements and guidance. Metal-contaminated soils encountered during construction would be handled and disposed of at a Resource Conservation and Recovery Act (RCRA) - permitted facility in accordance with EPA standards.

Construction activities may create the potential for hazardous material spills or require disposal of hazardous materials. Potentially hazardous materials used for construction include diesel fuel, gasoline, lubricants, and coolants. Accidental dropping of equipment or equipment malfunctions could create ruptures resulting in hazardous materials being released to the environment. The contractor would be required to comply with Occupational Safety and Health Administration (OSHA) standards and hazardous materials use and disposal standards (CERCLA, SARA and

Resource Conservation and Recovery Act of 1976 [RCRA] [24 USC 6901 et seq. {414}]) during construction of the proposed project to reduce the potential for hazardous materials spills.

The contractor would be responsible for clean up of any hazardous spills that may occur, and disposal of potentially contaminated soils in accordance with EPA standards. Impacts from hazardous materials during construction of the proposed project would not be significant because the contractor would be required to adhere to OSHA, CERCLA, SARA, RCRA, and EPA guidelines.

Hazardous and potentially hazardous chemicals would be used to maintain and operate the proposed project. Determination as to whether a chemical is hazardous depends on concentration, degradation, bioaccumulation potential, quantities, ignitability, corrosivity, reactivity, and toxicity. The following equipment components require lubricants, oils, or coolants. These potentially hazardous liquids would periodically need to be checked, refilled, or tested. Routine checks of the oil, diesel fuel, lubricants, and other fluids would be performed.

The hazardous chemicals or substances expected to be used during construction and/or operation of the proposed project include:

- 2-cycle oil (contains distillates and hydro-treated heavy paraffin),
- ABC fire extinguisher,
- Acetylene gas,
- Air-tool oil,
- Ammonium hydroxide,
- Automatic transmission fluid,
- Battery acid (in vehicles),
- Canned spray paint,
- Connector grease (penotox),
- Diesel fuel additive,
- Explosives (detonators, detonator assemblies),
- Gasoline, and
- Lubricating grease.

These chemicals would be transported to the proposed site from a permitted storage facility. The chemicals are considered hazardous or potentially hazardous and could create off-site consequences in the event of a spill during transportation. Most of the chemicals are raw materials while others are basic operating liquids such as diesel fuel, cleaning compounds, lubricants and oils, and coolants.

Any hazardous materials stored at the staging areas would be regulated under SARA and implemented by the State Fire Marshal's office. Materials with user identification codes or that have flammable listings on their material safety data sheets would need to be reported and managed under the SARA Title III regulations for the storage of hazardous materials. These regulations include disclosure notification, hazardous-chemical inventory reporting, and toxic-release reporting.

Detailed information about the use, storage, and disposal of hazardous materials would be provided in the Construction, Operation, and Maintenance Plan and submitted to the NDEP. The Plan would define specific procedures for vehicle refueling and servicing, transportation and storage of hazardous materials, and disposal of hazardous wastes. For example, construction vehicles and equipment would be required to be serviced and fueled at least 100 ft (30 m) from wetlands and streams.

The proposed EI-Alignment A would not block the use of paved roadways and is not expected to interfere with adopted emergency response plans.

4.5.2.2 Lake Conveyance System, Boulder Islands North

Construction and operational hazardous materials impacts presented under Section 4.5.2.1 would be similar for the LCS portion of this alternative.

Soil and rock borings would be collected prior to construction of the LCS to determine the geologic and hydrologic conditions along the alignment. The samples would be analyzed to determine whether contaminants are present in the soils or rock cuttings. Soil sampling and analyses would be conducted as directed by NDEP in accordance with NDEP requirements and guidance. Metal-contaminated soils encountered during construction would be handled and disposed of at a RCRA-permitted facility in accordance with EPA standards.

Dredging activities would result in short-term negative impacts to benthic organisms in the immediate area. The area would recolonize with organisms that move in once construction activities cease. The effect of redistribution of benthic contaminants is unknown for this area of the Lake.

The proposed LCS under the Boulder Islands North Alternative would not block the use of paved roadways, and therefore is not expected to interfere with adopted emergency response plans.

No impacts would occur downstream of Hoover Dam.

4.5.3 Boulder Islands South Alternative

The impacts relating to hazardous materials and items of concern that may result from the construction and operation of the Boulder Islands South Alternative are described in this section. The discussion of potential impacts is separated into two subsections: EI-Alignment B and LCS.

4.5.3.1 Effluent Interceptor – Alignment B

Potential impacts from EI-Alignment B would be similar to those described for EI-Alignment A as described in Section 4.5.2.1. Any different or additional impacts that may result are described in the following paragraphs.

Depending on the depth of excavation and groundwater elevations in a given area, the existing perchlorate plume in the groundwater may be encountered during construction of EI-Alignment B, including the South Lateral Pipeline. If contaminated groundwater is exposed, it would be handled according to NDEP requirements as described in Section 4.5.2.1.

The South Lateral Pipeline trench may act as a conduit for the transport of perchlorate-contaminated groundwater. The transport of contaminated groundwater to a location downstream may impact efficiency of the remediation system that is in place to intercept and treat the perchlorate entering the Las Vegas Wash.

Portions of the South Lateral Pipeline would cross near the Henderson Landfill, a known metal-contamination area. The proposed project alignment does not enter the boundaries of the landfill. However, soil sampling and analyses would be conducted as directed by NDEP in accordance with NDEP requirements and guidance. Metal-contaminated soils encountered during construction would be handled and disposed of at a RCRA-permitted facility in accordance with EPA standards.

The proposed EI-Alignment B would not block the use of paved roadways, and thus, is not expected to interfere with adopted emergency response plans.

4.5.3.2 Lake Conveyance System, Boulder Islands South

Construction and operational hazardous materials impacts presented under Section 4.5.3.1 would be similar for the LCS portion of this alternative.

Additionally, hazardous materials may be present along the proposed alignment, particularly in the vicinity of two historical RECs, the Three Kids Mine and Henderson Landfill. Construction of the SRMT3 would pass near the Three Kids Mine and the Henderson Landfill, which have known metal (e.g., manganese, lead, and arsenic) and petroleum contamination from historical mining and landfill operations, respectively. Construction would be in close proximity to both RECs, but would not be conducted in direct contact with either. Soil and rock borings would be collected prior to construction of the LCS to determine the geologic and hydrologic conditions along the alignment. The samples would be analyzed to determine whether contaminants are present in the soils or rock cuttings. Soil sampling and analyses would be conducted as directed by NDEP requirements and guidance. If contamination is encountered, the contaminated materials would be disposed of in accordance with EPA standards.

The proposed LCS under the Boulder Islands South Alternative would not block the use of paved roadways, and therefore is not expected to interfere with adopted emergency response plans.

4.5.4 Las Vegas Bay Alternative

The impacts relating to hazardous materials and items of concern that may result from the construction and operation of the Las Vegas Bay Alternative are described in this section.

4.5.4.1 Effluent Interceptor – Alignment B

Impacts presented for EI-Alignment B described under the Boulder Islands South Alternative, Section 4.5.3.1, would be the same for the Las Vegas Bay Alternative.

4.5.4.2 Lake Conveyance System, Las Vegas Bay

Impacts presented for the LCS described under the Boulder Islands North Alternative, Section 4.5.2.2, are the same for the Las Vegas Bay Alternative.

4.5.5 Process Improvements Alternative

Under the Process Improvements Alternative, the CWC would not construct the pipeline to transport treated effluent from their facilities to Lake Mead. The facilities would treat the effluent using the best available technology. The facilities would continuously upgrade their treatment process as technology changes and improves. The current discharge locations would not change. Hazardous materials would continue to be stored, handled, and disposed of appropriately at the three treatment facilities.

In addition to the MF/UF membranes, additional alum must be added to remove TP (down to a concentration between 0.05 and 0.02 mg/L on an annual average basis). This would generate additional chemical sludge. The treatment facilities would generate approximately 800 wet tons of additional sludge per day. The sludge would be transported to the Apex Landfill for disposal. The Apex Landfill has assured landfill capacity for decades in the future (NDEP 2004c).

No impacts would occur downstream of Hoover Dam.

4.5.6 Mitigation

Construction activities and maintenance of construction equipment could create the potential for hazardous material spills. The contractor would be required to clean up any leaks or spills immediately and responsibly dispose of any contaminated materials or soils at an approved recycling, incineration, or disposal facility.

Procedures during construction of the proposed alternatives would be outlined to minimize the chance of a fuel spill during servicing and refueling. Vehicles would be required to carry absorbent material to handle potential spills, inspected for fuel leaks regularly, and be equipped with fire-fighting equipment. Hazardous materials would be transported in NDEP-approved containers and allowed only on approved access roads. Vehicles carrying hazardous materials would be equipped with appropriate equipment and materials to contain a small spill should one occur during transport. Vehicles and storage containers would be properly signed/marked and inspected for leakage and other potential safety problems prior to transportation.

Every effort would be made to minimize the production of hazardous waste during the project, such as using non-hazardous substances when available, minimizing the amount of hazardous materials used for the project, and recycling and filtering hazardous materials. Furthermore, refueling locations on flat terrain/ground decreases the chance of a spilled substance reaching a stream, wetland, or lake.

As part of standard operating procedures and plans, a health and safety plan with procedures for emergencies and coordination with local hospitals and public safety officials would be made available to workers.

Construction activities may encounter perchlorate-contaminated groundwater in various locations along the pipeline alignments. Groundwater suspected of containing perchlorate will be analyzed. If it is determined that the groundwater is contaminated it will be disposed of in accordance with NDEP guidelines.

4.6 Noise and Vibration Impacts

The implementation of any proposed alternative could affect the noise environments of lands under the jurisdiction of the COH, CLV, Clark County, or the NPS. Sensitive receptors exist as mentioned in Section 3.6 within the LMNRA boundaries, the Wetlands Park, and residential developments along both EI alignments. Each government entity regulates noise and vibration through the establishment of ordinances and policies that are identified in Section 3.6 and the following subsections.

Impacts involving noise would be considered significant if an alternative would result in:

- A substantial permanent increase in ambient noise levels,
- Exposure of people to noise levels in excess of local standards,
- Exposure of people to excessive ground-borne vibrations, or
- A substantial temporary or periodic increase in ambient noise levels in excess of local standards.

The impairment analysis for noise and vibration used the following criteria.

- *Negligible impacts*: The impact is at the lower level of detection; there would be no measurable change.
- *Minor impacts*: The impact is slight but detectable; there would be a small change.
- *Moderate impacts*: The impact is readily apparent; there would be a measurable change that could result in a small but permanent change.
- *Major impacts*: The impact is severe; there would be a highly noticeable, permanent measurable change.

The noise and vibration impacts from the proposed project presented in the following subsections would reflect short-term, long-term, direct, and indirect impacts. Potential noise and vibration impacts to biological resources are presented in Section 4.2.

4.6.1 No Action Alternative

Under the No Action Alternative, the construction of additional facilities at each WWTP would be necessary, though the magnitude of construction activities would not be comparable to the proposed action alternatives. The construction activities would have temporary noise effects on receptors in the immediate vicinity of the construction site. However, the area that would be subjected to construction noise would be relatively small.

No impacts would occur downstream of Hoover Dam.

4.6.2 Boulder Islands North Alternative

The following subsections describe noise and vibration impacts from the Boulder Islands North Alternative.

4.6.2.1 Effluent Interceptor – Alignment A

Major construction phases would consist of site preparation, installation (either cut-and-cover or tunneling), and site cleanup. Noise emissions would vary with each phase of construction depending on the construction activity and the associated equipment. Site preparation would require the use of combustion-engine powered earth-moving equipment. Equipment would include: backhoes, scrapers, dump trucks, graders, and front-end loaders. Vehicle-engine noise, vehicle movement, and rock and debris removal would dominate noise emissions during site preparation. The pipeline installation would involve the use of trenchers, tunnel-boring machines, mobile cranes, earth-moving equipment, equipment and materials delivery vehicles, welders, air compressors, and dewatering pumps, that all emit substantial noise.

Construction activities would be subject to County statutes, which prohibit disturbing the peace. It is anticipated that short-term sound levels from construction activities would be less than 45 dBA at the nearest residences. Based on EPA guidelines, 45 dBA is consistent with "normal suburban residential" areas (EPA 1971). Therefore, construction noise is not expected to significantly impact residential communities near the proposed project. Likewise, long-term operational noise impacts would be minimal and not significantly impact residential communities.

The noise and vibration impacts to wildlife and biological resources within the Wetlands Park are discussed in Section 4.2. Any impacts from noise to Wetlands Park visitors would be minimal and short-term. Construction activities would be temporary and at a distance such that visitor experiences would not be adversely impacted by noise. Implementation of mitigation measures discussed in Section 4.6.6 would create additional noise barriers for Wetlands Park visitors.

Heavy earth-moving equipment, such as bulldozers and other heavy-tracked equipment, produces typical peak vibration velocities of less than 0.20 inches-per-second (0.5 cm-per-second) at distances of 25 to 50 ft (7 to 15 m) while operating in various stages of construction. At distances of 100 to 200 ft (30 to 61 m) the peak vibration velocities are typically below 0.04 inches-per-second (0.1 cm-per-second). This is below the recommended criterion for building damage at 25 to 50 ft (7 to 15 m) and below the human annoyance criterion at distances over 100 ft (30 m). During construction, it is not anticipated that heavy earth-moving equipment would operate within 100 ft (30 m) of residential or industrial structures. Therefore, vibration impacts resulting from construction activities along EI-Alignment A are not expected.

The potential for noise and vibration exists during pipeline operation due to pressurized water flow in the pipeline. Generally, noise and vibration is caused by high-velocity water turbulence, water surge or thrust, and water hammer. Water hammer occurs when a valve is opened or closed too quickly, resulting in hydraulic surge or thrust. High-velocity water turbulence is a design factor of the pipeline, and is produced when the pipe diameter is very small compared to the flow rate. All portions of the proposed pipeline would be designed to withstand maximum capacities and surge control systems would be utilized where required. Furthermore, the proposed pipeline would be buried to provide a natural barrier and means of vibration damping. Therefore,

excessive noise from high-pressure water is not expected. No significant noise impacts are anticipated during normal pipeline operation.

4.6.2.2 Lake Conveyance System, Boulder Islands North

Major construction phases would be similar to that described under the EI, consisting of site preparation, installation (either cut-and-cover or tunneling), and site cleanup. Noise emissions would vary with each phase of construction depending on the construction activity and the associated equipment. Site preparation would require the use of combustion-engine powered earth-moving equipment. Equipment would include: backhoes, scrapers, dump trucks, graders, and front-end loaders. Engine noise, vehicle movement, and rock and debris removal would dominate noise emissions during site preparation. The pipeline installation would involve the use of trenchers, tunnel boring machines, mobile cranes, earth-moving equipment, equipment and materials delivery, welders, air compressors, and dewatering pumps, that all emit substantial noise.

Temporary increases in noise levels within the NPS boundaries may be expected. Noise impacts would be moderately loud to LMNRA users that get within 50 ft (15 m) of the construction activities (Table 3.6-1). Mitigation measures discussed in Section 4.6.6 would be implemented to minimize potential noise impacts to LMNRA visitors. All activities would be conducted in accordance with NPS requirements. Long-term operational noise impacts would be minor and not significantly impact LMNRA visitors or residents.

The HPRS near the AMSWTF would be located underground in an area that is not considered a high-use visitor location. Therefore, operation of the HPRS would not create significant noise or vibration impacts. Impacts to the LMNRA would be negligible.

Construction activities related to the BINDP would involve barges and boats used to anchor equipment and transport spoils to the staging area. Noise from these vessels is not anticipated to be greater than what is already created from jet skis and motorboats. Noise on the beach and at the Lake Mead Resort Marina from the construction boats and barges may impact LMNRA visitor experiences. However, construction would be done during the winter season when there are less LMNRA visitors on the beach. Therefore, impacts from construction noise would be minor.

No impacts would occur downstream of Hoover Dam.

4.6.3 Boulder Islands South Alternative

The following subsections describe noise and vibration impacts from the Boulder Islands South Alternative.

4.6.3.1 Effluent Interceptor – Alignment B

Potential noise impacts resulting from the construction and operation of EI-Alignment B are basically the same as described for EI-Alignment A in Section 4.6.2.1. In addition to the impacts described in Section 4.6.2.1, the PRS located at the EI Terminus would consist of electrical

equipment, and major piping and valves that emit noise. The construction of the PRS would create some short-term noise impacts. However, these noise disturbances would be in compliance with noise regulations. Furthermore, the PRS building would fully enclose all piping and electrical equipment thus creating a long-term noise barrier during regular operation. Therefore, the construction and operation of the PRS at the EI Terminus would not create significant noise and vibration impacts.

4.6.3.2 Lake Conveyance System, Boulder Islands South

The potential impacts resulting from the Boulder Islands South LCS would be similar to those described for the Boulder Islands North LCS is Section 4.6.2.2. Any different or additional impacts are described in the following paragraphs.

Temporary increases in noise levels within the NPS boundaries and near the trailer park and campground at Boulder Beach may be expected. Noise impacts would be moderately loud to LMNRA users that get within 50 ft (15 m) of the construction activities (Table 3.6-1). Mitigation measures discussed in Section 4.6.6 would be implemented to minimize potential noise impacts to LMNRA visitors. All activities would be conducted in accordance with NPS requirements. Long-term operational noise impacts would be minor and not significantly impact LMNRA visitors or residents.

The PRS at Boulder Beach would be located underground. Existing power within the LMNRA at this location would not create the need for an electric generator to operate the PRS. Therefore, operation of the PRS at Boulder Beach would not create significant noise or vibration impacts. Impacts to the LMNRA would be negligible.

4.6.4 Las Vegas Bay Alternative

The following subsections describe the noise and vibration impacts from the Las Vegas Bay Alternative.

4.6.4.1 Effluent Interceptor – Alignment B

Potential noise impacts resulting from construction and operation of EI-Alignment B are presented in Section 4.6.3.1.

4.6.4.2 Lake Conveyance System, Las Vegas Bay

The impacts resulting from the Las Vegas Bay Alternative would be the same as those described for the Boulder Islands North Alternative except for the location of the PRS. The PRS at Las Vegas Bay would create short-term impacts during construction as presented in Section 4.6.3.2. The PRS would be located underground creating a natural sound barrier. Therefore, there would be no significant adverse long-term noise or vibration impacts within the LMNRA from the PRS under the Las Vegas Bay Alternative. Impacts within the LMNRA would be minor.

4.6.5 Process Improvements Alternative

The impacts resulting from the Process Improvements Alternative would be the same as those described for the No Action Alternative.

4.6.6 Mitigation

The following measures would be implemented as standard operating procedures and considered BMPs. The measures include:

- Locating stationary construction equipment as far from nearby noise receptors as possible;
- Shutting off idling equipment;
- Scheduling construction operations to avoid periods of noise annoyance, as determined through consultation with the NPS and Reclamation and defined in special provisions;
- Notifying nearby affected parties in the event extremely noisy work occurs; and
- Installing temporary or portable acoustic barriers around stationary construction noise sources.

The following noise control measures would be implemented to avoid noise disturbances when construction activities come within 600 ft (183 m) of noise-sensitive lands.

- Normally scheduled construction activities would be limited to daytime hours, 6 a.m. to 6 p.m. Night-time or late evening construction would not be allowed. Construction would not begin before noon on Saturdays, Sundays, and recognized legal holidays.
- All construction equipment would be equipped with manufacturer's standard noise control devices (e.g., mufflers, acoustical lagging, and/or engine closure), which would normally achieve compliance with the recommended noise limits. The operator would take special care not to throttle the engine excessively and would keep engine speed as low as possible. Also, the operator would not leave the equipment running or idling needlessly, especially when near noise-sensitive areas.
- Newer equipment would be requested and used, whenever possible. Newer equipment is generally quieter in operation than older models.
- The distance between noisy construction-related activities and noise-sensitive land uses would be maximized. For example, stationary noisy equipment would be located away from construction boundaries that are near noise-sensitive lands.
- Heavy-truck routes would be selected if available to avoid noise-sensitive lands.
- Concrete trucks would perform mixing and other activities that require revving of the truck engine a minimum of 600 ft (183 m) from noise-sensitive lands. Engine revolutions per minute would be kept as low as possible.
- Electric hand-tools would be used instead of gas-powered tools, whenever possible.
- If dewatering pumps and generators are required to operate between the hours of 6 p.m. and 7 a.m. at any city or county location, they would be treated with acoustical noise control measures (e.g. mufflers, shrouding, and/or enclosures) so as not to exceed 56 dBA at 50 ft (15 m).

- Temporary noise barriers may be required to protect against excessive noise levels if construction activities (including contractor staging areas) occur in an area closer than 100 ft (30 m) of noise-sensitive lands. Noise barriers may be made of plywood, heavy vinyl curtain material, natural or temporary earth berms, or stockpiles of construction material, if available. The amount of noise reduction achievable by the use of barriers is dependent mainly on their height. The objective is to attempt to block the line-of-sight between the noise-creating sources and the observer locations on nearby noise sensitive lands. Typically, a barrier would provide 5 to 10 dBA of noise reduction.
- A noise-monitoring plan would help determine specific areas where noise barriers would be used to reduce the noise when construction is expected to continue for several weeks or months near noise-sensitive lands.

4.7 Air Quality

Air pollutant emissions would be generated by implementation of the project alternatives during construction of the various alternative components and, to a much lesser degree, by O&M activities after construction has been completed. Impacts to air quality following construction are not evaluated in this section because O&M activities have the potential for minimal emissions. Therefore, quantifying these emissions would not be practical. Potential air pollutants resulting from construction of the alternatives include CO, NOx, SO_2, VOCs, PM_{10}, $PM_{2.5}$, and hazardous air pollutants (HAPs). Air pollutant emissions arise from combustion of fuels in construction and maintenance equipment, fugitive dust (PM_{10}) emissions from vehicular traffic on paved and unpaved areas, and dust emissions from soil and rock disturbances.

This section describes the regulatory considerations for air quality that must be addressed as part of this EIS. Significance criteria are provided, along with a description of the methodology used for analyzing air quality effects. An analysis of potential air quality impacts is provided for each alternative.

Regulatory Applicability

The water conveyance system does not emit air pollutants under normal operations. As a result, local and federal requirements that regulate air pollution sources do not apply to the operation and construction of the EI and LCS. The *New Source Performance Standards* of 40 CFR Part 60, the *National Emission Standards for Hazardous Air Pollutants* of 40 CFR Parts 61 and 63 apply to specific major air pollution source categories. Local air-permitting requirements of Clark County apply to air emission sources that emit air pollutants as part of their normal operations. The NPS requires that local, state, and federal air quality regulatory requirements be met for projects located within the LMNRA. A project may not gain approval of the NPS if it is likely to result in an impairment of park resources.

The PM_{10} SIP for the Valley includes strict monitoring and regulation of construction activities because construction activities are the largest contributor to PM_{10} emissions. The PM_{10} emissions result from mechanical activities that disturb soil surfaces, wind erosion of those disturbed areas, and tracking of material onto paved surfaces of access roads by vehicles leaving these sites. New regulations, adopted to support the SIP, include the requirement to apply for and obtain a dust

control permit prior to commencing construction that involves soil disturbances. A dust control plan must be prepared as part of the submittal for the dust control permit. The plan identifies the measures that would be implemented during construction to minimize fugitive dust emissions.

Effective July 1, 2005, the EPA determined that the Valley "serious" nonattainment area has attained the NAAQS for CO by the applicable attainment date. This finding relieves the State of Nevada from the obligation under section 187(g) of the CAA to prepare and submit a SIP revision providing for a reduction of CO emissions within the Valley by at least five percent per year in each year after approval of the SIP revision until the CO NAAQS is attained. However, this action does not redesignate this area from "nonattainment" to "attainment". Under section 107(d)(3)(E), the CAA requires that, for an area to be redesignated from nonattainment to attainment, five criteria must be satisfied including the submittal by the State (and approval by EPA) of a maintenance plan as a SIP revision. Therefore, the designation status of Las Vegas Valley in 40 CFR part 81 is unaffected by this action, and the Valley will remain a "serious" nonattainment area for CO until such time as EPA finds that the State of Nevada has met the CAA requirements for redesignation to attainment (70 Federal Register 31353).

Portions of the EI would be constructed in the Las Vegas airshed, which is classified as non-attainment for CO, O_3, and PM_{10}. Federal projects or projects located on federal lands, in non-attainment areas, are subject to the conformity regulations (*Determining Conformity of Federal Actions to State or Federal Implementation Plans,* 40 CFR 93.153). The conformity regulations require that the impacts resulting from implementation of a project be in conformance with the SIP. In general, conformance to the SIP means that the proposed action:

- Is not specifically prohibited in the SIP (such as seasonal open burning prohibitions),
- Does not cause or contribute to new violations,
- Does not aggravate existing violations, or
- Does not delay attainment of air quality standards.

In order to determine if a proposed action is in conformance with a SIP, the potential non-attainment pollutant emissions from direct and indirect sources associated with the project are estimated and compared to major source thresholds. No further analysis is required if the potential emissions are less than the threshold values. Threshold values for the Valley airshed are:

- CO – 100 tons (91 metric tons) per year,
- VOCs (precursor pollutant for O_3) – 100 tons (91 metric tons) per year,
- NOx (precursor pollutant for O_3) – 100 tons (91 metric tons) per year,
- PM_{10} – 70 tons (64 metric tons) per year.

A conformity determination is required if potential emissions associated with a project are above the threshold level. Clark County is a newly designated non-attainment area for O_3, and conformity demonstrations for this pollutant were required as of June 15, 2005, (one year from the effective date of the area's designation). A conformity determination is completed by the federal agency that is sponsoring the project.

For the purposes of this EIS, impacts to air quality are considered significant if:

- Emissions of any non-attainment pollutant exceed conformity thresholds and generate the need for a conformity determination, or
- Emissions are not in conformance with any Clark County SIP (i.e., cause or contribute to a new violation of any ambient air quality standard, aggravate existing violations of any ambient air quality standards, or delay attainment of air quality standards.)

The impairment analysis for air quality used the following criteria.

- *Negligible impacts:* Dust from construction activities can be controlled by mitigation. There is no smell of exhaust and no visible smoke.
- *Minor impacts:* Dust from construction activities is visible for brief periods and only during the work period, but most can be controlled by mitigation. There may be a slight smell of exhaust, and smoke may be visible for brief periods of time.
- *Moderate impacts:* Dust from construction activities is visible for an extended area for an extended period, but is reduced by mitigation. Smoke and exhaust fumes are detectable in high-use areas.
- *Major impacts:* Dust from construction activities is visible for an extended area for an extended amount of time, and mitigation is unable to alleviate the conditions. Smoke and exhaust fumes are easily detectable for extended periods of time in a large area.
- *Impairment:* Air quality is degraded over the long-term to the point that the LMNRA's purpose could not be fulfilled and the visitor experience is negatively affected.

Analysis Methodology

Appendix G provides detailed information about the analysis, which has been summarized in this section. Emissions of criteria pollutants associated with construction activities were estimated for each alternative in terms of fugitive dust emissions and engine exhaust emissions. These emissions were compared to conformity threshold values. Emission factors from Section 13.2.3 of EPA's *AP-42 EPA's Office of Mobile Sources* (EPA 1997, 1998) and *San Joaquin Valley Unified Air Pollution Control District 2000* were used to perform these calculations.

In addition, simple dispersion modeling was conducted to determine whether construction emissions could cause a local exceedance of a NAAQS. The SCREEN3 Model was used to predict criteria pollutant concentrations in the vicinity of the construction areas. The assumptions used for this modeling and supporting tables are provided in Appendix G.

Hazardous air pollutants were not analyzed in detail in this section because there are no ambient air quality standards set for these pollutants. Furthermore, HAPs potentially emitted from construction equipment can also be classified as either VOCs or PM, which are analyzed.

Fugitive Dust Emissions

Fugitive dust emissions (PM_{10}) are generated during construction from disturbance of soils and movement of construction equipment and motor-vehicle traffic on paved and unpaved surfaces. The Clark County DAQEM has classified the potential of different soils in the County to produce fugitive dust emissions when disturbed. Soils in the vicinity of the treatment plants are rated from moderately high to high for their potential to produce fugitive dust emissions.

Fugitive dust emissions from soil disturbances and movement of construction equipment were estimated using the amount of soil to be disturbed, air quality control requirements of Clark County for active construction sites, implementation of mitigation measures required by Clark County, and emission factors based on Section 13.2.3 of AP-42 (EPA 1995a). Fugitive dust emissions are summarized for each segment and detailed assumptions are provided in Appendix G.

Exhaust Emissions

Two methods were used to determine if exhaust emissions would cause or contribute to an exceedance of the NAAQS. First, the annual emissions from construction equipment exhaust were compared to major source-threshold levels. Major source-threshold levels set the value at which exhaust emissions from a stationary source must undergo more in-depth review to determine if exhaust emissions would result in deterioration of the ambient air. In general, if potential emissions are below major source threshold levels the emission source is considered to be minor. Minor sources are presumed not to cause or contribute to an exceedance of the annual NAAQS.

To estimate the magnitude of potential air quality impacts from construction equipment exhausts, worst-case pollutant emissions were quantified following guidance for estimating emissions from land use development projects *(*San Joaquin Valley Unified Air Pollution Control District 2000) and engine emissions standards set by the EPA in 40 CFR Part 89 (oxides of nitrogen, CO, hydrocarbon and PM exhaust emission standards 1999). Appendix G provides detailed information regarding engine emissions, and the assumptions and methods used to calculate these emissions.

Although a variety of construction equipment is needed for construction of the alternatives, not all construction activities occur simultaneously. To determine impacts to air resources, the first step was to identify what 12-month sequence of construction activities resulted in the maximum number of construction equipment used at the various sites, as indicated by the proposed construction schedule and sequencing of construction activities. The *RSMeans Heavy Construction Cost Data* manual (Reed Construction Data 2004) was used to determine the type and size of equipment used for the various construction activities, as well as the daily construction progress. The daily construction progress estimate was used to decide the number of material delivery trucks and haul trucks needed to support the construction activities. This construction could be occurring simultaneously at the various segments of the alternatives. Exhaust emissions from construction equipment were determined in the same manner for all the alternatives, using the same equipment assumptions. Total daily and annual criteria pollutant exhaust emissions from construction activities are provided in Appendix G.

In addition, for all construction activities, a maximum of three diesel-fueled support vehicles and three gasoline-fueled support vehicles are assumed to operate continuously throughout the day. Based on these estimates, the worst-case 12-month construction period exhaust emissions were determined, assuming an 8-hour day, 6 days per week.

To determine if exhaust emissions could cause or contribute to an exceedance of the short-term NAAQS, a simple screen model (EPA 1995b) was executed to determine the maximum 1-hour concentration of each pollutant emitted from each source. Screening models incorporate

assumptions that are overly conservative in order to provide assurance that the maximum concentration of the pollutant would not be under estimated.

The model was executed in order to obtain the hourly concentration of various pollutants at the edge of the construction ROWs, at the edges of staging areas, and at distances of approximately 500, 1,000, and 2,000 ft (152, 305, and 610 m) from the construction sites. Once the 1-hour maximum concentrations were determined for each pollutant, these values were converted into a 3-hour, 8-hour, 24-hour, or annual averaging value in order to compare the impact of the project plus the existing background concentration to their respective NAAQS.

4.7.1 No Action Alternative

Under the No Action Alternative the EI and LCS would not be built. There would be no construction emissions associated with this alternative. No air quality impacts would result.

4.7.2 Boulder Islands North Alternative

This section describes impacts associated with the construction of EI-Alignment A and the LCS for the Boulder Islands North Alternative. There would be no air quality impacts downstream of Hoover Dam.

4.7.2.1 Effluent Interceptor – Alignment A

Air quality impacts associated with construction of EI-Alignment A consist of fugitive dust emissions and engine exhaust emissions. Temporary and localized increases in criteria pollutant concentrations would occur during the construction of EI-Alignment A. Emissions come from the exhaust of construction equipment, fugitive dust emissions from traffic on paved and unpaved areas, and fugitive dust emissions from soil and rock disturbances. These emissions are not continuous and would vary with location, time of day, and type of activity.

4.7.2.1.1 Fugitive Dust Emissions

The fugitive dust emissions shown in Table 4.7-1 represent the amount of dust generated by the various construction activities for EI-Alignment A, but not the amount of dust that remains entrained in the ambient air and travels offsite. These particles are more likely to fall to the ground than to be transported away from the source of emissions (Countess et al. 2001). Backfill material would be obtained from a commercially available source that possesses the appropriate operations and environmental permits including dust permits. Therefore, obtaining the backfill materials would not result in additional fugitive dust in the Valley.

Clark County has developed strict dust control regulations for all construction activities in order to bring the area into attainment with the PM_{10} standards. Implementation of these standards can minimize the formation and transport of fugitive dusts. The *General Standards for Construction*

Table 4.7-1 Fugitive Dust Emissions from Construction Activities (Tons) EI-Alignment A.

Source [1]	Uncontrolled PM_{10} Emissions [2](tons)	PM_{10} Emissions after Controls [3](tons)
Reach 1	12.0	6.0
Reach 2	12.4	6.2
Reach 3	1.6	0.8
COH Forcemain	4.2	2.1
AWT Pipeline	0.1	0.0
CCWRD Connector	0.1	0.1
EI Terminus	0.0	0.00
Total	**30.4**	**15.2**

Notes:

[1] Soil disturbed is from cut-and-cover construction, staging areas, chat trail construction and tunnel retrieval and working shafts.

[2] Fugitive dust emissions reported only for dust with an aerodynamic diameter less than or equal to ≤ 10 µm. Uncontrolled PM_{10} emissions from earth disturbances were calculated using an emission factor of 0.42 tons PM_{10} per acre (i.e. 3,148,917.5 ft^2 ÷ 4,3560 [ft^2 per acre] = 72.3 acres x 0.42 [tons per acre] = 30.36 tons). The value of 0.42 tons PM_{10} per acre comes from the PM_{10} State Implementation Plan (SIP) for Clark County (Clark County 2001).

[3] Controls include those required in the Clark County SIP for construction activities (Clark County 2001). Controlled PM_{10} emissions were calculated using an emission factor of 0.21 tons PM_{10} per acre.

Activity (Section 94.5) require that visible fugitive dust emissions generated from construction activity do not exceed 20 percent opacity. Dust plumes that extend more than 100 yards (91 m) horizontally or vertically from the emission source at a construction site is prohibited.

Compliance with the General Standards for Construction Activity (Clark County requirements) would limit the potential air quality impacts on nearby properties. Assuming that regulatory obligations are met, impacts to air quality from fugitive dust emissions would be minor.

4.7.2.1.2 Exhaust Emissions

The PM_{10} emissions from construction equipment exhaust are combined with fugitive dust emissions from soil disturbances to obtain the total dust emissions from construction activities. As shown in Table 4.7-2, potential emissions of CO, $PM_{10,}$ and SO_2 are below their respective major source-threshold levels. Therefore, exhaust emissions of these pollutants from construction activities are not likely to cause or contribute to an exceedance of the ambient air quality standards.

Emissions of NO_x, however are above the management area major source threshold (50 tons/year), but not above the major source threshold (100 tons/year) for conformity purposes.

Worst-case concentrations do not exceed the most stringent federal, state, or local standards for CO and SO_2 for all scenarios. This is expected, because the annual mass emission of these compounds was below the major source threshold. Emissions that are below major source

Table 4.7-2 Total Construction Emissions Compared to Major Source Thresholds EI-Alignment A.

Pollutant	Construction Emissions (tons/year)	Valley Airshed Major Source Threshold (tons/year)	Conformity Major Source Threshold (tons/year)
CO	21.4	70	100
NO_x + VOC	57.9	50	100
PM_{10}	2.3	70	70
SO_2	1.0.	100	100

threshold levels are presumed not to cause or contribute to a violation of the NAAQS. Since PM_{10} emissions are well below major source threshold levels, these emissions are assumed not to cause or contribute to existing violations.

Predicted emissions of NO_x + hydrocarbons (HC) are above the ambient air quality standard for NO_2 at the edge of the construction corridor. The estimate of an annual concentration based on the 1-hour maximum is overly conservative as it is based on continuous emissions occurring 24 hours per day, 365 days per year. Nitrogen oxides emitted from construction equipment are reactive gases, which are likely to undergo chemical reactions as they disperse in the atmosphere. The SCREEN3 model used for this initial impact assessment does not account for removal of components due to atmospheric reactions. At a distance of 2,000 ft (610 m) from the source, concentrations of NO_x + HC are predicted to be less than the NAAQS.

The largest influence on the pollutant concentrations comes from the large number of trucks used to transport materials to and from the construction sites. These units account for over 50 percent of the total emissions, but are unlikely to be operating continuously at the site. Further, Clark County air quality regulations prohibit idling the engine of a diesel-fueled vehicle for more than 15 consecutive minutes unless the engine must be at idle to perform a specific task such as hoisting or trenching.

Given the conservative nature of the SCREEN3 model and the assumptions used in executing the model, the impacts from operation of the construction equipment are unlikely to cause or contribute to an exceedance of the 1-hour, 3-hour or 8-hour NAAQS. Localized concentrations of CO may be elevated due to the density of vehicles at staging areas and the low vehicle speeds.

Short-term impacts to air quality resources are anticipated as a result of construction equipment exhaust emissions. There would be a temporary, but detectable change in ambient air pollutant concentrations. However, the change is not expected to cause or contribute to an exceedance of the NAAQS, does not produce objectionable odors, or exceed recommended exposure standards. The impact would be temporary and occur only during construction activities. The project must comply with Clark County requirements regarding dust control and other measures designed to reduce pollutant emissions during construction. Compliance with existing regulatory requirements would minimize adverse air quality impacts from construction activities. Therefore, impacts to air quality would be insignificant and minor.

4.7.2.2 Lake Conveyance System, Boulder Islands North

Air quality impacts associated with construction of the Boulder Islands North LCS were analyzed using the same approach as was used for EI-Alignment A.

4.7.2.2.1 Fugitive Dust Emissions

Soils in the LMNRA and public lands adjacent to the LMNRA are classified as having a slight to low potential to produce fugitive dust emissions as shown in Table 4.7-3.

Compliance with Clark County requirements would limit the potential air quality impacts on nearby properties. Assuming that regulatory obligations are met, impacts to air quality from fugitive dust emissions would be minor.

4.7.2.2.2 Exhaust Emissions

Exhaust emissions from construction equipment were determined in the same manner as in Section 4.7.2.1, using the same equipment assumptions. Table 4.7-4 shows the potential emissions of CO, $PM_{10,}$ and SO_2 and the major source-threshold levels. Total daily and annual criteria pollutant exhaust emissions from construction activities are provided in Appendix G.

Short-term impacts to air quality resources are anticipated as a result of construction equipment exhaust emissions. The maximum annual emissions of CO, SO_2, and PM_{10} emitted from construction activities are below their respective major source-threshold levels. As shown previously, if potential emissions are below major source-threshold levels, the emission source is presumed not to cause or contribute to an exceedance of the annual NAAQS.

Because NO_x are projected to be above the major source threshold, the SCREEN3 model was used to estimate concentrations at the edge of the staging area and at a distance of 2,000 ft (610 m). The results of the SCREEN3 mode indicate that project impacts and background concentrations could potentially exceed the NAAQS. The SCREEN3 model is conservative because emissions are assumed to be continuous and the annual average concentration is based on emissions occurring 24 hours a day, 365 days per year.

New diesel-engine emission standards have been promulgated for calendar year 2007 models and retrofit technologies are available for existing diesel engines. Predicted concentrations of NO_x at a distance of 2,000 ft (610 m) from the source if these engines or retrofit engines were used during the construction phase are also provided in Appendix G. The use of engines that meet the newer emission standard would result in a predicted impact plus background concentration that is less than the NAAQS.

Short-term impacts to air quality resources are anticipated as a result of construction equipment exhaust emissions under the Boulder Islands North Alternative. Impacts are classified as minor because there would be a temporary, but detectable change in ambient air pollutant concentrations. No impairment would occur to air quality within the LMNRA.

Table 4.7-3 Fugitive Dust Emissions from Construction Activities (Tons)
Boulder Islands North LCS.

Source [1]	Uncontrolled PM_{10} Emissions [2] (tons)	PM_{10} Emissions after Controls [3] (tons)
NRMT3-West Tunnel	4.3	2.2
NRMT3-East Tunnel	4.3	2.2
BINDP	3.5	3.5
HPRS	0.4	0.4
Total	**12.5**	**8.3**

Notes:

[1] Soil disturbed is from cut-and-cover construction, staging areas, chat trail construction and tunnel retrieval and working shafts.

[2] Fugitive dust emissions reported only for dust with an aerodynamic diameter less than or equal to ≤ 10 µm. Uncontrolled PM_{10} emissions from earth disturbances were calculated using an emission factor of 0.42 tons PM_{10} per acre (i.e. 3,148,917.5 ft^2 ÷ 4,3560 [ft^2 per acre] = 72.3 acres x 0.42 [tons per acre] = 30.36 tons). The value of 0.42 tons PM_{10} per acre comes from the PM_{10} State Implementation Plan (SIP) for Clark County (Clark County 2001).

[3] Controls include those required in the Clark County SIP for construction activities (Clark County 2001). Controlled PM_{10} emissions were calculated using an emission factor of 0.21 tons PM_{10} per acre.

Table 4.7-4 Total Construction Emissions Compared to Major Source Thresholds
Boulder Islands North LCS.

Pollutant	Construction Emissions (tons/year)	Valley Airshed Major Source Threshold (tons/year)	Conformity Major Source Threshold (tons/year)
CO	32.1	70	100
NO_x + VOC	119.8	50	100
PM_{10}	4.6	70	70
SO_2	1.3	100	100

Because emissions from construction activities do not occur 24 hours per day, the concentrations estimated by the SCREEN3 model are overly conservative. It is not likely that the project would cause or contribute to an exceedance of the NAAQS. Therefore, no impairment would occur.

In addition, the use of diesel engines that meet calendar year 2007 emission standards would decrease nitrogen-oxide emissions below major source-threshold levels.

4.7.3 Boulder Islands South Alternative

This section describes impacts associated with the construction of the EI and LCS for the Boulder Islands South Alternative. There would be no air quality impacts downstream of Hoover Dam.

4.7.3.1 Effluent Interceptor – Alignment B

Air quality impacts associated with construction of EI-Alignment B consist of fugitive dust emissions and engine exhaust emissions. Temporary and localized increases in criteria pollutant concentrations would occur during the construction of EI-Alignment B. Fugitive dust emissions come from the exhaust of construction equipment, traffic on paved and unpaved areas, and soil and rock disturbances. Fugitive dust emissions are not continuous and would vary with location, time of day, and type of activity. Backfill material would be obtained from a commercially available source that possesses the appropriate operations and environmental permits including dust permits. Therefore, obtaining the backfill materials would not result in additional fugitive dust in the Valley.

4.7.3.1.1 Fugitive Dust Emissions

Compliance with the Clark County dust control requirements would limit the potential air quality impacts on nearby properties. Assuming that regulatory obligations are met, impacts to air quality from fugitive dust emissions would be minor. The fugitive dust emissions expected to be generated from this site are listed in Table 4.7-5.

4.7.3.1.2 Exhaust Emissions

Table 4.7-6 shows the potential emissions of CO, NOx and VOC's, $PM_{10,}$ and SO_2 from EI-Alignment B and the major source-threshold levels. The emissions would be below their respective major source-threshold levels. Therefore, emissions of these pollutants from construction activities are not likely to cause or contribute to an exceedance of the ambient air quality standards. Emissions of NO_x , however are above the management area major source threshold (50 tons/year), but not above the major source threshold (100 tons/year) for conformity purposes.

Short-term impacts to air quality resources are anticipated as a result of construction equipment exhaust emissions. There would be a temporary, but detectable change in ambient air pollutant concentrations. However, the change is not expected to cause or contribute to an exceedance of the NAAQS, does not produce objectionable odors, or exceed recommended exposure standards. The impact would be temporary and would occur only during construction activities. The project must comply with Clark County requirements regarding dust control and other measures designed to reduce pollutant emissions during construction. Compliance with existing regulatory requirements would minimize adverse air quality impacts from construction activities. Therefore, impacts to air quality would be insignificant and minor.

4.7.3.2 Lake Conveyance System, Boulder Islands South

Air quality impacts associated with construction of the Boulder Islands South LCS were analyzed using the same approach as was used for EI-Alignment B.

Table 4.7-5 Fugitive Dust Emissions from Construction Activities (Tons)
EI-Alignment B.

Source [1]	Uncontrolled PM_{10} Emissions [2] (tons)	PM_{10} Emissions after Controls [3] (tons)
Reach 1	12.0	6.0
Reach 2	12.7	6.3
Reach 3	1.6	0.8
South lateral	7.1	3.5
AWT Pipeline	0.1	0.0
CCWRD Conn.	0.1	0.0
EI Terminus	3.6	1.8
Total	**37.2**	**18.6**

Notes:

[1] Soil disturbed is from cut-and-cover construction, staging areas, chat trail construction and tunnel retrieval and working shafts.

[2] Fugitive dust emissions reported only for dust with an aerodynamic diameter less than or equal to ≤ 10 µm. Uncontrolled PM_{10} emissions from earth disturbances were calculated using an emission factor of 0.42 tons PM_{10} per acre (i.e. 3,148,917.5 ft^2 ÷ 4,3560 [ft^2 per acre] = 72.3 acres x 0.42 [tons per acre] = 30.36 tons). The value of 0.42 tons PM_{10} per acre comes from the PM_{10} State Implementation Plan (SIP) for Clark County (Clark County 2001).

[3] Controls include those required in the Clark County SIP for construction activities (Clark County 2001). Controlled PM_{10} emissions were calculated using an emission factor of 0.21 tons PM_{10} per acre.

Table 4.7-6 Total Construction Emissions Compared to Major Source Thresholds
EI - Alignment B

Pollutant	Construction Emissions (tons/year)	Valley Airshed Major Source Threshold (tons/year)	Conformity Major Source Threshold (tons/year)
CO	27.54	70	100
NO_x + VOC	72.38	50	100
PM_{10}	2.91	70	70
SO_2	1.29	100	100

4.7.3.2.1 Fugitive Dust Emissions

Soils in the LMNRA and public lands adjacent to the LMNRA are classified as having a slight to low potential to produce fugitive dust emissions for the Boulder Islands South LCS as shown in Table 4.7-7.

Compliance with Clark County requirements would limit the potential air quality impacts on nearby properties. Assuming that regulatory obligations are met, impacts to air quality from fugitive dust emissions would be minor.

Table 4.7-7 Fugitive Dust Emissions from Construction Activities (Tons)
Boulder Islands South LCS.

Source [1]	Uncontrolled PM_{10} Emissions [2] (tons)	PM_{10} Emissions after Controls [3] (tons)
SRMT3-West Tunnel	4.3	2.2
SRMT3-East Tunnel	4.3	2.2
BISOP	4.2	2.1
BISDP	1.2	1.2
Total	**14.0**	**7.7**

Notes:

[1] Soil disturbed is from cut-and-cover construction, staging areas, chat trail construction and tunnel retrieval and working shafts.

[2] Fugitive dust emissions reported only for dust with an aerodynamic diameter less than or equal to ≤ 10 µm. Uncontrolled PM_{10} emissions from earth disturbances were calculated using an emission factor of 0.42 tons PM_{10} per acre (i.e. 3,148,917.5 $ft^2 \div$ 4,3560 [ft^2 per acre] = 72.3 acres x 0.42 [tons per acre] = 30.36 tons). The value of 0.42 tons PM_{10} per acre comes from the PM_{10} State Implementation Plan (SIP) for Clark County (Clark County 2001).

[3] Controls include those required in the Clark County SIP for construction activities (Clark County 2001). Controlled PM_{10} emissions were calculated using an emission factor of 0.21 tons PM_{10} per acre.

4.7.3.2.2 Exhaust Emissions

Short-term impacts to air quality resources are anticipated as a result of construction equipment exhaust emissions. Table 4.7-8 shows the potential emissions of CO, $PM_{10,}$ and SO_2 from the Boulder Islands South LCS and the major source-threshold levels. The emissions would be below their respective major source-threshold levels. As shown previously, if potential emissions are below major source-threshold levels the emission source is presumed not to cause or contribute to an exceedance of the annual NAAQS.

Short-term impacts to air quality resources are anticipated as a result of construction equipment exhaust emissions, under the Boulder Islands South Alternative. Impacts are classified as minor

Table 4.7-8 Total Construction Emissions Compared to Major Source Thresholds
Boulder Islands South LCS.

Pollutant	Construction Emissions (tons/year)	Las Vegas Valley Airshed Major Source Threshold (tons/year)	Conformity Major Source Threshold (tons/year)
CO	35.6	70	100
NO_x + VOC	135.2	50	100
PM_{10}	5.2	70	70
SO_2	1.4	100	100

because there would be a temporary, but detectable, change in ambient air pollutant concentrations. No impairment would occur to air quality within the LMNRA.

Because emissions from construction activities do not occur 24 hours per day, the concentrations estimated by the SCREEN3 model are overly conservative. It is not likely that the project would cause or contribute to an exceedance of the NAAQS. Therefore, no impairment would occur.

In addition, the use of diesel engines that meet calendar year 2007 emission standards would decrease nitrogen-oxide emissions below major source-threshold levels.

4.7.4 Las Vegas Bay Alternative

This section describes impacts associated with construction and operation of the EI portion of the proposed project and the Las Vegas Bay LCS. There would be no air quality impacts downstream of Hoover Dam.

4.7.4.1 Effluent Interceptor – Alignment B

Direct and indirect impacts from EI-Alignment B would be the same as described in Section 4.7.3.1.

4.7.4.2 Lake Conveyance System, Las Vegas Bay

The same methodology used for the Boulder Islands North Alternative was used to calculate air quality impacts for the Las Vegas Bay Alternative.

4.7.4.2.1 Fugitive Dust Emissions

Fugitive dust emissions are generated during construction from movement of construction equipment and motor vehicle traffic on paved and unpaved surfaces. Soils in the LMNRA and public lands adjacent to the LMNRA are classified as having a slight to low potential to produce dust emissions. Fugitive dust emissions for the Las Vegas Bay LCS are provided on Table 4.7-9.

Table 4.7-9 Fugitive Dust Emissions from Construction Activities (Tons)
Las Vegas Bay LCS.

Source	Uncontrolled PM_{10} Emissions [1] (tons)	PM_{10} Emissions after Controls [2] (tons)
LVBT1	4.3	2.2
LVBT2	4.4	2.2
Las Vegas Bay Diffuser	3.5	1.7
Total	**12.2**	**6.1**

Notes:
[1] Fugitive dust emissions reported only for dust with an aerodynamic diameter less than or equal to ≤ 10 µm.
[2] Implementation of controls required in the Clark County SIP for construction activities.

Compliance with Clark County requirements would limit the potential air quality impacts on nearby properties. Assuming that regulatory obligations are met, impacts to air quality from fugitive dust emissions would be insignificant and minor.

4.7.4.2.2 Exhaust Emissions

Short-term impacts to air quality resources are anticipated as a result of construction equipment exhaust emissions. Table 4.7-10 shows the potential emissions of CO, NOx and VOC's, PM_{10}, and SO_2 and the major source-threshold levels. The impacts would be minor. Therefore, impairment would not occur.

Short-term impacts to air quality resources are anticipated as a result of construction equipment exhaust emissions under the Las Vegas Bay Alternative. Impacts are classified as minor because there would be a temporary, but detectable change in ambient air pollutant concentrations. Impairment to LMNRA resources would not occur.

In addition, emissions of NO_x can be decreased to levels that are below major source thresholds by using diesel engines that meet calendar year 2007 emission standards.

Table 4.7-10 Total Construction Emissions Compared to Major Source Thresholds Las Vegas Bay LCS.

Pollutant	Construction Emissions (tons/year)	Valley Airshed Major Source Threshold (tons/year)	Conformity Major Source Threshold (tons/year)
CO	23.3	70	100
NO_x + VOC	89.3	50	100
PM_{10}	3.4	70	70
SO_2	0.9	100	100

4.7.5 Process Improvements Alternative

Under the Process Improvements Alternative the pipeline would not be built. Facilities would be upgraded to handle future volumes, and to implement the best available technologies. There would be temporary impacts associated with construction of the facilities (i.e. emissions and fugitive dust). Air quality impacts associated with construction would be temporary and minimal.

4.7.6 Mitigation

This project is subject to Clark County air quality regulations, which require a number of specific actions by construction contractors, to reduce emissions of criteria pollutants during construction. The EPA has established new air quality standards for diesel engines for the year 2007. The 2007 diesel engines will reduce PM by 90 percent, and reduce sulfur to 15 ppm, which will reduce NOx by 50 percent (EPA 2004c). The use of engines that meet the newer emission standard

would result in a predicted impact from this project plus background concentration that is less than the NAAQS.

Compliance with these measures will substantially limit the magnitude of potential air quality impacts associated with the three action alternatives. Additional measures that can be incorporated into the required dust control plan would include:

- Using wind breaks,
- Regulating vehicle speeds, and
- Reducing vehicle volume by providing perimeter parking and shuttle service to the construction areas.

4.8 Earth Resources

This section describes the potential environmental impacts involving earth resources that may result from implementation of the alternatives. Impacts to earth resources are presented for the No Action Alternative and each action alternative. Mitigation measures are provided for any significant impacts.

As stated at the beginning of this chapter, NPS Management Policies are applicable to this project. Thus, this section includes an analysis to determine whether the alternatives would impair resources within the LMNRA.

An impact would be considered significant if it would:

- Expose people or property to hazards involving seismic events, landslides, or subsidence;
- Result in substantial soil erosion or loss of topsoil;
- Substantially alter the topography or ground surface relief beyond that resulting from natural erosion and deposition;
- Be located on expansive soils, creating a risk to people or property;
- Result in the loss of availability of a known mineral resource; or
- Conflict with mining claims or patents.

The impairment analysis for earth resources used the following criteria.

- *Negligible impacts:* Impacts have no measurable or perceptible changes in soil structure and occur in a relatively small area.
- *Minor impacts:* Impacts are measurable or perceptible, but localized in a relatively small area. The overall soil structure would not be affected.
- *Moderate impacts:* Impacts would be localized and small in size, but would cause a permanent change in the soil structure in that particular area.
- *Major impacts:* Impact to the soil structure would be substantial, highly noticeable, and permanent.
- *Impairment:* For this analysis, impairment is considered a permanent change in a large portion of the overall acreage of the park, affecting the resource to the point that the park's purpose

could not be fulfilled and the resource would be degraded precluding the enjoyment of future generations. The impact would contribute substantially to the deterioration of the park's soils.

4.8.1 No Action Alternative

New construction under this alternative would occur on property owned by the CLV, Clark County, or COH. Therefore, mineral resources would not be impacted in the vicinity of the EI and the LCS alignment. The treatment facilities are not located on lands that experience geologic hazards or expansive soils.

4.8.2 Boulder Islands North Alternative

This discussion of environmental impacts associated with the Boulder Islands North Alternative is divided into two parts. The first section addresses impacts associated with construction and operation of EI-Alignment A. The remainder of the section addresses impacts associated with construction and operation of the Boulder Islands North LCS.

4.8.2.1 Effluent Interceptor – Alignment A

The construction activities associated with EI-Alignment A would not have an affect on subsidence or landslide potential. The EI facilities would not significantly affect groundwater levels in the area or induce overdraft conditions that could lead to land subsidence. Potential impacts to groundwater are presented in Section 4.1. Effluent Interceptor – Alignment A would not be subject to potential damage from a landslide because it would be predominantly below ground. In addition, the facilities would not create or exacerbate conditions that could induce a landslide during construction, because the facilities would not be constructed in areas with steep slopes that could be subject to landslide activity.

The project area may experience low to moderate levels of seismic activity due to the presence of several faults. Current design practices, as defined in the Uniform Building Code for this seismic area, would be required. The EI and ancillary facilities would be designed such that each wastewater facility has the capability to redirect up to 100 percent of their effluent flows directly into the Las Vegas Wash. Thus, in the event of a seismic event resulting in a pipeline rupture, effluent flows can be discharged via alternate means.

Generally, the soils in the areas that would be affected by the EI facilities have low to moderate potential for water erosion and moderate to high potential for wind erosion. Disturbances to these soils during construction would create the potential for inducing soil erosion from storm runoff and wind. These impacts would be reduced substantially through implementation of BMPs that would be required as part of compliance with local dust control ordinances, Clark County air quality permit requirements, and stormwater pollution prevention plans.

The topography and natural ground surface would be restored to its preconstruction condition following installation of the pipeline. Therefore, no impacts to topography would occur.

There are few areas of expansive soils in the project study area. The EI would primarily be constructed in areas with low shrink-swell potential. The one area in the vicinity of the EI, near the EI Terminus, that contains soils with moderate shrink-swell potential would be tunneled under to avoid placement of the pipeline in that soil layer. For these reasons, no impacts relating to expansive soils are anticipated.

The primary mineral resources along EI-Alignment A are sand and gravel. Sand and gravel resources are abundant throughout Nevada, and the resources that may be located along EI-Alignment A are not unique. The two gravel pits within the Wetlands Park would not be impacted by construction or operation of EI-Alignment A. Soils used for backfill are abundant throughout Nevada and would be obtained from local sand and gravel operations.

Mineral resources and mining activities are present in the project study area, but the EI facilities would not significantly affect these resources or the potential for the resources to be mined in the future. There are no active mining claims filed under the Mining Act of 1872 listed in the DOI's land status database. Therefore, mining claims would not be affected by the EI and ancillary facilities.

The project area is classified as having a moderate potential for development of oil and gas (BLM 1998). However, there are no active oil and gas leases on federal lands in the project area listed in the DOI's land status database. No impact to these resources is anticipated as a result of the proposed alternative.

Construction of the project components would have short-term environmental effects that are not considered significant. Short-term uses of the environment, in this case, earth resources, would not affect the maintenance and enhancement of long-term productivity. The project would not significantly affect the availability of mineral resources in the area because of the relatively small area that would be affected.

There would be no impacts to earth resources downstream of Hoover Dam.

4.8.2.2 Lake Conveyance System, Boulder Islands North

Impacts to earth resources from the Boulder Islands North LCS would be similar to impacts from the EI. Due to the size of the LMNRA, and the large amount of protected geologic resources and desert soils, no impairment to soils or geologic resources would occur from this alternative.

4.8.3 Boulder Islands South Alternative

This discussion of environmental impacts associated with the Boulder Islands South Alternative is divided into two parts. The first section addresses impacts associated with construction and operation of EI-Alignment B. The remainder of the section addresses impacts associated with construction and operation of the Boulder Islands South LCS.

4.8.3.1 Effluent Interceptor – Alignment B

Potential impacts to earth resources resulting from the construction and operation of EI-Alignment B would be the same as described for EI-Alignment A in Section 4.8.2.1.

4.8.3.2 Lake Conveyance System, Boulder Islands South

Impacts to earth resources from the Boulder Islands South LCS would be similar to impacts from the EI. Due to the size of the LMNRA, and the large amount of protected geologic resources and desert soils, no impairment to soils or geologic resources would occur from this alternative.

4.8.4 Las Vegas Bay Alternative

The impacts resulting from the construction and operation of the Las Vegas Bay Alternative would be similar to those described for EI-Alignment B and Boulder Islands South LCS (Section 4.8.3). Therefore, this alternative would not have significant impacts to earth resources. Impacts to earth resources within the LMNRA would be negligible. Therefore, no impairment would occur.

4.8.5 Process Improvements Alternative

The impacts to earth resources under the Process Improvements Alternative would be the same as those described for the No Action Alternative.

4.8.6 Mitigation

No significant impacts to earth resources would occur. Restoration of the project site would be completed in accordance with a project-specific Reclamation- or NPS-approved restoration plan. The restoration plan will address salvage of topsoil for reseeding purposes, recontouring the natural land surface, blending colors and textures, treating weeds, and revegetating the disturbed areas.

4.9 Land Use

Community development land-use plans and the LMNRA Management Plan were reviewed to determine impacts and compatible uses. For purposes of this EIS an impact to land use would be considered significant if the action were to:

- Substantially conflict with land use plans and community goals,
- Substantially conflict with currently established uses of the area,
- Disrupt or divide the physical arrangement of an established community,
- Substantially conflict with existing utilities and public ROWs,
- Substantially conflict with mining claims or patents, or
- Create a long-term loss of access to public facilities, businesses, or residences.

4.9.1 No Action Alternative

Under the No Action Alternative, the SCOP pipeline would not be constructed. Treatment facility improvements would occur on lands owned by the CLV, COH, and Clark County. There would not be any changes to existing land use or land-use plans. There would be no conflicts with land-use plans, community goals, established uses, existing utilities or public ROWs, mining claims or patents, or access to public facilities or private businesses. This alternative would not cause a disruption or division of the physical arrangement of an established community. Therefore, no impacts to land use would occur.

There would be no impacts to land use downstream of Hoover Dam.

4.9.2 Boulder Islands North Alternative

Overall, the potential impacts to land use that may result from the construction and operation of the Boulder Islands North Alternative would be short-term and limited to the immediate construction areas. Additional information regarding the temporary impacts are presented in this section.

There would be no impacts to land use downstream of Hoover Dam.

4.9.2.1 Effluent Interceptor – Alignment A

Reach 1 of EI-Alignment A would be located on land owned by the CLV and within the CCRFCD's easement along the Las Vegas Wash. This area has been designated as Business Park/Industrial Land Use in the *Sunrise Manor Land Use Plan*. The proposed EI would be compatible with existing land use and land-use plan goals for Sunrise Manor (Clark County 1999).

Reaches 1, 2, and 3 of EI-Alignment A are located within the area addressed by the *Whitney Land Use Plan*. The land use in these areas has been designated as parks/public facilities (Clark County 2000b). The proposed EI alignment through these areas would not conflict with existing or planned land uses.

Portions of Reaches 2, 3, and the COH Forcemain would traverse the Wetlands Park. Access to the EI construction area within the Wetlands Park would be temporarily restricted during construction activities.

The land use adjacent to the proposed EI Terminus site is dominated by open space and recreational-use areas within the Wetlands Park. The land at the EI Terminus site for EI-Alignment B would contain a working shaft for the EI mainline tunnel and NRMT3 during construction. After construction, there would be an at-grade access shaft to the tunnels. No other facilities would be located at the EI Terminus site. Therefore, the land use would remain as open space except for the small area containing the access shaft manhole. Current use of the site is minimal and the minimal change in land use would not conflict with existing land-use plans. In addition, construction and operation of the EI Terminus working shaft would not impact the recreational uses of lands within the Wetlands Park. Therefore, no significant impacts on land

use would occur. Short-term impacts that would occur during construction activities include a reduction in the land dominated by open space, and restrictions on land use for recreational purposes within the construction zone.

The pipeline would cross several underground utilities including water, gas, and sewer main lines (Figure 3.9-1). The proposed pipeline would be installed beneath these utilities using tunneling construction techniques as described in Section 2.2.1.6. The location of utility lines would be identified prior to construction of the EI to prevent damage to the lines. Adverse impacts to existing utilities in the vicinity of the EI are not expected to occur.

Temporary construction easements and permanent ROWs would be required along the EI alignment and at the EI Terminus site. The staging area locations were selected based on existing land use and would be within the temporary construction easements. These easements and ROWs would not conflict with existing or planned land uses.

Lands traversed by the proposed EI-Alignment A and the EI Terminus site are not available for appropriation and there are no active mining claims in those areas (Kennedy Jenks et al. 2003). Therefore, mining claims would not be impacted.

4.9.2.2 Lake Conveyance System, Boulder Islands North

The Boulder Islands North LCS tunnel from the EI Terminus to the NRMT3-East working retrieval shaft would be entirely underground. Therefore, community land-use plans, goals, and established land uses would not be affected.

The Boulder Islands North LCS would not cross any existing mining claims.

The proposed NRMT3 would be constructed under Lake Mead Parkway and Lakeshore Drive. Public access would not be diverted away from the LMNRA during construction or operation of the LCS. However, temporary detours or delays may be experienced by LMNRA visitors. Additional information regarding impacts to traffic is presented in Section 4.13.

Temporary fencing around the construction area at the LMNRA would be installed for public safety. However, construction activities would occur during low-use periods, thus minimizing access conflicts.

Water activities in the vicinity of the Lake Mead Resort Marina and Boulder Islands would be restricted during construction of the pipeline and diffuser. However, construction activities would occur during the winter months, thus minimizing access conflicts. Additional actions that will be taken to minimize the impacts are described in Section 4.9.6.

4.9.3 Boulder Islands South Alternative

Overall, the potential impacts to land use that may result from the construction and operation of the Boulder Islands South Alternative would be short-term and limited to the immediate construction areas. Additional information regarding the temporary impacts are presented in this section.

There would be no impacts to land use downstream of Hoover Dam.

4.9.3.1 Effluent Interceptor – Alignment B

Potential impact to land use resulting from the construction and operation of EI-Alignment B would be basically the same as described for EI-Alignment A in Section 4.9.2.1. Any different or additional impacts are described in the following paragraphs.

Portions of Reaches 2, 3, and the South Lateral Pipeline would traverse the Wetlands Park. Access to the EI construction area within the Wetlands Park would be temporarily restricted during construction activities. Following installation of the pipeline, chat trails would be constructed on the segments of the EI alignment that are located within the Wetlands Park. The trails are compatible with planned uses described in the *Wetlands Park Master Plan*.

The land use adjacent to the proposed EI Terminus site is dominated by open space and recreational-use areas within the Wetlands Park. The land use on the proposed 40-acre (16 hectares) EI Terminus site would change from open space to public facilities with utility crossings. Current use of the site is minimal and the change in land use would not conflict with existing land use plans. In addition, construction and operation of the EI Terminus facility would not impact the recreational uses of lands within the Wetlands Park. Therefore, no significant impacts on land use would occur. Short-term impacts that would occur during construction activities include a reduction in the land dominated by open space, and restrictions on land use for recreational purposes within the construction zone.

4.9.3.2 Lake Conveyance System, Boulder Islands South

Potential impacts to land use resulting from the Boulder Islands South LCS would be the same as described for the Boulder Islands North LCS in Section 4.9.2.2 with the addition of the following potential impacts.

The Boulder Islands South LCS would not cross any existing mining claims.

Boulder Beach is one of the most heavily visited areas of the LMNRA and supports a wide range of recreational uses as discussed in Section 3.4. However, public access to portions of Boulder Beach may be impacted during construction. Temporary fencing around the construction area would be installed for public safety. Construction activities would occur during low-use periods, thus minimizing access conflicts.

Impacts to land use in the Boulder Beach area would be temporary and insignificant.

4.9.4 Las Vegas Bay Alternative

Overall, the potential impacts to land use that may result from the construction and operation of the Las Vegas Bay Alternative would be short-term and limited to the immediate construction areas.

There would be no impacts to land use downstream of Hoover Dam.

4.9.4.1 Effluent Interceptor – Alignment B

Impacts that may result from the construction and operation of EI-Alignment B are described in Section 4.9.3.1.

4.9.4.2 Lake Conveyance System, Las Vegas Bay

The potential impacts to land use resulting from the construction and operation of the Las Vegas Bay Alternative would generally be the same as those described for the Boulder Islands North Alternative in Section 4.9.2.2.

Water activities in the vicinity of the Las Vegas Bay Diffuser would be restricted during construction of the pipeline and diffuser. However, construction activities would occur during the winter months, thus minimizing access conflicts.

There are no designated specific use activities for the Las Vegas Bay (NPS 2004b). Therefore, there would be no impacts to designated land use under the Las Vegas Bay Alternative.

4.9.5 Process Improvements Alternative

The impacts to land use under the Process Improvements Alternative would be the same as those described for the No Action Alternative.

4.9.6 Mitigation

Water activities in the vicinity of the Lake Mead Resort Marina and Boulder Islands would be restricted during construction of the pipeline and diffuser. To minimize the impacts to Marina and Lake users, Notices to Mariners will be published and posted prior to construction activities. Aids to Navigation for Inland Waterways will be implemented, and a minimum-width construction corridor will be used to ensure that at least one-way boat traffic is maintained throughout the construction period.

4.10 Visual Resources

The NPS and Reclamation do not have any formalized guidance procedures for assessing visual resources. However, the *National Park Service Organic Act of 1916* (16 USC 1) directs the NPS "to conserve the scenery and the natural and historic objects and the wildlife therein and to provide for the enjoyment of the same in such a manner as will leave them unimpaired for the enjoyment of future generations."

The BLM *VRM Guidelines* (BLM 1986a) and the BLM *Manual Handbook - Visual Resource Contrast Rating* (BLM 1986b) were used to analyze impacts associated with implementation of the proposed alternatives. The methodology used to analyze the potential impacts to visual resources is described in Appendix H.

The visual resource classes that have been assigned to the various areas within the project vicinity are Class II, Class III, and Class IV. Inventory classes provide the basis for considering visual values and are informational in nature (BLM 1986a).

- *Class II:* The objective of Class II is to retain the existing character of the landscape. The level of change to the characteristic landscape should be low. Management activities may be seen, but should not attract the attention of the casual observer. Any changes must repeat the basic element of form, line, color, and texture found in the predominant natural features of the characteristic landscape.
- *Class III:* The objective of Class III is to partially retain the existing character of the landscape. The level of change to the characteristic landscape can be moderate. Management activities may attract attention, but should not dominate the view of the casual observer. As in Class II, changes should repeat the basic elements found in the predominant natural features of the characteristic landscape.
- *Class IV:* The objective of Class IV is to provide management activities that require major modifications of the existing character of the landscape. The level of change to the characteristic landscape can be high. These management activities may dominate the view and be the major focus of viewer attention. However, every attempt should be made to minimize the impact of these activities through careful location, minimal disturbance, and repeating the basic elements.

For purposes of this EIS, impacts to visual resources would be significant if the action being considered would:

- Cause inconsistencies related to the management objectives of the associated applicable VRM class;
- Result in a strong degree of contrast;
- Substantially change the overall visual character of the project region; or
- Substantially alter the view from a scenic point, vista, corridor, or other sensitive area.

The impairment analysis for visual resources used the following criteria.

- *Negligible impacts:* The impact is at the lower level of detection; there would be no measurable change.
- *Minor impacts:* The impact is slight but detectable; there would be a small change.
- *Moderate impacts:* The impact is readily apparent; there would be a measurable change that could result in a small but permanent change.
- *Major impacts:* The impact is severe; there would be a highly noticeable, permanent measurable change.

4.10.1 No Action Alternative

Under the No Action Alternative, the SCOP pipeline would not be constructed. Additional facilities would be constructed at each treatment plant. However, the facilities would be located on land already being used for treatment of wastewater, and the facilities would be similar in style

and character to the existing buildings. Therefore, no disturbance to visual resources would occur. Therefore, no impairment to the LMNRA would occur.

There would be no impacts to visual resources downstream of Hoover Dam.

4.10.2 Boulder Islands North Alternative

The impacts to visual resources that may result from the construction and operation of the Boulder Islands North Alternative are described in this section. The VRM class assigned to the areas along the EI differs from those assigned to the areas along the LCS. Therefore, the discussion of potential impacts is separated into two subsections: EI and LCS. There would be no impacts to visual resources downstream of Hoover Dam.

4.10.2.1 Effluent Interceptor – Alignment A

The majority of EI-Alignment A and ancillary facilities have been classified as Class IV VRM areas based on the type of user (commuter or work related), and the dominance of numerous unpaved roads throughout the area. Based on the definition of Class IV areas, impacts to visual resources along the proposed alignment are expected to be minimal during the construction phase. The natural topography along the alignment would be restored after construction is complete. There would be no inconsistencies related to management objectives of this VRM Class.

Foreground views along the proposed pipeline alignment would be impacted during construction. These impacts would include change in degree of contrast in line, texture, and form due to clearing of vegetation and earth-moving activities associated with placement of the pipeline and staging of materials and equipment. The impacts would be temporary.

The majority of the EI would be along existing ROWs and impacts to the existing overall visual character of the area are expected to be insignificant following completion of construction activities. The access portals to the manways would be placed at grade, and would be colored to blend with the surrounding soils. The access portals would be barely visible in the foreground and would not affect either the visual character or the views from scenic points.

The EI Terminus site would require grading at the working shaft site. Middleground and background views would be temporarily disrupted by these modifications during construction activities. Grading modifications would be at grade and therefore, following completion of construction, they would not disrupt visual resources.

The current visual character at the EI Terminus site is considered low based on ongoing construction activities in the immediate area, and the presence of high-power electrical lines adjacent to the proposed facility site. Access to the EI Terminus would be provided by an existing municipal unpaved road, and no visual impact changes are expected.

The majority of the EI and ancillary facilities would be at or below grade. Middleground and background views may be impacted by the presence of construction equipment and dust. However, middleground and background views would not be impacted following completion of construction activities because of the recessed nature of the Las Vegas Wash.

The Wetlands Park area would experience temporary impacts associated with construction activities. This area has been previously designated by the BLM as a Class III VRM area. The views within the Wetlands Park would not experience impacts associated with the operation of the pipeline.

Views from the Rainbow Gardens area (KOP 3, Figure 3.10-1) toward the Wetlands Park would not be impacted because vegetation in the area would cover any view of the proposed chat trail. Views from the Rainbow Gardens area would essentially remain unchanged.

4.10.2.2 Lake Conveyance System, Boulder Islands North

Impacts for the Boulder Islands North LCS are discussed in terms of what would be seen from KOPs at Lake Mead Parkway, Lakeshore Drive, and on Boulder Beach (Figure 3.10-1). The view from Lake Mead Parkway along the proposed LCS alignment has been classified as Class IV (Appendix H, Table H.2-3). Impacts to visual resources along the proposed alignment are expected to be minimal during the construction phase. There would be no inconsistencies related to management objectives of this VRM Class after construction is completed.

Views from Lake Mead Parkway would be temporarily impacted by the presence of large construction equipment. However, Lake Mead Parkway has a large volume of traffic, and therefore the overall impact to the visual character of this area would be insignificant.

The view from Lakeshore Drive toward the proposed LCS alignment has been classified as Class II (Appendix H, Table H.2-3). The objective of Class II is to retain the existing character of the landscape. However, views from Lakeshore Drive are not expected to be impacted because the proposed project would be constructed below the surface.

Construction activities between the NRMT3-East working shaft and Lake Mead would be visible from Lakeshore Drive and Lake Mead. This portion of the pipeline would be constructed during the off-peak months of October through March. Therefore, the impacts to LMNRA visitors would be minimal. The construction would take 2 years, and following each season of construction, all materials associated with construction activities would be removed from the casual observer's view.

The cut-and-cover pipeline alignment construction from the HPRS to Lake Mead would entail the removal of vegetation when digging the trench. This removal would create a contrasting straight line of brown against the surrounding gray-green Mojave Desert scrub vegetation community. This line would provide a temporary rise in the degree of contrast, and possibly attract the attention of the casual observer.

Impacts to visual resources would occur during the construction phase of the project. Foreground and middleground views would be disrupted by large construction equipment that would be visible from Lakeshore Drive and Lake Mead. However, construction activities would be restricted to the winter months minimizing the number of LMNRA visitors that would be affected.

The visual character of the BINDP area are dominated by views of Lake Mead and visual character is determined by the sheer size of the Lake and the relative rarity of bodies of water

found in the Mojave Desert. The visual character of Lake Mead is not expected to be impacted by activities associated with the operation of the pipeline because it would be placed underground or underwater. The diffuser would be below the surface of the Lake and as such, would not be visible to LMNRA visitors.

Impacts to views along all areas of the Boulder Islands North LCS would occur as a result of blowing dust caused by construction activities. Dust control BMPs would be implemented during construction. Impacts from dust would be minor.

The LCS pipeline and facilities would be below grade and would not affect the visual contrast to any areas. There would be no impacts to the overall visual character, scenic points, vistas, corridors, or other sensitive areas following completion of the construction activities. The intended uses and purposes of the LMNRA would not be affected under this alternative.

The HPRS would be constructed in a predominantly below-grade structure that would be enclosed with fencing. An earthen berm would be constructed around the HPRS to act as a visual barrier between the facility and Lake Mead.

4.10.3 Boulder Islands South Alternative

The impacts to visual resources that may result from the construction and operation of the Boulder Islands South Alternative are described in this section. The VRM class assigned to the areas along the EI differs from those assigned to the areas along the LCS. Therefore, the discussion of potential impacts is separated into two subsections: EI and LCS.

There would be no impacts to visual resources downstream of Hoover Dam.

4.10.3.1 Effluent Interceptor – Alignment B

The visual impacts resulting from the construction of EI-Alignment B would be basically the same as described for EI-Alignment A in Section 4.10.2.1. Any different or additional potential impacts are described in the following paragraphs.

The EI Terminus site would require grading modifications to allow natural drainage channels to flow around the site. Middleground and background views would be temporarily disrupted by these modifications during construction activities. The drainage modification would incorporate natural drainage channels in the vicinity of the site. Grading modifications would be at grade and therefore, following completion of construction they would not disrupt visual resources. All areas disturbed by the drainage improvements would be restored to match existing visual contrast conditions as closely as possible.

The current visual character at the EI Terminus site is considered low, based on ongoing construction activities in the immediate area, and the presence of high-power electrical lines adjacent to the proposed facility site. Access to the EI Terminus would be provided by an existing municipal unpaved road, and no visual impact changes are expected. Paving of the parking area and the access road to the site would form a visible contrasting band and change the color and texture for middleground and background views. Background views from

Lake Las Vegas would be moderately impacted; however the visual impact would be minimal due to the ongoing construction activities in the immediate area.

The proposed EI includes the construction of the EI Terminus building, which would be visible from foreground and middleground vistas. The building would be designed to be residential in character and painted to blend with the desert landscape (Figure 4.10-1). Public-access viewing points in this area are minimal, and the proposed facility is not expected to impact views from scenic points or corridors.

A pedestrian bridge that crosses the C-1 Channel would be built along the South Lateral Pipeline alignment. The pedestrian bridge would be constructed in accordance with guidelines from the *Clark County Wetlands Park Master Plan* (Clark County 1995). The bridge would provide additional view of the C-1 Channel and the Las Vegas Wash, and additional access to areas of the Wetlands Park. This impact is expected to be beneficial to the recreational viewer.

A 16-ft (5-m) wide chat trail would be constructed along the portion of the alignment that crosses open terrain in Reach 2. The existing grade would be matched to the extent possible with minor grade limitations for access to facilitate pipeline maintenance. The chat trail would not be visible to the casual viewer from Telephone Line Road to the north of the Wetlands Park, or from most view areas within the Wetlands Park. The proposed chat trail would be consistent with management objectives of a Class III VRM area, would not interfere with the visual experience of the recreational user, and would provide new access to viewing areas within the Wetlands Park that are not currently available.

4.10.3.2 Lake Conveyance System, Boulder Islands South

Impacts for the Boulder Islands South LCS are discussed in terms of what would be seen from KOPs at Lake Mead Parkway, Lakeshore Drive, and on Boulder Beach (Figure 3.10-1). The potential impacts are similar to those described for the Boulder Islands North LCS. The view from Lake Mead Parkway along the proposed LCS alignment has been classified as Class IV (Appendix H, Table H.2-3). Impacts to visual resources along the proposed alignment are expected to be minimal during the construction phase. There would be no inconsistencies related to management objectives of this VRM Class after construction is completed.

Views from Lake Mead Parkway would be temporarily impacted by the presence of large construction equipment. However, Lake Mead Parkway has a large volume of traffic, and therefore the overall impact to the visual character of this area would be insignificant.

The view from Lakeshore Drive toward the proposed LCS alignment has been classified as Class II (Appendix H, Table H.2-3). The objective of Class II is to retain the existing character of the landscape. However, views from Lakeshore Drive are not expected to be impacted because the proposed project would be constructed below the surface.

Boulder Beach has also been classified as Class II (Appendix H, Table H.2-3). The directive of management activities requires that activities may be seen, but should not attract the attention of the casual observer. Changes must repeat the basic elements of form, line, color, and texture. Construction activities between the SRMT3-East working shaft and Lake Mead would be visible from Boulder Beach. This portion of the pipeline would be constructed during the off-peak



Before



After

Figure 4.10-1 Effluent Interceptor Terminus Facility.

months of October through March; therefore, the impacts to LMNRA visitors would be minimal. The construction would take 2 years, and following each season of construction, all materials associated with construction activities would be removed from the casual observer's view.

The cut-and-cover pipeline alignment construction at Boulder Beach would entail the removal of vegetation when digging the trench. This removal would create a contrasting straight line of brown against the surrounding gray-green Mojave Desert scrub vegetation community. This line would provide a temporary rise in the degree of contrast, and possibly attract the attention of the casual observer.

Impacts to visual resources would occur in the vicinity of Boulder Beach during the construction phase of the project. Foreground and middleground views would be disrupted by large construction equipment that would be visible from the beach. However, construction activities would be restricted to the winter months minimizing the number of LMNRA visitors that would be affected.

The visual character of the BISOP and BISDP areas are dominated by views of Lake Mead. This dominance of visual character is determined by the sheer size of the Lake and the relative rarity of bodies of water found in the Mojave Desert. The visual character of Lake Mead is not expected to be impacted by activities associated with the operation of the pipeline because it would be placed underground or underwater. The diffuser would be below the surface of the Lake and as such, would not be visible to LMNRA visitors.

Impacts to views along all areas of the Boulder Islands South LCS would occur as a result of blowing dust caused by construction activities. Dust control BMPs would be implemented during construction. Impacts from dust would be minor.

The LCS pipeline and facilities would be below grade and would not affect the visual contrast to any areas. There would be no impacts to the overall visual character, scenic points, vistas, corridors, or other sensitive areas following completion of the construction activities. The intended uses and purposes of the LMNRA would not be affected under this alternative.

The PRS would be constructed in a below-grade structure except for the top slab and a small at-grade structure for access and ventilation equipment. The permanent footprint of the below-grade structure would be approximately 180 x 60 ft (55 x 18 m), and a fence would surround this slab. The fence would represent a minor visual point to the casual observer at Boulder Beach. However, there are several permanent and temporary structures, such as NPS buildings and trailer/campers in the immediate area, and this fencing would conform to the line and design of the nearby structures.

4.10.4 Las Vegas Bay Alternative

The impacts to visual resources that may result from the construction and operation of the Las Vegas Bay Alternative are described in this section.

4.10.4.1 Effluent Interceptor – Alignment B

Impacts for the EI portion of this alternative would be the same as those described for the Boulder Islands South Alternative in Section 4.10.3.1.

4.10.4.2 Lake Conveyance System, Las Vegas Bay

Impacts for the Las Vegas Bay LCS are defined in terms of what would be seen from KOPs at Lake Mead Parkway, Lakeshore Drive, and on Las Vegas Bay (Figure 3.10-1). The view from Lakeshore Drive toward the proposed LCS alignment has been classified as a Class II VRM (Appendix H, Table H.2-3). The objective of Class II is to retain the existing character of the landscape during construction. There would be no inconsistencies related to management objectives of this VRM Class following construction and the removal of equipment.

Views from Lake Mead Parkway would be temporarily impacted by the presence of large construction equipment. However, Lake Mead Parkway has a large volume of traffic, and therefore the overall impact to the visual character of this area would be insignificant.

The view from Lakeshore Drive toward the proposed Las Vegas Bay LCS alignment has been classified as Class II. However, views from Lakeshore Drive are not expected to be impacted because the proposed project would be constructed below the ground surface.

The Las Vegas Bay has also been classified as a Class II VRM area. Construction equipment and activities would be visible from various locations in the Las Vegas Bay area. Foreground and middleground views may be disrupted by large construction equipment that would be visible from public viewing areas and may provide a high degree of contrast in color and line to the casual viewer. However, construction of the diffuser segment would occur during the winter months when LMNRA visitation is low. The construction would take 2 years, and following each season of construction, all materials associated with construction activities would be removed from the casual observer's view. Thus, impacts would not be significant. The intended uses and purposes of the LMNRA would not be affected under this alternative.

The scene from public viewing areas near Las Vegas Bay is dominated by Lake Mead and the Las Vegas Wash and Delta. The visual character of Lake Mead and the Las Vegas Wash is not expected to be impacted by activities associated with either the construction or operation of the project. The pipeline and diffuser would not be visible from the Las Vegas Bay Scenic Overlook or recreational boaters. Scenic points, vistas, and corridor views would not be affected by the proposed project.

4.10.5 Process Improvements Alternative

The impacts to visual resources under the Process Improvements Alternative would be the same as those described for the No Action Alternative.

4.10.6 Mitigation

Although no significant impacts to visual resources would occur from the proposed alternatives, steps would be taken to further minimize the potential for impacts to visual resources. Restoration of the project site would be completed in accordance with a project-specific Reclamation- or NPS-approved restoration plan. The restoration plan will address salvage of topsoil for reseeding purposes, recontouring the natural land surface, blending colors and textures, treating weeds, and revegetating the disturbed areas. Coordination with Clark County Parks and Community Services would occur, to the extent required by Reclamation, during restoration activities within the Wetlands Park**.** Segments of the open-cut alignment that may be viewed by LMNRA visitors would be revegetated with native species at the completion of construction activities. The restoration and revegetation of the alignment would reduce the visual impact of the pipeline scar.

4.11 Socioeconomics

The impact methodology included a qualitative and quantitative analysis of various sources of data and an input-output (I-O) computer model to predict project related impacts within Clark County. The I-O model results are the main focus of this section. Specific details regarding the methodology and assumptions used in the analysis, and the completed data are presented in Appendix I. The total cost and breakdown for each alternative is provided in Chapter 2.

IMPLAN Professional (Version 2.0) (IMPLAN), a computer-based modeling program, was used to predict economic effects associated with the proposed project alternatives. Input-output modeling is a mathematical accounting of the flow of dollars and commodities through an area's economy. The IMPLAN model provides an estimate of how a given amount of a particular economic activity translates into jobs and income in the area. It predicts how expenditures would affect specific industries within the area as dollars are spent and re-spent locally.

The IMPLAN results are expressed as a culmination of construction dollars (direct impacts) other commercial industries (indirect) and projected changes in spending as a reaction to direct and indirect impacts (induced). Indirect business taxes and impacts to employment are also analyzed through this model. These categories are discussed in terms of total output in this chapter. The model was also run to predict value added output, and the detailed tables for all results are presented in Appendix I.

There would be impacts associated with all alternatives, including the No Action Alternative. The impact to the economy would be from either the necessary upgrading of existing facilities (No Action Alternative and Process Improvements Alternative), or the construction of the SCOP pipeline. Specific assumptions regarding future development scenarios were used for the IMPLAN model to estimate economic impacts. These assumptions include:

- All project construction expenditures are assumed to occur in Clark County, Nevada;
- All project construction for the three pipeline alternatives is assumed to occur over the 6-year construction schedule beginning in January 2007 and ending in approximately 2012;

- Construction of the EI is assumed to occur over 2 years beginning in January 2007 and ending in approximately 2009. The EI is evaluated in the action alternatives during the first 2 years of project construction;
- All project construction expenditures associated with the pipeline alternatives were applied to IMPLAN industry sector #40, Water, Sewer, and Pipeline Construction, which most closely represents construction of the proposed project; and
- All alternatives would include a $29 million cost associated with plant optimization. This cost is not used in the I-O model, and therefore the beneficial economic impacts do not reflect these expenditures.

All dollars presented in the Socioeconomics section for the No Action and four action alternatives are presented in 2005 dollars. The average annual percentage change in the Consumer Price Index from 1998 to 2003 was used as the basis to deflate construction costs from 2003 dollars to 2001 dollars for use in IMPLAN and to inflate economic impacts generated by IMPLAN from 2001 dollars to 2005 dollars. The economic effects associated with O&M of the proposed project was not evaluated in this study.

The IMPLAN modeling program does not predict population impacts. Therefore, predictions for population impacts were based on past population fluctuations and assumptions of the area's past ability to absorb growth or recover from reduction in population numbers.

For the purposes of this EIS, impacts to socioeconomic features would be considered significant if the action being considered resulted in:

- Population growth beyond the capacity of communities to provide adequate housing, schools, and services or otherwise adapt to growth-related social and economic changes;
- Revenue flows and expenditures by local, county, or state governments that are inadequate to maintain public services and facilities at established levels;
- Any permanent displacement of residents or users of affected areas;
- Perceived changes in the existing ways of life resulting in community discontent sufficient to create organizational response and conflict; and/or
- A "boom and bust" cycle of employment and related economic growth and decline.

4.11.1 No Action Alternative

Water quality modeling indicates that under the No Action Alternative, using current conventional treatment processes when the Lake level is at 1,000 ft (305 m), effluent flows of 200 mgd (308 cfs) or more would not exceed the WLA for the Las Vegas Wash, but would result in exceedances of the water-quality standard for chlorophyll in the Las Vegas Bay. Therefore, the wastewater treatment agencies would need to increase treatment at their facilities to reduce the amount of phosphorus being discharged. The cost to treat TP to a level of 0.2 mg/L using current conventional treatment processes is approximately $361 million. Optimization of the treatment facilities would cost an additional $29 million. A description of current conventional treatment processes and plant optimization actions is presented in Section 2.1. Mitigation measures to ensure that water quality standards are not exceeded would be implementation of the Process Improvements Alternative. Costs associated with the Process Improvements Alternative

are described in Section 4.11.5. Additional information regarding the costs are presented in the *Systems Conveyance and Operations Program Process Assessment* (Black & Veatch 2004b).

4.11.1.1 Employment and Economy

Future employment and economic effects associated with the No Action Alternative are expected to remain consistent with historic trends of the local economy. Potential economic impacts to the Lake Mead recreational industry may occur if water-quality standards are not met. Increased chlorophyll levels may result in algae blooms. Algae have the potential to change the apparent color of water when excessive amounts are present, and they may create undesirable surface scum that can affect recreational use and create taste and odor problems.

The facility additions are expected to provide an increase in employment opportunities within the region. Most employees would be hired locally for construction of the proposed treatment facility expansions. Therefore, the impacts to employment would be beneficial almost entirely within the Las Vegas metropolitan area. Considering the diverse economy of the Las Vegas metropolitan area, an adequate supply of workers would be easily satisfied.

Employment increases as a result of the proposed treatment facilities' expansions would be less than one percent of total employment in Clark County during project construction. Construction employment would be a short-term beneficial impact in Clark County. After the construction, there would likely be a relatively small effect on the temporary workforce as construction workers look for work elsewhere. However, if the Las Vegas construction industry continues to boom as it has during the 1990s, the workers should have a fairly easy time finding new employment.

4.11.1.2 Population

The No Action Alternative would have no impact on population in Clark County. Project workers would be hired locally, so few workers would move to the area to work on the project. The response to the demand on wastewater service within the Las Vegas metropolitan area would continue to increase as the population increases.

4.11.1.3 Housing

Assuming that Clark County continues to add new housing at the rate of 4.7 percent annually, there would be approximately 737,154 new housing units in 2007, and 912,138 new housing units in 2012. Currently, rental units are the largest type of single-family units advertised in Henderson, Las Vegas, and North Las Vegas. Clearly, there are an adequate number of available housing units in Clark County to accommodate the workforce associated with the No Action Alternative.

4.11.1.4 Schools

The overall population of the Valley is expected to increase between 2.0 and 3.8 percent per year through 2018. The Clark County School District currently plans for overall growth in the district

to be approximately 5 percent per year (see Section 3.11). There would be increases in school enrollment resulting from the No Action Alternative.

4.11.1.5 Government Taxation and Revenue

Indirect business taxes consist of excise taxes, property taxes, fees, licenses, and sales taxes paid by businesses. These taxes occur during the normal operation of businesses, but do not include taxes on profit or income. These taxes include both State and major local taxing jurisdictions (County and City taxes). Indirect business tax numbers are derived from BEA Gross State Product data.

4.11.2 Boulder Islands North Alternative

Capital cost estimates for the EI and pipeline alternatives, as well as the Process Improvements Alternative are provided in Table 4.11-1. These figures represent the total costs during the 6-year pipeline construction period of the Boulder Islands North, Boulder Islands South, and Las Vegas Bay alternatives and 2-year construction of the EI. The capital costs associated with the Process Improvements Alternative are also presented in Table 4.11-1. The Boulder Islands North Alternative also includes the construction cost of the hydroelectric power generation facility. Cost breakdowns of the individual components of the alternatives are provided in Chapter 2.

Table 4.11-1 Estimated Capital Costs – EI and Action Alternatives.

Construction Description	Estimated Construction Costs [1]
EI	$87,073,596
Boulder Islands North Alternative [2]	$594,363,000
Boulder Islands South Alternative [3]	$590,000,000
Las Vegas Bay Alternative [3]	$540,000,000
Process Improvements Alternative	$205,483,592

Notes:
[1] All costs are expressed in 2005 dollars.
[2] This estimated cost includes EI and hydroelectric power generation facility construction cost estimates.
[3] This estimated cost includes EI construction cost estimates.

Source: Black Veatch 2004a.

The overall socioeconomic dollar impacts resulting from the Boulder Islands North Alternative are shown in Table 4.11-2 and 4.11-3. A brief discussion of each impact is presented in the following sections. The IMPLAN model results are presented and discussed in detail in Appendix I.

Table 4.11-2 Total Socioeconomic Impacts – Boulder Islands North Alternative (Pipeline Only).

Year	Total Economic Output	Employment (per year)	Indirect Business Tax [1]
2005	$1,007,877,009	8,906	$29,366,474
2007 (Year 1)	$1,031,058,181	8,906	$30,732,868
2008 (Year 2)	$1,054,772,519	8,906	$31,439,724
2009 (Year 3)	$1,079,032,287	8,906	$32,162,837
2010 [2] (Year 4)	$949,982,733	7,662	$28,215,925
2011 [2] (Year 5)	$971,832,336	7,662	$28,864,892
2012 [2] (Year 6)	$994,184,480	7,662	$29,528,784

Notes:
[1] All impacts are expressed in 2005 dollars.
[2] Does not include EI impacts.

Source: IMPLAN 2001.

Table 4.11-3 Total Socioeconomic Impacts – Boulder Islands North Alternative (Hydroelectric Power Generation Facility Only).

Year	Total Economic Output	Employment (per year)	Indirect Business Tax [1]
2005	$41,958,497	151	$4,319,522
2012 (Year 1)	$48,092,098	151	$5,064,833
2030	$72,416,099	151	$114,116,331
2050	$7,455,056	151	$11,747,990

Note:
[1] All impacts are expressed in 2005 dollars.

Source: IMPLAN 2001.

4.11.2.1 Employment and Economy

Under the Boulder Islands North Alternative, there would be a temporary increase in construction-related employment and additional local and State tax revenue generated as a result of economic activity associated with the project. The estimated construction cost for the

Boulder Islands North Alternative is approximately $594,363,000. This cost does not include the $29 million for treatment plant optimization. The greatest total output during the 6-year pipeline construction period for the Boulder Islands North Alternative are estimated to be $1,079,032,287 in 2009 and the least total output are estimated to be approximately $949,982,733 in 2010. The

greatest total output during construction of the hydroelectric power generation facility are approximately $114,116,331 in 2050 and the least total output during construction of the hydroelectric power generation facility are approximately $42,923,542 in 2007.

The total output would be greatest under the Boulder Islands North Alternative than the other pipeline alternatives. The total output impacts associated with the pipeline are higher from 2007 until 2009 because of EI construction. The EI construction would last approximately 2 years. The total output would be less from 2010 until 2012 when pipeline construction of the Boulder Islands North Alternative would be completed.

The increase in employment associated with the Boulder Islands North Alternative would be less than one percent of total employment in Clark County from 2007 to 2012 during project construction. Most employees would be hired locally for construction of the proposed project and impacts on employment would be beneficial to the Las Vegas metropolitan area. Considering the diverse economy and the size of the construction industry in the Las Vegas metropolitan area, an adequate supply of workers would be easily satisfied.

Construction employment would be a short-term beneficial impact to Clark County. After the 6-year pipeline construction period, there would be a relatively small effect on the temporary workforce as construction workers from the project site look for work elsewhere. However, if the Las Vegas construction industry continues to boom as it has during the 1990s, the workers should have a fairly easy time finding new employment.

Employment under the Boulder Islands North Alternative would consist of approximately 8,906 workers each year from 2007 until 2009. Once the EI is constructed, the number of workers needed would be lowered to approximately 7,662 workers. However, in 2012, the total number of workers would increase to approximately 7,813 workers when construction of the hydroelectric power generation facility would be constructed. The number of workers required each year does not reflect an additional 8,906, 7,662, and 7,813 people per year, rather it is expected that this is the total level of employment required per year to sustain the construction, construction support, and other commercial growth rate. Many employees would retain their employment year after year. Employment impacts under the Boulder Islands North Alternative would be less than the other two pipeline alternatives during the 6-year pipeline construction period, and greater than the employment generated by the Process Improvements Alternative. Total employment impacts for the top ten industries are provided in Appendix I.

4.11.2.2 Population

Impacts to employment would be less than one percent. Based on the 2.7 percent average annual increase in population, the workers that would be hired for the proposed project would be negligible (Ridell and Schwer 2003). As discussed in Section 4.11.2.1, direct employment associated with the Boulder Islands North Alternative would be approximately 8,906 employees each year during the 6-year pipeline construction period including the EI construction and approximately 7,662 workers once the EI is constructed. A large majority of the workers would be Clark County residents. It is unknown how many workers might move to Clark County, from other areas of the country, to work on construction of the proposed project. The Las Vegas metropolitan area would have adequate infrastructure, schools, and community facilities to

accommodate the relatively small increase in population that would occur due to employment that is generated by project construction.

4.11.2.3 Housing

Impacts to housing would be similar to those discussed in Section 4.11.1.3.

The proposed project would be one of many factors shaping future urban growth within the Las Vegas metropolitan area. To sustain current growth, the Las Vegas metropolitan area must build new roads, schools, water and wastewater lines, other utilities, and expand its community services. The Boulder Islands North Alternative would improve upon the wastewater capacity needed to handle additional growth in the area. While this expanded capacity would allow additional growth to be accommodated with infrastructure improvements, the demand for such growth would not be in direct response to the completion of the proposed project.

4.11.2.4 Schools

Impacts to schools would be the same as discussed under Section 4.11.1.4.

4.11.2.5 Government Taxation and Revenue

Information is reported based on the same criteria in Section 4.11.1.5. An annual average of $30,925,476 would be realized during the 4 year pipeline construction. The greatest total indirect

business tax impacts are estimated to be $32,162,837 in 2009 and least total indirect business tax impacts are estimated to be $28,215,925 in 2010 during the 4-year pipeline construction. During construction of the hydroelectric power generation facility the greatest total indirect business tax impacts are estimated to be $11,747,990 in 2050 and the least total indirect business tax impacts are estimated to be $4,950,961. With all of the impacts calculated for the Boulder Islands North Alternative, the greatest impacts would occur during the second year of the EI construction and

the least amount of impacts would occur during the first year of construction of the hydroelectric power generation facility.

The funding method for the Boulder Islands North Alternative has not yet been determined.

4.11.3 Boulder Islands South Alternative

Capital-cost estimates for the EI and pipeline alternatives, as well as the Process Improvements Alternative are provided in Table 4.11-1. Cost breakdowns of the components of the alternatives are provided in Chapter 2.

The overall socioeconomic dollar impacts resulting from the Boulder Islands South Alternative are shown in Table 4.11-4. A brief discussion of each impact is presented in the following sections.

Table 4.11-4 Total Socioeconomic Impacts – Boulder Islands South Alternative.

Year	Total Economic Output	Employment (per year)	Indirect Business Tax [1]
2005	$1,076,062,911	9,509	$31,346,167
2007 (Year 1)	$1,100,812,358	9,509	$32,804,673
2008 (Year 2)	$1,126,131,042	9,509	$33,559,181
2009 (Year 3)	$1,152,032,056	9,509	$34,331,042
2010 [2] (Year 4)	$1,024,661,497	8,265	$30,433,999
2011 [2] (Year 5)	$1,048,228,712	8,265	$31,133,981
2012 [2] (Year 6)	$1,072,337,972	8,265	$31,850,063

Notes:
[1] Expressed in 2005 dollars.
[2] Does not include EI impacts.
Source: IMPLAN 2001.

4.11.3.1 Employment and Economy

Under the Boulder Islands South Alternative, there would be a temporary increase in construction-related employment and additional local and State tax revenue generated as a result of economic activity associated with the project. The estimated construction cost for the Boulder Islands South Alternative, including EI construction, is approximately $590 million. This cost does not include the $29 million for treatment plant optimization. The greatest total output impacts during the 6-year construction period for the Boulder Islands South Alternative are estimated to be $1,152,032,056 in 2009 and the least total output impacts are estimated to be $1,024,661,497 in 2010. Total output impacts are a combination of direct, indirect, and induced impacts generated from the original estimated construction costs within the water, sewer, and pipeline industry for each year between 2007 and 2012.

The total output impacts are higher from 2007 through 2009 because of EI construction. The EI construction would last approximately 2 years. The total output would be less from 2010 until 2012 when construction of the Boulder Islands Alternative would be completed.

The increase in employment associated with the Boulder Islands South Alternative would be less than 1 percent of total employment in Clark County from 2007 to 2012 during project construction. The project would be approximately 6 percent of total construction employment in Clark County. Most employees would be hired locally for construction of the proposed project; therefore, the impacts on employment would be beneficial to the Las Vegas metropolitan area. Considering the diverse economy and the size of the construction industry in the Las Vegas metropolitan area, an adequate supply of workers would be easily satisfied.

Construction employment would be a short-term beneficial impact to Clark County. After the 6-year construction period, there would be a relatively small effect on the temporary workforce as construction workers from the project site look for work elsewhere.

As a result of project construction, there would be direct, indirect, and induced employment created both regionally and locally. Additional jobs would be generated in the construction industry specifically on the proposed project, and employment would be generated in other industries that would provide services or products for the proposed project.

Employment under the Boulder Islands South Alternative would consist of approximately 9,509 workers each year from 2005 until 2009. Once the EI is constructed, the number of workers needed would be lowered to approximately 8,265 workers. The number of workers required each year does not reflect an additional 9,509 and 8,265 people per year, rather it is expected that this is the total level of employment required per year to sustain the construction, construction support, and other commercial growth rate. Many employees would retain their employment year after year. Total employment impacts for the top ten industries are provided in Appendix I.

4.11.3.2 Population

A large majority of the workers would be Clark County residents. It is unknown how many workers might move to Clark County from other areas of the country to work on construction of the proposed project, but it is assumed the numbers would be low. The Las Vegas metropolitan area would have adequate infrastructure, schools, and community facilities to accommodate the relatively small increase in population that would occur due to employment that is generated by project construction.

4.11.3.3 Housing

Impact to housing would be similar to those discussed in Section 4.11.1.3.

4.11.3.4 Schools

Impacts to schools would be the same as discussed in Section 4.11.1.4.

4.11.3.5 Government Taxation and Revenue

An annual average of $32,208,444 in indirect business taxes would be realized during the 6 years of the project. The greatest total indirect business tax impacts are estimated to be $34,331,042 in 2009 and $30,433,999 in 2010. With all of the impacts calculated for the Boulder Islands South Alternative, the greatest impacts would occur during the second year of the EI construction and the least amount of impacts would occur during the first year of construction of the EI.

4.11.4 Las Vegas Bay Alternative

Capital-cost estimates for the Las Vegas Bay Alternative, including the construction cost estimates for the EI, are provided in Table 4.11-1.

The overall socioeconomic dollar impacts resulting from the Las Vegas Bay Alternative are shown in Table 4.11-5. A brief discussion of each impact is presented in the following sections. The IMPLAN model results are presented and discussed in detail in Appendix I.

4.11.4.1 Employment and Economy

Employment and economic effects associated with the Las Vegas Bay Alternative would be similar to those described for the Boulder Islands South Alternative with the exception of the total output. The estimated construction cost for the Las Vegas Bay Alternative, including EI construction, is approximately $540 million. This cost does not include the $29 million for treatment plant optimization. Total output impacts would be the greatest in 2009 (Year 3) at $1,067,148,624. Total output impacts would be the least in 2010 (Year 4) at $937,825,747. During the 6-year construction schedule, the total output impacts are the greatest from 2007 to 2009 as a result of more construction occurring during this time when the EI would be built. Additional information regarding total output and value-added impacts for the Las Vegas Bay Alternative is included in Appendix I.

As a result of project construction, there would be direct, indirect, and induced employment created both regionally and locally. Additional jobs would be generated in the construction industry specifically on the proposed project, and employment would be generated in other industries that would provide services or products for the proposed project.

Employment for project construction under the Las Vegas Bay Alternative would consist of approximately 8,808 workers for each year of construction from 2005 until 2009. Once the EI is constructed, the number of workers needed would be lowered to approximately 7,564 workers. The number of workers required each year does not reflect an additional 8,808 and 7,564 people per year, rather it is expected that this is the total level of employment required per year to sustain the construction, construction support, and other commercial growth rate. Many employees would retain their employment year after year. Most employees would be hired locally for construction of the proposed project. Therefore, the impacts on employment would be beneficial to the Las Vegas metropolitan area.

Although water-quality standards would be met, potential economic impacts to the Lake Mead recreational industry may occur if increased chlorophyll levels result in algae blooms. Algae have the potential to change the apparent color of water when excessive amounts are present, and they may create undesirable surface scum that can affect recreational use and create taste and odor problems.

4.11.4.2 Population

Potential impacts on population resulting from the Las Vegas Bay Alternative would be the same as those described for the Boulder Islands South Alternative, except that the number of employees associated with the proposed project would be 952 less per year during the 6-year project construction schedule. This increase in employment would have a negligible affect on population within Clark County, and would represent less than 1 percent of total population throughout the years of project construction from 2007 to 2012.

Table 4.11-5 Total Socioeconomic Impacts – Las Vegas Bay Alternative.

Year	Total Economic Output [1]	Employment (per year)	Indirect Business Tax
2005	$996,776,998	8,808	$29,044,200
2007 (Year 1)	$1,019,702,870	8,808	$30,395,598
2008 (Year 2)	$1,043,156,036	8,808	$31,094,697
2009 (Year 3)	$1,067,148,624	8,808	$31,809,874
2010 [2](Year 4)	$937,825,747	7,564	$27,854,845
2011 [2] (Year 5)	$959,395,739	7,564	$28,495,506
2012 [2] (Year 6)	$981,461,841	7,564	$29,150,903

Notes:
[1] Expressed in 2005 dollars.
[2] Does not include EI impacts.
Source: IMPLAN 2001.

4.11.4.3 Housing

Housing effects associated with the Las Vegas Bay Alternative would be similar to those described for the Boulder Islands South Alternative in Section 4.11.3.3.

4.11.4.4 Schools

Potential impacts on schools associated with the Las Vegas Bay Alternative would be similar to those described for the Boulder Islands South Alternative, Section 4.11.3.4.

4.11.4.5 Government Taxation and Revenue

The greatest total indirect business impacts are estimated to be $31,809,874 in 2009 and the least total indirect business impacts are estimated to be $27,854,845 in 2010. The direct, indirect, and induced indirect business tax impacts are the greatest from 2007 to 2009 due to construction of the EI during this 2-year time period.

4.11.5 Process Improvements Alternative

As stated in Section 2.5, the CWC would not construct pipelines under the Process Improvements Alternative. The costs associated with the Process Improvements Alternative relate to capital expenditures associated with the MF/UF improvements to the three treatment facilities and O&M costs throughout the life of the project associated with these process improvements. Table 4.11-6 summarizes the capital costs, and Table 4.11-7 summarizes the O&M costs associated with the Process Improvements Alternative in 2030 and 2050.

The total capital costs for implementation of MF/UF membranes for the life of the project (includes costs in 2030 and 2050) is estimated to be $205,483,592. The total annual O&M cost for MF/UF improvements is estimated to be $29,751,688. Construction and installation of the

Table 4.11-6 Estimated Capital Costs for MF/UF Improvements, 2030 and 2050.[1]

Treatment Facility	MF/UF Capital Costs	
	2030	2050
CLV	$60,108,352	$20,030,249
CCWRD	$80,144,469	$26,706,999
COH	$13,871,158	$4,622,365
Subtotal	$154,123,979	$51,359,613
Total (2030 + 2050)	$205,483,592	

Notes:
[1] All costs are expressed in 2005 dollars.
Source: Black & Veatch 2006.

Table 4.11-7 Estimated Annual Operations and Maintenance Costs for MF/UF Improvements, 2030 and 2050.[1]

Treatment Facility	Annual MF/UF O&M Costs	
	2030	2050
CLV	$4,894,140	$8,210,593
CCWRD	$5,718,799	$4,058,209
COH	$3,449,503	$3,420,444
Subtotal	$14,062,442	$15,689,246
Total (2030 + 2050)	$29,751,688	

Notes:
[1] All costs are expressed in 2005 dollars.
Source: Black & Veatch 2006.

MF/UF improvements would occur at each treatment plant between 2007 and 2009, with implementation beginning in 2010. A breakdown of the major components of the capital costs and O&M costs are provided in Chapter 2.

An I-O model was not used to quantify economic impacts within Clark County related to implementation of the Process Improvements Alternative. The capital and O&M expenditures associated with this alternative are assumed to have a relatively minimal economic impact within Clark County. It is assumed that most, if not all, of the MF/UF membranes and equipment would be designed, built, and installed by firms that are located outside of Clark County and costs that would be incurred during the O&M phase of the project would be mostly paid to firms that are located outside of Clark County. There are some expenditures that would be made during the

construction phase and the operations phase that would not exhibit this type of economic "leakage" outside of Clark County. However, at this stage of project development it would be difficult (and likely would not yield accurate results) to quantify expenditures and predict economic impacts associated with these local expenditures. Any expenditures that occur locally, related to this alternative, for construction-phase or O&M-phase activities would have a beneficial, but likely negligible affect on the overall Clark County economy.

4.11.5.1 Employment and Economy

As discussed in Section 4.11.5, for the purpose of this EIS it is assumed that most of the capital and O&M expenditures associated with the Process Improvements Alternative would be made to firms located outside of Clark County. Therefore, a negligible increase in Clark County employment is expected as a result of capital- and O&M-related expenditures for the MF/UF improvements at the treatment plants throughout the life of the project. The relatively small increase in construction-phase employment within Clark County would occur mostly within the construction, engineering, land development and related industries, and within the government sector, and would occur between 2007 and 2014. Similarly, a relatively small increase in Clark County employment can be expected related to O&M activities during the operations phase beginning in 2010 and extending into the future. This increase in employment would occur mostly within the water and wastewater services, scientific equipment industries, and the government sector.

The implementation of this alternative is expected to cause a negligible increase in economic output within Clark County during the life of the project. During the construction phase, construction, engineering, land development and related industries, and the government sector would experience a small rise in revenue. Also, during the O&M phase the water and wastewater services, scientific equipment industries, and the government sector would experience a small rise in revenue. This small increase in revenue within these industries would also have a small effect on revenue within other industries as money spent locally on capital improvements, construction, and O&M is re-spent within the Clark County economy. The direct, indirect, and induced effects of these expenditures are expected to have a small increase in economic output within Clark County during the life of the project.

4.11.5.2 Population

The relatively small number of workers that would be hired locally during the construction and O&M phases of the Process Improvements Alternative would be almost entirely from Clark County. It is unknown how many workers might move to Clark County to fill these jobs, but it is assumed that this number would be negligible. The Las Vegas metropolitan area would have adequate infrastructure, schools, and community facilities to accommodate the negligible increase in population that may occur due to employment that is generated by this alternative.

4.11.5.3 Housing

Impacts to housing would be similar to those discussed in Section 4.11.1.3.

4.11.5.4 Schools

The overall population of the Valley is expected to increase between 2.0 and 3.8 percent per year through 2018. The Clark County School District currently plans for overall growth in the district to be approximately 5 percent per year (see Section 3.11). A negligible increase in school enrollment is anticipated as a result of the Process Improvements Alternative.

4.11.5.5 Government Taxation and Revenue

A negligible increase in indirect business taxes is anticipated as a result of implementation of the Process Improvements Alternative during the life of the project.

4.11.6 Mitigation

No mitigation would be required for any of the alternatives.

4.12 Environmental Justice

The SCOP pipelines and facilities addressed in this EIS would be constructed on CLV, Clark County, COH, private, and federal property. Twelve census tracts were identified that are directly adjacent to or near the location of the proposed alternatives. Minority or low-income populations are found in most census tracts in the Study Area, but the population consists of primarily non-minority people living above low-income levels (Section 3.12). There are no population groups in the study area that are considered to be predominantly minority or low-income.

The purpose of an environmental justice analysis is to determine whether adverse environmental impacts would disproportionately affect minority and low-income communities compared to other communities in the project area. Impacts related to environmental justice would be significant if environmental justice populations exist in the affected area, and those populations are disproportionately affected by adverse impacts compared to other population groups.

4.12.1 No Action Alternative

Under the No Action Alternative, the proposed SCOP pipeline would not be constructed and no disturbance to populations in any census tracts would occur. The current method of effluent discharge into the Las Vegas Wash would continue. Therefore, no direct or indirect impacts to any of the populations within the study area census tracts would occur.

Total phosphorus levels going through Hoover Dam, based on the Lake Mead model, are predicted to increase slightly from 5 ppb to 6 ppb. Despite this increase, phosphorus concentrations below Hoover Dam would remain well below historic concentrations (the past three decades), during which no negative consequences were identified in the Colorado River below Hoover Dam. Concentrations would remain well below Nevada water quality standard and RMHQ criteria. No significant effect to ITAs downstream of Hoover Dam are expected.

4.12.2 Boulder Islands North Alternative

None of the census tracts in the study area contain predominantly minority or low-income population groups; therefore there would be no environmental justice impacts from implementation of the Boulder Islands North Alternative.

Total phosphorus levels going through Hoover Dam, based on the Lake Mead model, are predicted to increase slightly from 5 ppb to 6 ppb. Despite this increase, phosphorus concentrations below Hoover Dam would remain well below historic concentrations (the past three decades), during which no negative consequences were identified in the Colorado River below Hoover Dam. Concentrations would remain well below Nevada water quality standard and RMHQ criteria. No significant effect to ITAs downstream of Hoover Dam are expected.

4.12.3 Boulder Islands South Alternative

None of the census tracts in the study area contain predominantly minority or low-income population groups; therefore there would be no environmental justice impacts from implementation of the Boulder Islands South Alternative.

Total phosphorus levels going through Hoover Dam, based on the Lake Mead model, are predicted to increase slightly from 5 ppb to 6 ppb. Despite this increase, phosphorus concentrations below Hoover Dam would remain well below historic concentrations (the past three decades), during which no negative consequences were identified in the Colorado River below Hoover Dam. Concentrations would remain well below Nevada water quality standard and RMHQ criteria. No significant effect to ITAs downstream of Hoover Dam are expected.

4.12.4 Las Vegas Bay Alternative

None of the census tracts in the study area contain predominantly minority or low-income population groups; therefore there would be no environmental justice impacts from implementation of the Las Vegas Bay Alternative.

Total phosphorus levels going through Hoover Dam, based on the Lake Mead model, are predicted to increase slightly from 5 ppb to 6 ppb. Despite this increase, phosphorus concentrations below Hoover Dam would remain well below historic concentrations (the past three decades), during which no negative consequences were identified in the Colorado River below Hoover Dam. Concentrations would remain well below Nevada water quality standard and RMHQ criteria. No significant effect to ITAs downstream of Hoover Dam are expected.

4.12.5 Process Improvements Alternative

The impacts resulting from the Process Improvements Alternative would be the same as those described for the No Action Alternative.

4.12.6 Mitigation

There would be no direct or indirect impacts to minority or low-income populations as a result of the proposed alternatives. Therefore, mitigation would not be required.

4.13 Traffic

The following section provides an analysis of the traffic-related impacts associated with the proposed alternatives. This section defines significant criteria for determining traffic impacts for the proposed alternatives and describes mitigation measures, if appropriate. For purposes of estimating the potential impacts of construction-related traffic, it has been assumed that no ridesharing or shuttling of employees in buses to and from the construction sites would occur.

An impact would be considered significant if:

- The maximum traffic-carrying capacity of an affected roadway would be exceeded as a result of implementation of an alternative; or
- Project traffic exacerbates conditions on a roadway that already exceeds its maximum traffic-carrying capacity.

The analysis addresses both the short-term construction and long-term operational impacts of the proposed alternatives.

The analysis of impacts is based upon daily traffic volume criteria. The criteria considered includes daily traffic-carrying capacities of potentially impacted roadways, daily trip generation of the project alternatives, projected background traffic levels, and the combination of the daily trip generation of the project alternatives and the background traffic levels. Understanding the relationship of daily capacity as a maximum sustained rate of traffic flow for the specified time period requires knowledge of the existing roadway capacity. A detailed traffic analysis was not conducted for this project; therefore specific traffic data for most roads and intersections potentially impacted by the proposed project were not available.

4.13.1 No Action Alternative

There would be no adverse impacts to traffic conditions within the vicinity of the proposed project from implementation of the No Action Alternative. Existing traffic conditions on the local arterials and highways as described in Section 3.13 would not be impacted by the proposed project. Some additional construction and employee vehicles would be required under the No Action Alternative during expansion of the treatment plants. However, modifications to the treatment plants are on-going, and the increase in vehicles is not expected to be significantly more than the number of construction vehicles currently accessing the treatment facility sites.

There would be no impacts to traffic downstream of Hoover Dam.

4.13.2 Boulder Islands North Alternative

The following subsections describe the potential traffic impacts from the proposed Boulder Islands North Alternative.

There would be no impacts to traffic downstream of Hoover Dam.

4.13.2.1 Effluent Interceptor – Alignment A

Potential traffic-related impacts during construction, operation, and maintenance of the proposed EI-Alignment A and ancillary facilities may result from employee vehicles, construction equipment, and material delivery vehicles accessing the work site. General construction, operation, and maintenance access to the project area would be via the principal regional highways in the area, including US 95, US 93, US 515, Boulder Highway, and Lake Mead Parkway. Local arterials such as Desert Inn Road, Hollywood Boulevard, Telephone Line Road, Pabco Road, Olson Street/Sunset Road, and Russell Road may also be used to access the EI and ancillary facilities. Delivery of construction materials would primarily come from Las Vegas.

South Hollywood Boulevard, which turns into Telephone Line Road is the main access route that would be used by construction and employee vehicles. No roads would require closure due to construction of this alternative. However, short-term impacts may include restriction to one lane periodically to allow access for construction vehicles. It is anticipated that the EI and connection facilities would be constructed over approximately a 24-month period. On a typical work day, approximately 50 employee vehicles would enter and exit the construction site, approximately 56 truckloads of spoils would be removed from the construction site, and approximately 20 truckloads of pipe and materials would be delivered to the construction site.

The majority of the construction traffic along the EI would use South Hollywood Boulevard and Telephone Line Road, but the LOS would remain unchanged. Other roads, such as Boulder Highway, which already experiences a poor LOS, would remain operable but poor. Although traffic impacts would not be significant, construction and operation mitigation measures described in Section 4.13.6 would further reduce the potential for construction-related traffic congestion.

Detours and loss of roadway capacity may increase travel times for some area residents and workers on other arterials and highways mentioned in Section 3.13. Although inconvenient, these residual impacts are considered acceptable as they would be transient in nature, and overall area-wide traffic circulation would be maintained.

Significant adverse short-term impacts from construction-related traffic would occur daily in the form of LOS F (poor) traffic conditions on Boulder Highway. Implementation of the recommended measures described in Section 4.13.6 would greatly reduce the magnitude of this impact.

Travel on existing roads by maintenance personnel in the long-term would be required once construction of the EI and ancillary facilities is completed. However, the frequency of site visits and number of vehicles would be minimal. Therefore, long-term operational impacts to traffic from the proposed project would be minimal.

4.13.2.2 Lake Conveyance System, Boulder Islands North

The proposed alignment for the Boulder Islands North LCS would cross two roads east of the EI Terminus: Lakeshore Drive and Lake Mead Parkway. The proposed pipeline would go beneath the roads. No major highways or arterials are planned for closure. Employee vehicles and construction equipment accessing the work site may generate potential traffic impacts similar to those mentioned in Section 4.13.2.1. Construction-related traffic (employee vehicles and construction equipment) would access the site via Lake Mead Parkway, Lakeshore Drive, and Lake Las Vegas Parkway near the EI Terminus. The number of estimated employee and construction vehicles would be slightly more than those described in Section 4.13.2.1. However, the LOS would remain unchanged for those roadways during construction.

It is estimated that construction of the Boulder Islands North Alternative would take up to 69 months. Several pipeline sections and ancillary facilities would be constructed simultaneously. This would generate more construction traffic in the proposed project area than if the segments were constructed consecutively. Additional construction-related vehicles in the LMNRA may create short-term inconveniences to LMNRA visitors. However, most of the construction activities within the LMNRA would occur during the winter months when LMNRA visitation is low. Temporary lane restrictions may be needed to allow construction vehicles to maneuver. The LOS would be unchanged, therefore, the short-term impacts from construction would be insignificant and minor.

Existing traffic at the intersection of US 93 and Lakeshore Drive is currently LOS Category A, but is approaching LOS Category B (Table 3.13-3). However, it would take several hundred additional vehicles per day for this to occur, and the number of additional vehicles that would be in the area during construction of the Boulder Islands North LCS would not be enough to change the LOS category.

Maintenance of the pipeline and ancillary facilities would be required throughout the operation of the pipeline. However, the frequency of site visits and number of vehicles would be minimal. Therefore, long-term operational impacts to traffic from the proposed project would be minimal.

4.13.3 Boulder Islands South Alternative

The following subsections describe the potential traffic impacts from the proposed Boulder Islands South Alternative.

There would be no impacts to traffic downstream of Hoover Dam.

4.13.3.1 Effluent Interceptor – Alignment B

Potential traffic-related impacts during construction, operation, and maintenance of the proposed EI-Alignment B and ancillary facilities would be the same as those described for EI-Alignment A in Section 4.13.2.1.

4.13.3.2 Lake Conveyance System, Boulder Islands South

Potential traffic-related impacts during construction, operation, and maintenance of the Boulder Islands South LCS would be similar to those described for the Boulder Islands North LCS in Section 4.13.2.2.

In addition, construction traffic for the Boulder Islands South LCS may use existing unpaved roads such as AR-76 to access the construction area. Closure of AR-76 may be required during construction activities. Maintenance access to existing facilities would be allowed, but there may be temporary delays due to road use by heavy equipment. The use of AR-76 by construction vehicles would reduce any impact to the US 93 and Lakeshore Drive intersection.

4.13.4 Las Vegas Bay Alternative

The following subsections describe the potential traffic impacts from the proposed Las Vegas Bay Alternative.

There would be no impacts to traffic downstream of Hoover Dam.

4.13.4.1 Effluent Interceptor – Alignment B

The impacts that may result from the construction, maintenance, and operation of the EI would be the same as those described under the Boulder Islands North Alternative in Section 4.13.2.1.

4.13.4.2 Lake Conveyance System, Las Vegas Bay

The number of vehicles used for the construction of the Las Vegas Bay Alternative would be similar to that described under the Boulder Islands North Alternative, Section 4.13.2.2. It is anticipated that the various segments of the Las Vegas Bay Alternative would be constructed simultaneously within a 64-month construction timeframe. Construction and operation impacts would be similar to those described in Section 4.13.2.2.

4.13.5 Process Improvements Alternative

The impacts resulting from the Process Improvements Alternative would be the same as those described for the No Action Alternative.

4.13.6 Mitigation

To reduce the magnitude of potentially significant traffic impacts, construction traffic management plans would be developed as part of the project approval process as specific segments or phases of the project are submitted to agencies with jurisdiction over potentially affected roadways. Implementation of the various plans allows construction of the proposed project to proceed efficiently and safely while maintaining acceptable traffic operations.

Materials developed for the construction traffic management plan may include, but are not limited to:

- Scaled drawings of the traffic control zone;
- Specification for special manpower needs, such as flag people;
- Copies of permits;
- Phone numbers of officials to be contacted in an emergency;
- Scaled drawings of construction stages, including detour plans (if required); and
- Schedule of times during the day, week, or year when work is not permitted or when certain lane restrictions may apply.

The construction traffic management plan will be typically prepared at or before 50 percent design completion. The construction traffic management plan will address the following construction zone safety considerations:

- Effective use of signage and barricades around the work sites,
- Use of flag people as necessary to slow or detour traffic,
- Development of detour plans around substantially restricted streets,
- Specifications for construction staging areas and material delivery routes, and
- Scheduling of oversized material deliveries to the work site.

To minimize employee-related increases in traffic congestion, work shifts may be scheduled so employees approach and depart the work sites during off-peak traffic periods. Employee car-pooling as well as the shuttling of employees between peripheral/off-site parking lots and the work sites should be encouraged. Material deliveries in the vicinity of major roadway segments and intersections will be scheduled during off-peak periods.

Access routes through the LMNRA will be determined in coordination with the NPS. The NPS will also be involved in the development and review of any construction traffic-related plans for areas within the LMNRA.

The current condition of roads within the LMNRA including Lakeshore Drive would be maintained to the extent possible. Road condition assessment and monitoring would be established by the NPS before construction activities begin. Damage to the roadway surfaces would be repaired in accordance with NPS guidance. In addition, the CWC would accept financial responsibility for the repair of roadways damaged as a result of SCOP construction.

4.14 Paleontological Resources

This section addresses potential impacts to paleontological resources associated with implementation of the No Action Alternative, Boulder Islands North Alternative, Boulder Islands South Alternative, and Las Vegas Bay Alternative.

For the purpose of this EIS, impacts to paleontological resources are considered significant if:

- The scientific and educational value of significant paleontological sites would be compromised by implementation of an alternative; and
- A paleontological site is disrupted or adversely affected, except as part of an approved scientific study.

The impairment analysis for paleontological resources used the following criteria.

- *Negligible impacts:* The impact is at the lower level of detection; there would be no measurable change.
- *Minor impacts:* The impact is slight but detectable; there would be a small change.
- *Moderate impacts:* The impact is readily apparent; there would be a measurable change that could result in a small but permanent change.
- *Major impacts:* The impact is severe; there would be a highly noticeable, permanent measurable change.

4.14.1 No Action Alternative

Under the No Action Alternative, the proposed SCOP pipeline would not be constructed and no disturbance to federal land from construction and operation of the project would occur. Therefore, no direct or indirect impacts to any potential paleontological resources within the proposed project area would occur. No impacts or impairment would occur within the LMNRA.

There would be no impacts to paleontological resources downstream of Hoover Dam.

4.14.2 Boulder Islands North Alternative

The EI and ancillary facilities would be constructed on lands that have been disturbed by previous activities. Paleontological resources that may have existed previously have presumably been destroyed through previous construction activities. In addition, only a small segment of Reach 1 would cross areas of high paleontologic sensitivity (Figure 3.14-1). The area crossed is highly disturbed from previous construction activities.

The Boulder Islands North LCS is not in an area designated as having high paleontologic sensitivity (Figure 3.14-1). Additionally, this portion of the proposed project would predominately consist of a deep tunnel with minimal surface disturbance.

Based on the above factors, no impacts to potential paleontological resources would occur from activities associated with this alternative. There would be no loss, destruction, or degradation to any paleontological resources in the LMNRA. Therefore, impairment of paleontological resources within the LMNRA would not occur.

4.14.3 Boulder Islands South Alternative

The potential impacts to paleontological resources resulting from the Boulder Islands South Alternative would be the same as described for the Boulder Islands North Alternative in Section 4.14.2.

4.14.4 Las Vegas Bay Alternative

The impacts resulting from the construction and operation of the Las Vegas Bay Alternative would be the same as those described for the Boulder Islands North Alternative in Section 4.14.2.

4.14.5 Process Improvements Alternative

The impacts to paleontological resources under the Process Improvements Alternative would be the same as those described for the No Action Alternative.

4.14.6 Mitigation

Significant impacts to paleontological resources are not expected to result from the construction or operation of the proposed alternatives. However, ground disturbance associated with construction activities has the potential to damage or destroy any fossils that may be present. Therefore, a field survey will be conducted on previously undisturbed lands that have a high potential to produce paleontological resources within the construction footprint.

Chapter 5

Cumulative Impacts

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5.0 Cumulative Impacts

This section addresses potential cumulative impacts to the environment that could be associated with the implementation of the proposed SCOP in conjunction with one or more past, present, or reasonably foreseeable future actions or projects. Specifically, this section is prepared in accordance with the requirements of NEPA; guidance from the CEQ, *Considering Cumulative Effects under NEPA;* and Reclamation's NEPA Handbook. The CEQ regulations define a "cumulative impact" for purposes of NEPA as "incremental impacts of the action when added to other past, present, and reasonably foreseeable actions regardless of what agency (federal or non-federal) or person undertakes such other actions." Reclamation's NEPA Handbook states that "cumulative impacts can be categorized as additive and interactive. An additive impact emerges from persistent additions from one kind of source whether through time or space. An interactive impact results from more than one kind of source." Cumulative impacts can result from individually minor, but collectively significant, actions taking place over a period of time.

Cumulative impacts are most likely to arise when a relationship exists between a proposed alternative and other actions that have, or are expected, to occur in a similar location, time period, or involving similar actions. Projects in close proximity to the proposed alternatives would be expected to have more potential for cumulative impacts than those more geographically separated. However, since water quality is of concern to water users of Lake Mead and downstream of Hoover Dam, the cumulative impacts analysis addresses potential effects beyond the immediate geographic area of Lake Mead and Las Vegas. Various agencies (federal, state, or local) or persons may be the proponents for these projects.

The cumulative effects assessment in this EIS focuses on addressing two fundamental questions:

- Does a relationship exist so the impacts from the proposed alternative might affect or be affected by the impacts of the other actions?
- If such a relationship exists, does this assessment reveal any potentially significant impacts not identified when the proposed alternative is considered alone?

The following activities have been identified, in combination with the proposed alternatives, to have the potential for contributing to cumulative impacts on resources within the vicinity of the proposed project.

5.1 Methodology

The following steps were taken to analyze cumulative impacts in the project study area. A list of reasonably foreseeable future and existing actions was developed for the project study area. The list of projects and a brief description of each project is presented in Section 5.2. The projects were grouped as past, present, or future actions, then the potential impacts of the actions were summarized. The environmental impacts associated with each project were reviewed collectively to determine the significance of the cumulative impacts for each resource. The potential cumulative impacts for each resource are presented in Section 5.3. It is important to note that the

potential cumulative impacts to many resources are not quantifiable. Uncertainties relating to the potential for cumulative impacts are stated within the text.

5.2 Past, Present, and Reasonably Foreseeable Future Actions

To analyze cumulative impacts associated with the proposed alternatives, other projects in the region were reviewed to determine whether the impacts of those projects, in combination with the proposed alternatives, would have a cumulative impact on a resource. This is not an exhaustive list of future and existing projects in the region, but can be used to help understand the magnitude of activity in the area (Figure 5.2-1). The following subsections describe the potential impacts resulting from the past, present, and future projects. However, mitigation measures and BMPs would be implemented to minimize the described impacts. No local, state, or federal statutes or regulations would be violated.

5.2.1 Past Actions

Actions considered to be "past" are projects that are currently (Spring 2006) ongoing, but that would be completed before construction of the SCOP begins in mid to late 2007.

5.2.1.1 Desert Inn Master Planned Community

John Laing Homes is currently developing a 190-acre (77-hectare) master planned residential development, the Desert Inn Master Plan, located on the west side of the Las Vegas Wash between Desert Inn Road and Flamingo Road. The project site is located within the 100-year floodplain; therefore, 6,500 linear ft (1,981 m) of bank stabilization and channel improvements were required to protect the property from flooding and erosion forces of floodwaters. The bank stabilization is considered a beneficial impact to the Las Vegas Wash. Wetlands are currently being created adjacent to the Las Vegas Wash to mitigate for the areas disturbed by the Desert Inn Master Planned Community. This project would create temporary and localized impacts to air quality and noise during construction activities. Construction of the community destroyed 190 acres (77 hectares) of potential Mojave desert tortoise habitat. Construction activities require dewatering, which may result in lowering groundwater levels in the area. There would be temporary and localized noise, air quality, traffic, and visual impacts during construction. In addition, the development of previously vacant land would increase the amount of impervious surfaces, which may increase urban runoff.

5.2.1.2 Woodside Homes Planned Residential Development

Woodside Homes of Nevada, Incorporated is developing a 52-acre (21-hectare) residential community on property adjacent to the Las Vegas Wash. Construction of the community destroyed 52 acres (21 hectares) of potential Mojave desert tortoise habitat. The impacts resulting from the Woodside Homes development would be similar to those described for the Desert Inn Master Planned Community. However, no dewatering was required at this site.

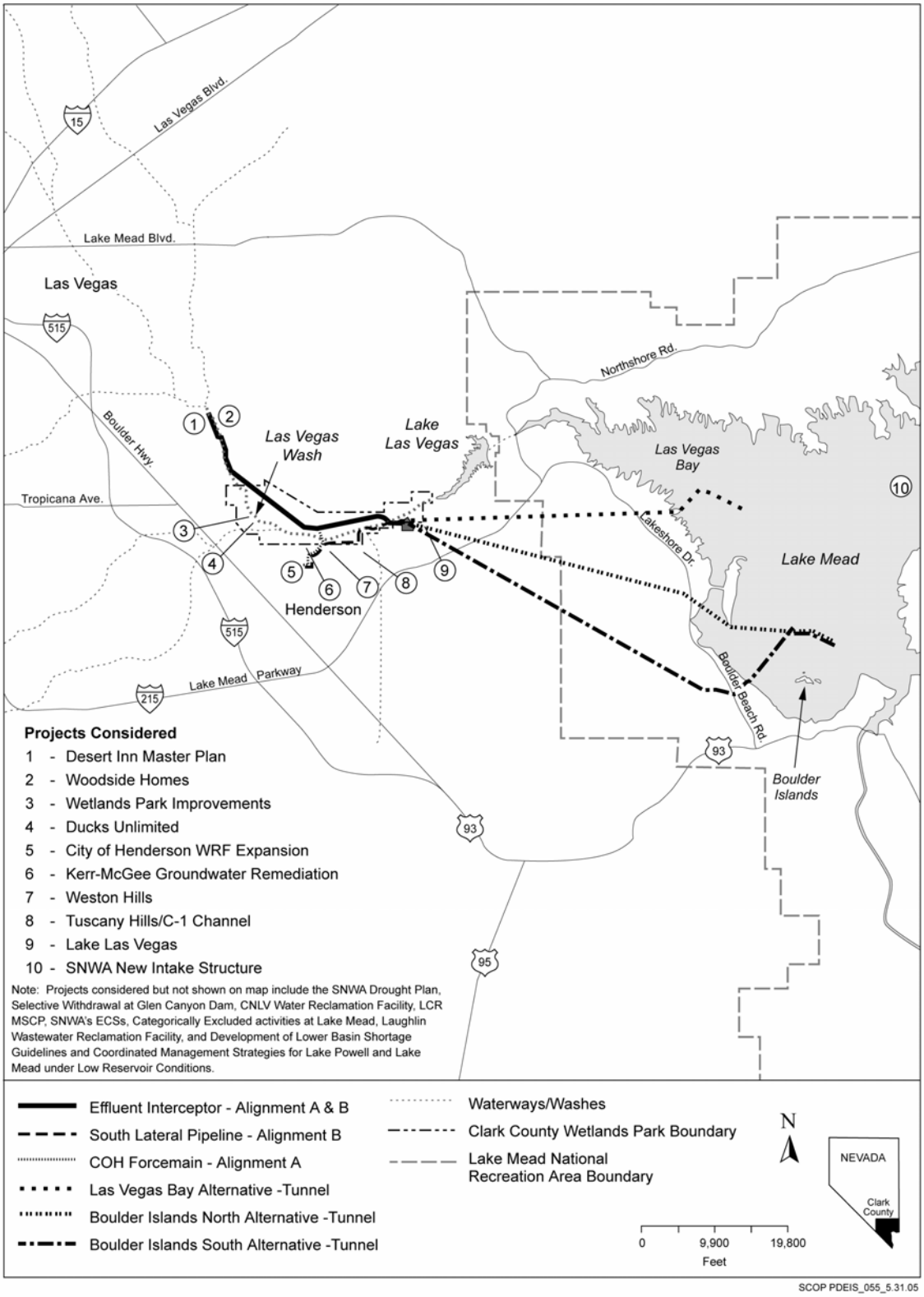


Figure 5.2-1 Cumulative Impacts – Projects Considered.

5.2.1.3 Lake Las Vegas Resort Master Planned Community

Approximately 350 acres (142 hectares) located adjacent to Lake Mead Parkway and the Lake Las Vegas were recently transferred from the BLM to the Lake Las Vegas Resort. This area is currently being developed into a golf course and residential community. The impacts resulting from the Lake Las Vegas Resort Master Planned Community would be similar to those described for the Desert Inn Master Planned Community.

5.2.1.4 Weston Hills Residential Development

The proposed Weston Hills Residential Development encompasses 170 acres (69 hectares) south of the Las Vegas Wash and southwest of the Tuscany Hills site. The Weston Hills Residential Development is currently under construction, and is expected to be completed in June 2007. Construction of the community destroyed 52 acres (21 hectares) of potential Mojave desert tortoise habitat. The impacts resulting from the Weston Hills Residential development would be similar to those described for the Desert Inn Master Planned Community.

5.2.1.5 Tuscany Hills Master Planned Community and C-1 Channel Extension

A master planned residential and golf community is under construction north of Lake Mead Parkway on the southern edge of the Wetlands Park boundary. Construction of the Tuscany Hills Master Planned Community is expected to be completed in June 2007. In association with the Tuscany Hills community, improvements to the C-1 Channel are planned. The Tuscany Hills development and C-1 Channel Extension includes 530 acres (214 hectares) of land. Construction destroyed 530 acres (214 hectares) of potential Mojave desert tortoise habitat. The impacts resulting from the Tuscany Hills Master Planned Community and C-1 Channel Extension would be similar to those described for the Desert Inn Master Planned Community.

5.2.1.6 Ducks Unlimited Las Vegas Wash Wetlands

Ducks Unlimited is currently preparing design drawings for Clark County Parks and Community Services for additional Las Vegas Wash Wetlands. Construction activities are scheduled to begin in July 2006 and be completed in early 2007. The proposed plan includes the creation or modification of approximately 100 acres (40 hectares) of wetlands. Ducks Unlimited has revised the alignment design for the proposed levees that are part of the project to better accommodate floodplain conditions encountered in the Las Vegas Wash area. Temporary and localized impacts to air quality and noise are expected during construction of the Ducks Unlimited project. Potential short-term impacts to biological resources during construction would occur.

5.2.2 Present Actions

For the purposes of this analysis, “present actions” are defined as projects/activities occurring at the time of this evaluation that would continue during construction and operation of the SCOP. Some of the actions would involve construction during the same timeframe as the planned SCOP

construction (2007 through 2012), others would not. Construction timeframes are specified for each action.

5.2.2.1 Clark County Wetlands Park

Construction activities at the Wetlands Park is estimated to be complete by 2015. The *Clark County Wetlands Park Master Plan* defines strategies for creating a system of trails, interpretive exhibits, and picnic areas along the Las Vegas Wash. It also includes a visitor center (i.e., Nature Center) with educational information and specific site improvements such as landscape design, building concepts, and roadway and parking concepts. The planned Wetlands Park trails and facilities would potentially disturb approximately 384 acres (155 hectares) of land within the Wetlands Park boundary (Clark County Parks and Community Services 2002). There would be temporary and localized noise, air quality, traffic, and visual impacts during construction. Impacts to biological resources and cultural resources may also occur during construction. The Wetlands Park would have beneficial impacts to habitat and recreation. The SNWA ECSs that are currently or would be located within the Wetlands Park are discussed in Section 5.2.2.6.

5.2.2.2 City of Henderson Water Reclamation Facility Expansion

The WRF expansion is currently under development on lands adjacent to the existing COH treatment facilities. Construction activities will be completed in 2009. The expansion includes the construction of new facilities to the east of the existing WRF and improvements to current infrastructure. New facilities include a northeast reclaimed water pumping station, chemical building, contact basins, and additional distribution piping. There would be temporary and localized noise, air quality, traffic, and visual impacts during construction.

5.2.2.3 Kerr-McGee Chemical LLC – Perchlorate Remediation

Kerr-McGee Chemical Company, working with the NDEP, began intercepting perchlorate-laden groundwater in 1999. This effort has significantly reduced the amount of perchlorate entering the Las Vegas Wash, and has been beneficial to water quality in the Las Vegas Wash, and downstream. No construction activities would be needed for this action, but perchlorate remediation is expected to continue for several years.

5.2.2.4 Southern Nevada Water Authority Drought Plan

The Drought Plan identifies drought response measures that can be implemented by the community to reduce water demands during drought conditions. The measures were intended to spread the burden of drought response as much as possible across all sectors of the community, while targeting those water uses with the greatest potential for water savings. A few of the drought response measures include landscape and outdoor water use restrictions and conservation provisions for golf courses and man-made lakes. One of the goals of the SNWA Drought Plan is to reduce the amount of urban runoff resulting from overwatering of landscapes in the Valley.

5.2.2.5 Lower Colorado River Multi-species Conservation Program

The LCR MSCP was developed to protect the LCR environment as well as the interests of water users and hydropower demands, protect threatened and endangered species, and prevent the listing of additional species in the lower Colorado River. The MSCP comprehensive, long-term, multi-agency effort is to work towards the recovery of several endangered species. The MSCP covers 400 river miles including the full-pool elevations of Lake Mead, Lake Mohave, and Lake Havasu, and the historical floodplain of the Colorado River from Lake Mead to the U.S.-Mexico Border. Current conservation measures are focused from Hoover Dam, which creates Lake Mead, to the Mexican border.

The MSCP has a 50-year goal to create more than 8,100 acres of riparian, marsh, and backwater habitat for four listed species and 16 other species native to the lower Colorado River. Goals also include measures to protect and enhance an additional two listed and four non-listed species and stocking more than 1.2 million juvenile razorback sucker and bonytail chub as part of an augmentation program for these populations in the lower Colorado River.

Endangered species covered by MSCP include the razorback sucker, bonytail chub, desert tortoise, southwestern willow flycatcher, Yuma clapper rail, and humpback chub. The humpback chub does not occur in the SCOP project area. A study of razorback suckers in the Las Vegas Bay, conducted by SNWA, is partially funded by the LCR MSCP.

5.2.2.6 Southern Nevada Water Authority Erosion Control Structures

Eleven of 26 planned ECSs in the Las Vegas Wash have been built by SNWA and the NPS. Construction of the additional ECSs will continue through 2015. The ECSs are designed and constructed to manage and reduce the impacts of storm flows on the Las Vegas Wash. Bank stabilization activities are also occurring in the Las Vegas Wash. The ECSs have reduced erosion by aiding in the stabilization of the Las Vegas Wash. Additional ECSs are planned and will further reduce the impacts of erosion in the Las Vegas Wash and Inner Las Vegas Bay.

5.2.2.7 Categorically Excluded Activities on Lake Mead

The NPS has identified and published a number of activities that are categorically excluded from further documentation under NEPA. The NPS and the USACE, Sacramento District, have cooperatively identified the following NPS' categorically excluded activities that are authorized by a Regional General Permit.

- Routine maintenance and repairs to non-historic structures, facilities, utilities, grounds, and trails.
- Installation of signs, displays, and kiosks.
- Installation of navigation aids.
- Replacement in kind of minor structures and facilities with little or no change in location, capacity, or appearance--for example, comfort stations, pit toilets, fences, kiosks, signs and campfire circles.

- Repair, resurfacing, striping, installation of traffic control devices, and repair/replacement of guardrails, culverts, signs, and other minor existing features on existing roads when no potential for environmental impact exists.
- Changes in sanitary facilities operation resulting in no new environmental effects.
- Installation of wells, comfort stations, and pit or vault toilets in areas of existing use and in developed areas.
- Restoration of non-controversial (based on internal scoping requirements) native species into suitable habitats within their historic range.
- Removal of individual members of a non-threatened/endangered species or populations of pests and exotic plants that pose an imminent danger to visitors or an immediate threat to park resources.
- Grants for replacement or renovation of facilities at their same location without altering the kind and amount of recreational, historic, or cultural resources of the area or the integrity of the existing setting.

Extended regional drought conditions and decreasing Lake Mead water levels have especially increased the number of necessary actions that are categorically excluded by the NPS and that also require a Department of the Army permit from the Sacramento District. Eventually, as Lake water levels rise, similar actions will be needed to meet this issue. These actions include:

- Repair and extend launch ramps as necessary;
- Adjust marina positions as water levels dictate;
- Reconfigure breakwaters and add new breakwaters as necessary;
- Manage water intakes, utilities, lift stations, and other infrastructure that exists below ordinary high water mark;
- Re-configuring bars and reefs as water level changes;
- Grading harbor bottoms as needed to move marina facilities as water level changes;
- Grading/maintenance of shoreline and beach areas;
- Grading washes after flood events; and
- Culvert maintenance in washes.

The majority of the categorically excluded actions would result in no impact to the environment, and those activities that require construction may result in temporary and localized minor impacts. Hence the reason they are eligible for a categorical exclusion.

5.2.2.8 Laughlin Wastewater Reclamation Facility

Laughlin Wastewater Division, Big Bend Water District operates the WWTP in Laughlin, NV. The Laughlin Wastewater Reclamation Facility discharges 3.5 mgd of treated effluent to the Colorado River. The Laughlin Wastewater Treatment Facility has been discharging treated wastewater to the lower Colorado River since 1997. This discharge would continue in the future.

5.2.3 Future Actions

Future actions are projects/activities that are currently in the planning stages. It is unknown whether these actions will become "real" projects, and only tentative schedules are available. The NEPA process is in progress for some of the future actions.

5.2.3.1 Southern Nevada Water Authority Intake Structure Modifications

The SNWA is planning modifications to the intake structures currently located at Saddle Island in Lake Mead. One potential plan is to construct a new intake structure that would withdraw drinking water from a location deeper in Lake Mead. The exact location of the intake structure is undetermined. Construction activities are tentatively scheduled to begin in 2008 and finish in 2012. Access to construction sites located within the LMNRA may be temporarily restricted during construction activities. There would also be temporary and localized impacts to air quality and noise during construction activities as well as an increase in construction traffic along Lakeshore Drive. Construction in Lake Mead would increase turbidity in the immediate area. Underwater archaeological resources may be impacted during construction. In addition, spoils from tunneling or open-cut construction would require transport and disposal.

5.2.3.2 Selective Withdrawal at Glen Canyon Dam (formerly known as Temperature Control Modifications)

Reclamation plans to conduct selective withdrawals at Glen Canyon Dam. Construction activities related to this project would be temporary and localized. Therefore, the construction timeframe is not relevant to the cumulative impacts analyses. The selective withdrawals would allow for water to be drawn from different depths of the reservoir. Instead of only drawing water from the existing intake openings, which are fairly deep and cold, the selective withdrawals would allow for water to be drawn closer to the reservoir surface, which is much warmer. Selective withdrawals at Glen Canyon Dam are scheduled to begin in 2010, and would continue for approximately 10 to 15 years. Modifications to the temperature of Glen Canyon's water, which is upstream from Lake Mead, would have impacts on aquatic species downstream and may raise the temperature of waters in Lake Mead.

5.2.3.3 City of North Las Vegas Water Reclamation Facility

The CNLV has plans to construct and operate a water reclamation facility at one of two locations: North 5th Street and Ann Road, or Losee Road and Gowan Avenue. The facility would be located on a 12- to 15-acre (5- to 6-hectare) parcel, and would be built in two phases. Phase 1 would include a 20 mgd (31 cfs) plant and Phase 2 would include a 26 mgd addition, for a total capacity of 46 mgd. This facility is in the preliminary planning stages. Therefore, the schedule for construction and operation is unknown. However, for the purposes of this analysis, it is assumed that construction would occur sometime between 2010 and 2015, and operation would occur from 2015 into the future. The treated effluent would be discharged to the Las Vegas Wash. Temporary impacts that would occur during the construction of the water reclamation facility include localized increases in dust, noise, and construction traffic. Wildlife and

vegetation habitat and previously unidentified cultural resources may be damaged during construction. During operation of the plant, effluent would be discharged to a segment of the Las Vegas Wash that does not currently contain constant flows. Impacts may include increased erosion in the Las Vegas Wash. Water quality parameters that may be of concern would be introduced into a segment of the Las Vegas Wash that currently does not receive effluent flows.

5.2.3.4 Development of Lower Basin Shortage Guidelines and Coordinated Management Strategies for Lake Powell and Lake Mead under Low Reservoir Conditions

Reclamation, acting on behalf of the Secretary of the Department of the Interior proposes to take action to adopt specific Colorado River Lower Basin shortage guidelines and coordinated reservoir management strategies to address operations of Lake Powell and Lake Mead, particularly under low reservoir conditions. This proposed action will provide a greater degree of certainty to all water users and managers in the Colorado River Basin by providing more detailed guidelines for the operation of Lake Powell and Lake Mead and by allowing water users in the Lower Basin to know when, and by how much, water deliveries will be reduced during drought and low reservoir conditions. In addition, this proposed action is designed to delay the onset and magnitude of shortages and will maximize the protection afforded to water supply, hydropower production, recreation and environmental benefits by water storage in Lakes Powell and Lake Mead.

5.3 Cumulative Impacts

To determine the potential for cumulative impacts, the impacts of the proposed SCOP alternatives were reviewed for each resource area and considered in combination with the projects listed in Section 5.2. Many of the projects previously described have a combination of beneficial and adverse effects on the various resources. Discussions of the cumulative impacts for each resource are presented in the following subsections. Mitigation measures would be implemented for many of the impacts described in the text, reducing the significance of the impact.

5.3.1 Water Resources

The proposed SCOP alternatives would induce impacts to surface water, shallow groundwater, and water quality. These impacts result from both construction activities and operation of the pipeline. Potential construction impacts to water resources are mitigated through compliance with required construction permits and are not considered significant. The same permit requirements are also applicable to the construction projects listed in Sections 5.2.2 and 5.2.3, and serve to limit the potential for cumulative impacts to water resources from construction activities. Though the SCOP schedule may overlap to some degree with other projects, project-specific mitigation and permitting requirements would minimize any potential for cumulative impacts.

The operation of the SCOP would result in the release of lower volumes of treated effluent to the Las Vegas Wash. This reduction in flows has the potential to lower groundwater levels in the

Las Vegas Wash. In addition, dewatering during construction of the SCOP pipeline may contribute to lowering groundwater levels. Cumulative impacts to groundwater may occur if extensive dewatering is required for projects in the region. However, as stated in Section 4.1.6.2, monitoring of groundwater levels in the vicinity of the dewatering operations will be conducted to detect harmful groundwater lowering, which could cause the surrounding layers to settle and therefore impose hazards to structures in the area. Additionally, structures will be monitored for possible movement.

Developments in the region would be constructing flood control structures and drainage improvements that would not have adverse cumulative impacts to surface water. Furthermore, implementation of BMPs during construction would minimize adverse impacts.

The proposed SNWA intake structures would be constructed upstream from the effluent discharge location at the Boulder Islands minimizing the potential for highly treated effluent to reach the drinking water intakes. Potential impacts occurring during the construction of the new intakes would be dependent on the alignment, method of construction, and schedule. Extending the existing intakes across Lake Mead to a location with deeper water may require construction activities being staged from barges and work boats. Should these activities occur during the same time period as the LCS construction, there may be a large area of Lake Mead that would be restricted for recreational use. However, it is presumed that construction activities would occur during the low-tourist season, which would minimize the impact to LMNRA users. If the No Action Alternative, Process Improvements Alternative, or Las Vegas Bay Alternative are implemented, the treated effluent would most likely come in contact with SNWA's new intake structure. Dilution of the effluent would occur before reaching the new intake structure, but the extent of the dilution is unknown at this time.

The proposed Selective Withdrawal at Glen Canyon Dam is expected to raise the temperature of flows exiting Glen Canyon Dam approximately 10°F (5°C), which would increase inflow temperatures into Lake Mead. This would increase the physical bioavailability of nutrients in the inflow area of Lake Mead resulting in a possible increase in algae production. Under the pipeline alternatives, the effluent would be discharged below the thermocline and is not expected to reach the surface of Lake Mead prior to dilution. However, the No Action Alternative and Las Vegas Bay Alternative are expected to exceed water quality standards for chlorophyll when Lake levels are at 1,000 ft (305 m). Therefore, the increase in temperature from the Glen Canyon Dam releases, combined with high chlorophyll levels in Lake Mead may result in significantly increased algae production.

Water quality modeling predicts that the TP through Hoover Dam from discharge near the Boulder Islands would increase from 5 ppb to 6 ppb. These TP levels are comparable to the baseline period, and lower than historical levels over an extended period of time. The Laughlin Wastewater Reclamation Facility has been discharging treated wastewater to the lower Colorado River 24 hours per day since 1997. No impacts to downstream users were identified for the 1999 to 2003 conditions, during which time the Laughlin Wastewater Reclamation Facility was discharging to the Colorado River. In addition, according to data collected by the USGS, concentrations of phosphorus leaving Lake Mead were higher in the past than they are now. No data have been received identifying impairment of water uses in the Colorado River downstream

of Hoover Dam, either in the present or past. Therefore, the cumulative impact to downstream users is expected to be insignificant.

Treated effluent discharged by the treatment plants contains potential EDCs and PPCPs. Concentrations of these substances generally decrease with increasing distance from the Las Vegas Wash, and drop to nondetectable levels, but the data are limited. It is not clear whether detectable levels are found below Hoover Dam. Even if there are detectable levels, or if detectable levels result from the project, downstream water users are unlikely to be affected by discharges of EDCs and PPCPs attributable to the project, because scientific evaluations have concluded that "no appreciable risk for humans exists at the low levels measured in drinking water" (Appendix K). Treated wastewater discharged from the Laughlin Wastewater Reclamation Facility likely contains some concentration of EDCs and PPCPs, but the 3.5 mgd of effluent discharged is minimal compared to the natural flows through the lower Colorado River. The EDCs and PPCPs contained in the Laughlin effluent would be dissipated quickly through mixing with the Colorado River water. Additionally, the MWD has reported that nondetectable levels of potential endocrine disrupters have been found at its water intake, although the majority of compounds of interest were not monitored (MWD 2001). Pharmaceuticals and personal care products were not identified as one of the four key constituents of concern to MWD in the *Colorado River Watershed Sanitary Survey – 2000 Update* (MWD 2001). Since the concentration of EDCs and PPCPs in water at the MWD water intakes has been nondetectable, it is assumed that the cumulative impact of the Las Vegas effluent and the Laughlin effluent is neglible. The long-term effect of EDCs and PPCPs in drinking water are unknown.

Some uncertainty exists about the effects on fish. Studies in Lake Mead have suggested that EDCs or PPCPs may have some effect on fish, although the cause of the effect has not been identified, and the magnitude is uncertain. This uncertainty may not be relevant to possible effects below Hoover Dam, however, because the effect appears to be associated with discharges from the Las Vegas Wash, which are highly concentrated as they enter Las Vegas Bay, but are rapidly diluted as they mix with Lake waters. A summary of existing credible scientific evidence is provided in Appendix K. Based on this evidence and the environmental setting, it is reasonable to conclude that potential effects to fish are likely to be focused in the area near the mouth of the Las Vegas Wash, where concentrations are higher and have not had the opportunity to dissipate through mixing and assimilation. Even in the area of higher concentrations, the potential effects appear modest. They are not lethal. No effect has been identified on fish population levels, which are high at the mouth of Las Vegas Wash. Because the effect is uncertain and modest, even at the higher concentration levels, and because of the great dilution and assimilation capacity of Lake Mead, EDCs and PPCPs in effluent from the Las Vegas treatment facilities are not expected to affect fish below Hoover Dam. As stated previously, the concentrations of EDCs and PPCPs in the the minimal effluent discharge from the Laughlin Wastewater Reclamation Facility would be dissipated quickly through mixing with Colorado River water. The combining of nondetectable concentrations of EDCs and PPCPs from the SCOP effluent and the Laughlin effluent are not expected to have a significant adverse impact on aquatic species along the lower Colorado River for the reasons stated. The existing scientific evidence summarized in Appendix K indicates that it is reasonable to conclude that potential effects to fish are likely to be focused in the areas where EDC and PPCP concentrations are higher and have not had the opportunity to dissipate through mixing and assimilation. For the previously described reasons, it

is assumed that there would be no cumulative impact on the lower Colorado River that would affect the goals of the LCR MSCP. However, because there is some uncertainty regarding the effects of EDCs and PPCPs on fish, a long-term water quality monitoring program, which includes monitoring of emerging compounds, would be implemented as part of the Boulder Basin AMP. A summary of the AMP including the emerging compounds to be monitored, is presented in Section 2.2.2.6 of the Final EIS.

Reclamation's adoption of Colorado River Lower Basin shortage guidelines and coordinated reservoir management strategies to address operations of Lake Powell and Lake Mead would not be affected by the SCOP alternatives. Reclamation would operate the dams and reservoirs in accordance with approved plans. The SCOP impacts analysis, presented in Chapter 4, includes conditions at a higher Lake level (1,178 ft) and a lower Lake level (1,000 ft). No cumulative impacts related to the SCOP alternatives and Colorado River Lower Basin shortage guidelines and coordinated reservoir management strategies would occur.

5.3.2 Biological Resources

Implementation of the proposed pipeline alternatives would result in construction-related impacts to biological resources located within the construction footprint. Mitigation measures have been proposed, including construction-site restrictions, land-reclamation plans, removal and storage of top soils and vegetation, noxious-weed management, preconstruction surveys for sensitive species, and seasonal restrictions on construction. These measures would serve to minimize the magnitude of construction impacts, which would be temporary. The other projects considered in this cumulative analysis would also have similar temporary construction impacts and would not be considered cumulatively significant.

Construction of the projects described in Section 5.2 would result in the disturbance of more than 2,386 acres (966 hectares) of land that may be potential Mojave desert tortoise habitat. Much of this land was previously disturbed, but the previously undisturbed vacant lands would result in the permanent loss of potential Mojave desert tortoise habitat. A cumulative impact would result. However, mitigation measures would be implemented to reduce the significance of this impact.

Operation of the proposed pipelines would substantially reduce flows to the Las Vegas Wash, affecting the diversity and location of wetlands and riparian vegetation. Implementation of SNWA's water conservation measures would potentially result in runoff flows to the Las Vegas Wash remaining constant. On-going construction of ECSs may serve to enhance the vegetation communities along the Las Vegas Wash. The ECSs stabilize sections of the channel by slowing the flow of water. Ponds are created behind the structures allowing for establishment of wetland and riparian vegetation. Therefore, the reduction in flows through the Las Vegas Wash are not expected to have a significant adverse impact on vegetation communities, and the ECSs have a potentially beneficial impact to vegetation communities. Additionally, the effects of reduced flows through the Las Vegas Wash would be analyzed and monitored regularly through the Boulder Basin AMP to ensure that no significant loss of valuable riparian or wetland habitat is occurring. Should loss of riparian or wetland habitat become apparent, the Boulder Basin AMP CMT, in coordination with associated committees and workgroups, would direct the treatment facilities to increase effluent delivery to the Las Vegas Wash.

The proposed Selective Withdrawal at Glen Canyon would improve temperatures for rainbow trout in the Colorado River immediately below Glen Canyon Dam. As the water flows downstream and warms, it would theoretically reach temperatures preferred by native and endangered fish in the Colorado River System. The proposed alternatives would not change the temperature of waters in Lake Mead. Therefore, a cumulative impact is not expected.

The potential cumulative impacts to human and aquatic resources related to EDCs, PPCPs, and other effluent-related constituents are described in Section 5.3.1. As stated in Section 5.3.1, some uncertainty exists about the effects of EDCs and PPCPs on fish. In areas of higher concentrations, the potential effects appear modest. They are not lethal. No effect has been identified on fish population levels, which are high at the mouth of Las Vegas Wash. Because the effect is uncertain and modest, even at the higher concentration levels, and because of the great dilution and assimilation capacity of Lake Mead, EDCs and PPCPs in effluent from the Las Vegas treatment facilities are not expected to affect fish below Hoover Dam. However, due to the uncertainty of effects, it is not known whether bioaccumulation occurs in aquatic species, or whether long-term exposure impacts reproductive success.

Based on the summary of the scientific studies summarized in Appendix K, it is assumed that there would be no cumulative impact on the lower Colorado River that would affect the goals of the LCR MSCP. However, because there is some uncertainty regarding the effects of EDCs and PPCPs on fish, a long-term water quality monitoring program, which includes monitoring of emerging compounds, would be implemented as part of the Boulder Basin AMP. A summary of the AMP including the emerging compounds to be monitored, is presented in Section 2.2.2.6 of the Final EIS.

5.3.3 Cultural Resources

The proposed pipeline alternatives may affect known and previously unknown cultural resources in the project area. Mitigation measures have been proposed as a means of limiting potential impacts to both known and unknown resources. The projects listed in Section 5.2 have a similar potential to impact cultural resources within the respective project footprints, which total 2,436 acres (986 hectares) of land. However, regulatory processes and mitigation measures are in place that would require specific actions to minimize impacts to important cultural resources. For this reason, no cumulative impacts would result from implementation of the proposed pipeline alternatives.

5.3.4 Recreation

The proposed pipeline alternatives would induce short-term impacts to recreational resources during construction of the project. Recreational resources in some areas would either be unavailable during construction or affected by construction-related dust, noise, or traffic. Mitigation measures have been proposed to limit the magnitude of these impacts.

The projects considered in this analysis would not all be constructed and implemented at the same time, and it is expected that they would have minimal adverse effects on recreational resources.

The temperature increase resulting from implementation of the Selective Withdrawal at Glen Canyon Dam is expected to increase the temperature of the inflow to Lake Mead. This would increase the physical bioavailability of nutrients in the inflow area of Lake Mead resulting in a possible increase in algae production. The SCOP effluent would be discharged below the thermocline and is not expected to reach the surface of Lake Mead prior to dilution. However, the No Action Alternative and Las Vegas Bay Alternative are expected to exceed water quality standards for chlorophyll when Lake levels are at 1,000 ft (305 m). Therefore, the increase in temperature from the Glen Canyon Dam releases, combined with high chlorophyll levels in Lake Mead may result in significantly increased algae production. This may have an adverse cumulative impact on some recreational resources within Lake Mead if LMNRA visitor numbers decrease because of a visible algae bloom. However, increased algae production provides nutrients for fish. This may result in a beneficial impact to sport fishing.

5.3.5 Hazardous Materials

The proposed pipeline alternatives would result in negligible impacts relating to hazardous materials. Mitigation measures would be implemented when necessary, and sampling and analysis of groundwater and soils would be conducted in accordance with NDEP guidance. No cumulative impacts are expected under the pipeline alternatives.

Implementation of MF/UF membranes under the Process Improvements Alternative would generate sludge that would require transport to and disposal at the Apex Landfill. The additional waste generated by growth in the Valley would also be disposed of at the Apex Landfill. However, the Apex Landfill has assured landfill capacity for decades into the future (NDEP 2004c). Therefore, no adverse cumulative impacts related to disposal of wastes are expected to occur.

5.3.6 Noise

The proposed pipeline alternatives would generate noise and vibration impacts along the project footprint from the operation of heavy construction vehicles and other construction-related activities. Mitigation measures have been proposed that would limit the potential effects of short-term construction noise on sensitive receptors, including visitors to the LMNRA.

A number of the projects listed in Section 5.2 would also generate short-term noise during construction of the respective projects. These projects are being constructed at different locations within the project vicinity and on separate schedules. Although some of these projects (and the proposed pipeline alternatives) may have overlapping schedules, the projects are not likely to have cumulative noise impacts because they are occurring over a large area. In addition, mitigation measures would minimize the noise impacts. For this reason, and because of the short duration of construction noise, no cumulative noise and vibration impacts would occur.

5.3.7 Air Quality

Implementation of the proposed pipeline alternatives would generate emissions of criteria pollutants during construction, in the form of fugitive dust from exposed soils, and engine exhaust emissions from construction equipment. The emissions would be temporary in duration and would be generated only during the construction phase. Negligible emissions would be generated from O&M after construction is completed. Local air pollution permitting requirements, supplemented by mitigation measures, would minimize impacts from fugitive dust.

The projects listed in Section 5.2 would also generate construction-related emissions that may coincide with the extended construction period associated with the proposed pipeline alternatives. The potential exists for these emissions to have a short-term cumulative effect if the construction schedules overlap and the construction sites are in close proximity. However, these impacts would be temporary in duration. Additionally, developed areas have less soil erosion from wind than undeveloped areas, so following completion of construction activities, soil erosion from wind (dust) would be minimal.

Potential air quality impacts from the proposed SCOP were used to analyze the potential air quality impacts from past, present, and future actions. Potential air emissions that may be generated from the construction of these projects were based upon the same general methodology used to calculate potential impacts to air quality from the SCOP (Appendix G). The potential air quality impacts (presented in Section 4.7 and Appendix G) from the proposed alternatives were used to extrapolate and calculate the potential air quality impacts from the past, present, and future actions presented in Section 5.2.

The air quality parameters analyzed for the SCOP were considered to determine the potential cumulative impacts to air quality. These parameters are:

- Construction Equipment Exhaust
  - CO
  - NO_x
  - PM_{10}
  - VOC
  - SO_2
- Dust
  - Uncontrolled Fugitive Dust Emissions
  - Controlled Fugitive Dust Emissions

Construction equipment exhaust emissions and fugitive dust for other projects were calculated based upon the worst-case 12-month potential emissions from construction activities (Table G.2-1 and G.7-6, respectively). These emissions were divided by the acres of disturbance expected to occur within the 12-month period. The resulting emissions per acre were then multiplied by the number of acres for each past, present, and future project. Table 5.3-1 presents an estimate of the equipment used for construction of the projects discussed in Section 5.2. Table 5.3-2 presents an estimate of the construction equipment exhaust that may be generated during construction of the

Table 5.3-1 Estimated Equipment Used for Past, Present, and Future Projects.

Equipment	Number onsite (per hour)	CO Emissions (g/hr)	NO_x + VOC Emissions (g/hr)	PM_{10} Emissions (g/hr)	SO_2 Emissions (g/hr)
65-ton Crane	1	650	1225	37.5	36.8
Front-end Loader	1	425.5	563.5	25.3	16.9
Backhoe/Grader	1	455	857.5	38.5	25.7
Bulldozers	1	455	857.5	38.5	28.7
Water Trucks	1	120.8	875	35	1.75
Haul Trucks for Excavated Materials	1	120.8	875	35	1.75
Haul Trucks for Fill Material	1	120.8	875	35	1.75
Material Delivery Trucks	1	120.8	875	35	1.75
Total Hourly Emissions (g/hr)	--	**2,468.7**	**7,003.5**	**279.8**	**115.1**
Total Daily Emissions (lb/day)	--	**43.54**	**123.52**	**4.93**	**2.03**
12-month Emissions (tons)	--	**6.79**	**19.27**	**0.77**	**0.32**

Table 5.3-2 Estimated Equipment Exhaust for Past, Present, and Future Projects.

Project	Surface Disturbance (acres)	Estimated Construction Duration (years)	Construction Equipment Exhaust Emissions			
			CO Emissions (tons/yr)	NOx + VOC Emissions (tons/yr)	PM10 Emissions (tons/yr)	SO2 Emissions (tons/yr)
Past						
Desert Inn Master Plan	190	3	29	95	17	1
Woodside Homes	52	2	12	39	7	1
Lake Las Vegas	350	5	32	105	19	1
Weston Hills	170	2	39	127	23	2
Tuscany Hills & C-1 Channel Extension	530	4	61	198	36	3
Ducks Unlimited	100	5	9	30	5	0

Table 5.3-2 Estimated Equipment Exhaust for Past, Present, and Future Projects (continued).

Project	Surface Disturbance (acres)	Estimated Construction Duration (years)	Construction Equipment Exhaust Emissions			
			CO Emissions (tons/yr)	CO Emissions (tons/yr)	CO Emissions (tons/yr)	CO Emissions (tons/yr)
SNWA Erosion Control Structures	2	2	0	1	0	0
Past Total	**1,394**	**23**	**182**	**595**	**107**	**8**
Present						
Wetlands Park	384	5	35	115	21	2
COH WRF Expansion	101	3	16	50	9	1
SNWA Drought Plan	NA	NA	NA	NA	NA	NA
Perchlorate Remediation	NA	NA	NA	NA	NA	NA
LCR MSCP	NA	NA	NA	NA	NA	NA
SNWA Erosion Control Structures	52	5	5	16	3	0
Categorically Excluded Activities on NPS Lands	NA	NA	NA	NA	NA	NA
Laughlin Wastewater Reclamation Facility	NA	NA	NA	NA	NA	NA
Present Total	**537**	**13**	**56**	**181**	**33**	**3**
Future						
SNWA Intakes	50	3	8	25	4	0
Glen Canyon Dam Selective Withdrawal Activities	NA	NA	NA	NA	NA	NA
CNLV Treatment Facility	15	2	3	11	2	0
Lower Basin Shortage Guidelines and Management Strategies	NA	NA	NA	NA	NA	NA
Future Total	**65**	**5**	**11**	**36**	**6**	**0**

Table 5.3-2 Estimated Equipment Exhaust for Past, Present, and Future Projects (continued).

Project	Surface Disturbance (acres)	Estimated Construction Duration (years)	Construction Equipment Exhaust Emissions			
			CO Emissions (tons/yr)	CO Emissions (tons/yr)	CO Emissions (tons/yr)	CO Emissions (tons/yr)
SCOP						
Boulder Islands North Alternative (Preferred Alternative)	595	5	55	178	32	2
Boulder Islands South Alternative	664	5	61	197	36	3
Las Vegas Bay Alternative	549	5	51	162	31	2
No Action Alternative	0	0				
Major Source Threshold-Valley Airshed			70	50	70	100
Major Source Threshold-Black Mountain Airshed			100	100	100	100
Major Source Threshold-Conformity Determinations			70	100	70	100

projects discussed in Section 5.2. Table 5.3-3 presents an estimate of the fugitive dust that may be generated during construction of the projects discussed in Section 5.2.

The results of the cumulative air quality impact analyses are grouped as they pertain to past, present, and future actions.

Past Actions: Based upon the estimated exhaust emissions, all of the past projects combined exceeded thresholds for CO, NOx + VOCs, and PM_{10}. The Lake Las Vegas, Desert Inn Master Plan, Westin Hills, and Tuscany Hills/C-1 Channel Extension projects each individually exceeded the thresholds for NOx + VOCs.

The Lake Las Vegas, Desert Inn Master Plan, Westin Hills, and Tuscany Hills/C-1 Channel Extension projects exceeded controlled fugitive dust emissions from construction activities. However, since construction of the past actions is complete, no cumulative impacts to air quality would occur from the combined construction of those projects with the SCOP project.

Present Actions: Impacts to air quality would not occur from the SNWA Drought Plan, perchlorate remediation activities, LCR MSCP, categorically excluded activities on NPS lands, and Laughlin Wastewater Reclamation Facility because they do not require construction activities and are not associated with emissions. The Wetlands Park project is expected to exceed conformity thresholds for NOx + VOCs. Combined, the present actions would not exceed the thresholds for CO, PM_{10}, SO_2 from exhaust emissions.

Table 5.3-3 Estimated Fugitive Dust Generated from Construction of Past, Present, and Future Projects.

Project	Surface Disturbance (acres)	Estimated Construction Duration (years)	Uncontrolled Fugitive Dust Emissions [1] (tons)	Controlled Fugitive Dust Emissions [2] (tons)	Uncontrolled Fugitive Dust Emissions [1] (tons/year)	Controlled Fugitive Dust Emissions [2] (tons/year)
Past						
Desert Inn Master Plan	190	3	737	369	246	123
Woodside Homes	52	2	202	101	101	50
Lake Las Vegas	350	5	1,358	679	272	136
Weston Hills	170	2	660	330	330	165
Tuscany Hills & C-1 Channel Extension	530	4	2,056	1,028	514	257
Ducks Unlimited	100	5	388	194	78	39
SNWA Erosion Control Structures	2	2	8	4	4	2
Past Total	**1,394**	**23**	**5,409**	**2,705**	**1,545**	**772**
Present						
Wetlands Park	384	5	1,490	745	298	149
COH WRF Expansion	101	3	392	196	131	65
SNWA Drought Plan	NA	NA	NA	NA	NA	NA
Perchlorate Remediation	NA	NA	NA	NA	NA	NA
Lower Colorado River Multi-species Conservation Plan	NA	NA	NA	NA	NA	NA
SNWA Erosion Control Structures	52	5	202	101	40	20
Categorically Excluded Activities on NPS lands	NA	NA	NA	NA	NA	NA

Table 5.3-3 Estimated Fugitive Dust Generated from Construction of Past, Present, and Future Projects (continued).

Project	Surface Disturbance (Acres)	Estimated Construction Duration (years)	Uncontrolled Fugitive Dust Emissions [1] (tons)	Controlled Fugitive Dust Emissions [2] (tons)	Uncontrolled Fugitive Dust Emissions [1] (tons/year)	Controlled Fugitive Dust Emissions [2] (tons/year)
Laughlin Wastewater Reclamation Facility	NA	NA	NA	NA	NA	NA
Present Total	**537**	**13**	**2,084**	**1,042**	**469**	**234**
Future						
SNWA Intakes	50	3	194	97	65	32
Glen Canyon Dam Selective Withdrawal Activities	NA	NA	NA	NA	NA	NA
City of North Las Vegas Treatment Facility	15	2	58	29	29	15
Lower Basin Shortage Guidelines and Management Strategies	NA	NA	NA	NA	NA	NA
Future Total	**65**	**5**	**252**	**126**	**94**	**47**
SCOP						
Boulder Islands North Alternative (Preferred Alternative)	595	5	2,309	1,154	462	231

Notes:

[1] Fugitive dust emissions reported only for dust with an aerodynamic diameter less than or equal to ≤ 10 µm. Uncontrolled PM_{10} emissions from earth disturbances were calculated using an emission factor of 0.42 tons PM_{10} per acre (i.e. 3,148,917.5 ft2 ÷ 4,3560 [ft2 per acre] = 72.3 acres x 0.42 [tons per acre] = 30.36 tons). The value of 0.42 tons PM_{10} per acre comes from the PM_{10} State Implementation Plan (SIP) for Clark County (Clark County 2001).

[2] The note for the Controlled Fugitive Dust Emissions is: Controls include those required in the Clark County SIP for construction activities (Clark County 2001). Controlled PM_{10} emissions were calculated using an emission factor of 0.21 tons PM_{10} per acre.

The Wetlands Park is expected to individually exceed thresholds for controlled fugitive dust emissions from construction activities.

Future Actions: Short-term impacts to air quality resources are anticipated as a result of construction equipment exhaust emissions under the SCOP proposed alternatives. Impacts are classified as minor because there would be a temporary, but detectable, change in ambient air pollutant concentrations. No impairment would occur to air quality within the LMNRA.

Because emissions from construction activities do not occur 24 hours per day, the concentrations estimated by the SCREEN3 model are overly conservative. It is not likely that the project would cause or contribute to an exceedance of the NAAQS. Therefore, no impairment would occur.

In addition, the use of diesel engines that meet calendar year 2007 emission standards would decrease nitrogen oxide emissions below major source threshold levels.

Projects planned to be constructed in the future are not expected (individually or combined) to exceed current air quality thresholds from construction equipment exhaust. However, since the SCOP project would be constructed in the future, it is considered in combination with the future projects in order to more accurately assess cumulative impacts to air quality. All of the proposed SCOP alternatives would individually exceed NOx + VOCs thresholds from equipment exhaust and thus the combined future projects would exceed those same thresholds. Only the CO thresholds would be exceeded if the future projects were combined with the Boulder Islands South Alternative. The future actions would not individually or combined exceed the PM_{10} and SO_2 thresholds. Each of the SCOP alternatives are expected to exceed the thresholds for controlled fugitive dust emissions and thus would exceed the thresholds when combined with other projects.

5.3.8 Earth Resources

The proposed pipeline alternatives would not have significant impacts involving earth resources. Development and construction from other projects in the region, and associated disturbance to soil, increases the potential for erosion. However, once construction is completed, developed areas typically experience less soil erosion than undeveloped areas. Compliance with erosion, stormwater, and water quality BMPs, and air quality requirements during construction, is required throughout Clark County, and would minimize the impacts.

5.3.9 Land Use

The proposed pipeline alternatives would result in temporary access restrictions during construction activities. These impacts are expected to be insignificant. Other construction actions in the vicinity would also restrict access to some areas. Some areas, particularly specific areas with the Wetlands Park or LMNRA, may not be accessible during specific times of the year and phases of construction. However, the access restrictions would not change the land use of the area, and would be temporary and localized. The restrictions would be removed once construction is complete. Therefore, cumulative impacts to land use would be insignificant.

5.3.10 Visual Resources

Visual resources impacts associated with the proposed pipeline alternatives consist primarily of temporary impacts to views during project construction. Impacts would be mitigated through post-construction land restoration activities. Permanent changes to the landscape and existing views would also occur, though these visual changes are expected to be minimal.

The proposed pipeline alternatives would not have cumulative adverse impacts on visual resources because the changes to the landscape would be temporary. In addition, other projects considered in this analysis would not have individual visual resources impacts that would contribute to a cumulative aesthetic degradation.

5.3.11 Socioeconomics

Implementation of the proposed pipeline alternatives would create socioeconomic effects in the form of increased employment, and increased local and state tax revenue associated with economic activity generated by this project. However, these changes would not have a significant socioeconomic impact within the study area.

A few of the projects considered in this cumulative analysis have the potential to require increases in water or wastewater rates, and increases in taxes to fund the projects. These increases would be experienced by residents and businesses within the Valley.

5.3.12 Environmental Justice

The SCOP alternatives would have no impact on Environmental Justice populations or ITAs. Therefore, the proposed alternatives would not contribute to cumulative impacts.

5.3.13 Transportation and Traffic

Implementation of the proposed pipeline alternatives would cause short-term localized traffic congestion in the vicinity of the construction sites. Traffic management plans are proposed as a means of reducing the magnitude of these impacts.

The listed projects would generate relatively minor levels of traffic during construction, and in some cases, during operation of the projects. Traffic impacts associated with the proposed pipeline alternatives would only occur during construction. However, depending on the timing and location of the various projects, the incremental addition of new traffic, particularly heavy trucks, may have a cumulative effect on local traffic conditions. This cumulative impact would occur over the entire construction period for the proposed alternatives and subside after construction is completed.

5.3.14 Paleontological Resources

The SCOP alternatives would have no impact on paleontological resources. Therefore, the proposed alternatives would not contribute to cumulative impacts.

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Chapter 6

Commitment of Resources, Unavoidable Impacts, and Relationship between Short-term Uses and Long-term Productivity

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6.0 Commitment of Resources, Unavoidable Impacts, and Relationship Between Short-term Uses and Long-term Productivity

6.1 Irreversible and Irretrievable Commitment of Resources

A commitment of resources is irreversible when its primary or secondary impacts limit the future option for a resource. An irretrievable commitment refers to the use or consumption of resources neither renewable nor recoverable for later use by future generations. Implementation of any of the pipeline alternatives involving construction would require a commitment of natural, physical, human, and fiscal resources. Construction and operation of any of the pipeline construction alternatives would require similar commitment of these resources. This discussion focuses on:

- The project's use of nonrenewable resources during construction and operation, which includes fossil fuels, electricity, water, and labor; and
- The changes expected to occur as a result of the proposed project including the commitment of land for the proposed project, physical changes in the environment, effects on human populations, and fiscal changes.

Construction of the proposed project would require the use of fossil fuels for construction vehicles, equipment, and construction-worker vehicles. Electricity would also be used at construction trailers or by portable generators during project construction.

Construction of the proposed project would require the use of various types of raw building materials, including cement, aggregate, steel and asphalt, electrical supplies, piping, and other building materials such as metal, stone, sand, and fill material. Additionally, the fabrication and preparation of these construction materials would require labor and natural resources. Utilization of these resources would be irretrievable. However, these resources are readily available at this time, and adverse effects on their continued availability are not expected.

Construction and operation of the proposed facilities would require labor, which would be otherwise unavailable for other projects. The commitment of labor is considered irretrievable. Furthermore, fiscal resources would be irretrievably committed to construction and operation of the proposed project. These funds would then not be available for other projects and activities.

In addition to the resources utilized in construction and operation of the proposed project, there would be irreversible and irretrievable loss of existing resources in the impact areas. These resources would include the loss of biological habitat as discussed in Section 4.2. Negative effects have been minimized to the extent possible, but some effects remain.

The three pipeline alternatives considered for the proposed project vary in their routes to Lake Mead. However, each alternative would require similar commitments of natural, physical, human, and fiscal resources. Benefits from the proposed project, in terms of flexible management of wastewater flows in the Valley, are considered to outweigh the irreversible and irretrievable commitment of these resources.

6.2 Unavoidable Impacts

Unavoidable impacts constitute a substantial adverse change to existing environmental conditions that cannot be fully mitigated by implementing mitigation measures. The potential unavoidable adverse impacts that could arise from implementing the alternatives discussed in Chapter 2 are presented in this section.

- Water Resources - Adaptation and implementation of the Boulder Basin AMP would ensure that no unavoidable impacts to water resources would occur.
- Biological Resources - Temporary displacement of wildlife and aquatic species; disturbance, loss, or damage to individual plants and seed bank; reduction of habitat for aquatic fauna; and potential impact to the quality of the sport fishery in Las Vegas Bay.
- Cultural Resources - Potential removal of eligible cultural sites from the landscape.
- Recreation - Some recreation areas would be inaccessible to the public during construction.
- Hazardous Materials - Possible encounter with perchlorate contaminated groundwater.
- Noise and Vibration - No unavoidable adverse impacts were identified.
- Air Quality - Fugitive dust and exhaust emissions from construction activities.
- Earth Resources - No unavoidable adverse impacts identified.
- Land Use - No unavoidable adverse impacts identified.
- Visual Resources - Visual scarring of landscape through placement of pipeline.
- Socioeconomics - No unavoidable adverse impacts identified.
- Environmental Justice - No unavoidable adverse impacts identified.
- Transportation and Traffic - Potential short term impacts to LOS traffic conditions on Boulder Highway.
- Paleontological Resources - Potential to damage or destroy any fossils that may be present.

6.3 Relationship Between Short-Term Uses and Long-Term Productivity

Short-term uses are defined as those that take place during the 30-year timeframe covered in this EIS analysis. Long-term is defined as the time period beyond the 30-year timeframe of this EIS. If the resource cannot be rehabilitated to its most productive long-term use within a 30-year timeframe, then it is considered in this analysis to be impaired for the long term.

Surface disturbance would produce short-term disruption of the ecosystem and soils. Ecological productivity would be reduced temporarily during construction activities, but would not continue long term. There would be some short-term alteration of surface-water drainage patterns, but natural drainage patterns would be restored following construction. Some PM_{10} and temporary mobile-source emissions would be produced in the short term from construction activities, but there would be no long-term effects.

Although it is not expected that cultural or paleontological resources would be encountered during construction, these resources would be subject to data recovery in order to mitigate the impact of the activity on their values. While this enhances the short-term knowledge base, it also removes some of the potential for an even greater recovery of information to be gained through future studies using improved technology. Vandalism and illicit artifact collecting within archaeologically and paleontologically sensitive areas are likely to cause a negative impact to cultural resources over the long term.

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Chapter 7

Consultation and Coordination

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7.0 Consultation and Coordination

The consultation and coordination efforts made by the lead agencies and the CWC during the preparation of this EIS are summarized in this chapter. Meetings, briefings, and consultations were conducted with federal, tribal, state, county, and local agencies and governments, as well as the public. Some actions taken by the lead agencies and the CWC were mandated by regulations; other actions were initiated by the CWC to further encourage participation in the NEPA process. Consulting and cooperating agencies reviewed the Draft SCOP EIS prior to its issuance, and provided comments, which have been addressed.

7.1 Cooperating Agencies

Two federal agencies, one state agency, and one local agency served as cooperating agencies with the NPS and Reclamation in accordance with 40 CFR 1501.5 and 1501.6. The NPS and Reclamation sought their cooperation to identify potential impacts to lands owned, administered, or managed by these agencies as a result of implementing the proposed alternatives. Specific areas of expertise within these agencies were critical to the lead agencies for the evaluation of its alternatives. General functions applicable to all cooperating agencies were to:

- Provide land-use plans and other reference documents that could assist in the analysis;
- Coordinate internal reviews and provide one set of comments for the Preliminary Draft EIS to assure accuracy;
- Attend and participate in periodic meetings such as technical working groups, public meetings and hearings, and interagency meetings related to the SCOP EIS; and
- Assist, where applicable, with response to public comments.

The following briefly describes the specific contributions of the four cooperating agencies.

U.S. Army Corps of Engineers. The USACE reviewed the SCOP Preliminary Draft EIS and provided comments that were incorporated into the Draft EIS. The USACE, in accordance with Section 404 of the CWA, regulates the discharge of dredged and fill material in waters of the U.S. e.g., Las Vegas Wash. The USACE also regulates construction and dredging in navigable waters of the U. S. e.g., Lake Mead, under Section 10 of the *Rivers and Harbors Act*. Aspects of the SCOP will require a permit from the USACE.

U.S. Bureau of Land Management. The BLM reviewed the SCOP Preliminary Draft EIS and provided comments that were incorporated into the Draft EIS. The BLM provides input for portions of the proposed SCOP alignments that would be located on BLM-managed lands and would require the issuance of BLM ROWs.

Colorado River Commission of Nevada. The Colorado River Commission of Nevada reviewed the SCOP Preliminary Draft EIS and provided comments that were incorporated into the Draft EIS. The Nevada Colorado River Commission of Nevada possesses expertise with Nevada water issues, including expertise and interest in Colorado River return flow credits. Therefore, the Colorado River Commission of Nevada provides assistance in their area of expertise during the EIS process.

Metropolitan Water District of Southern California. The MWD reviewed the SCOP Preliminary Draft EIS and provided comments that were incorporated into the Draft EIS. The MWD possesses expertise with Colorado River Water issues and water quality. Therefore, the MWD provides assistance in their area of expertise during the EIS process.

7.2 Native Americans

The DOI, SO 3175 established the policies, responsibilities, and procedures for operating on a government-to-government basis with federally recognized Native American tribes for the identification, conservation, and protection of Native American and Alaska Native trust resources to ensure the fulfillment of the Federal Indian Trust Responsibility. Legal interests in property held in trust by the U.S. for federally recognized Native American Tribes are ITA. Among other directives of SO 3175, it is a DOI requirement to consult with Native American tribes when trust property may be affected. This includes fishing and water rights. The ITA identification should be considered early in the NEPA process and involve consultation with tribes, Native American organizations, and the BIA.

Letters notifying tribal members of the proposed project and an attached copy of the Federal Register NOI were mailed on August 9, 2002 to 31 individual members representing 19 Native American Tribes located near and downstream from the proposed project (Table 7.2-1). No response letters from the tribes were received. No tribal members attended the Scoping Meetings that were held in August 2002.

Additionally, a Native American Coordination Meeting was held on March 31, 2004. Invitations were sent to the same tribal members mentioned previously. Three individuals representing the Fort Mojave, Las Vegas Paiute Tribal Council, and CRIT attended the meeting. The meeting was held in an open format, in which members of the tribes were encouraged to provide comments. Appendix C contains the transcripts of the meeting and comments received from the Native American Tribes.

7.3 Consultations

Consultation activities with the federal agencies responsible for the protection of biological and cultural resources are described in this section.

7.3.1 Endangered Species Act, Section 7 Consultation

The ESA of 1973, as amended (16 USC 1531 et seq.) directs the USFWS to protect listed plants and animals. It also directs all federal agencies to participate in endangered species conservation. Specifically, Section 7 of the ESA charges federal agencies to aid in the conservation of listed species (Section 7 (a) (1)) and requires federal agencies to ensure that their activities will not jeopardize the continued existence of listed species or adversely modify designated critical habitats (Section 7 (a)(2)). The ESA and its implementing regulations prohibit any action that would "take" (harass, harm, or kill) a federally listed threatened or endangered species, or its critical habitat (on public or private lands) (USFWS 1998).

Table 7.2-1 Native American Tribes Contacted.

Tribe	Letters	Meetings
Aha Mahav Cultural Society	August 9, 2002 March 2, 2004	Scoping Meetings – August 2002 Tribal Meeting – March 31, 2004
Chemehuevi Tribal Council	August 9, 2002 March 2, 2004	Scoping Meetings – August 2002 Tribal Meeting – March 31, 2004
Colorado River Indian Tribal Museum	August 9, 2002 March 2, 2004	Scoping Meetings – August 2002 Tribal Meeting – March 31, 2004
Colorado River Indian Tribe	August 9, 2002 March 2, 2004	Scoping Meetings – August 2002 Tribal Meeting – March 31, 2004
Fort McDowell Mohave-Apache Community Council	August 9, 2002 March 2, 2004	Scoping Meetings – August 2002 Tribal Meeting – March 31, 2004
Fort Mojave Tribal Council	August 9, 2002 March 2, 2004	Scoping Meetings – August 2002 Tribal Meeting – March 31, 2004
Havasupai Tribal Council	August 9, 2002 March 2, 2004	Scoping Meetings – August 2002 Tribal Meeting – March 31, 2004
Hopi Office of Cultural Preservation	August 9, 2002 March 2, 2004	Scoping Meetings – August 2002 Tribal Meeting – March 31, 2004
Hopi Tribe	August 9, 2002 March 2, 2004	Scoping Meetings – August 2002 Tribal Meeting – March 31, 2004
Hualapai Tribe	August 9, 2002 March 2, 2004	Scoping Meetings – August 2002 Tribal Meeting – March 31, 2004
Kaibab Paiute Tribal Council	August 9, 2002 March 2, 2004	Scoping Meetings – August 2002 Tribal Meeting – March 31, 2004
Kaibab Paiute Tribe	August 9, 2002 March 2, 2004	Scoping Meetings – August 2002 Tribal Meeting – March 31, 2004
Las Vegas Indian Center	August 9, 2002 March 2, 2004	Scoping Meetings – August 2002 Tribal Meeting – March 31, 2004
Las Vegas Paiute Tribe	August 9, 2002 March 2, 2004	Scoping Meetings – August 2002 Tribal Meeting – March 31, 2004
Las Vegas Paiute Tribal Council	August 9, 2002 March 2, 2004	Scoping Meetings – August 2002 Tribal Meeting – March 31, 2004
Moapa Paiute Band of Moapa Indian	August 9, 2002 March 2, 2004	Scoping Meetings – August 2002 Tribal Meeting – March 31, 2004
Navajo Nation	August 9, 2002 March 2, 2004	Scoping Meetings – August 2002 Tribal Meeting – March 31, 2004
Pahrump Paiute Tribe	August 9, 2002 March 2, 2004	Scoping Meetings – August 2002 Tribal Meeting – March 31, 2004
Paiute Indian Tribe of Utah Tribal Council	August 9, 2002 March 2, 2004	Scoping Meetings – August 2002 Tribal Meeting – March 31, 2004
Pueblo of Zuni	August 9, 2002 March 2, 2004	Scoping Meetings – August 2002 Tribal Meeting – March 31, 2004

Table 7.2-1 Native American Tribes Contacted (continued).

Tribe	Letters	Meetings
Pueblo of Zuni Tribal Council	August 9, 2002 March 2, 2004	Scoping Meetings – August 2002 Tribal Meeting – March 31, 2004
Yavapai Tribe	August 9, 2002 March 2, 2004	Scoping Meetings – August 2002 Tribal Meeting – March 31, 2004

Section 7(a)(2) of the ESA requires federal agencies to consult with the USFWS, prior to implementation of a project, to ensure that actions they fund, authorize, permit, or otherwise carry out will not jeopardize the continued existence of any listed species or adversely modify their habitats or designated critical habitats.

Before initiating an action, the federal action agency (the agency planning a specific action), or its non-federal permit applicant, must ask the USFWS to provide a list of threatened, endangered, proposed candidate species, and designated critical habitats that may be present in the project area. If the USFWS determines that there are no species or critical habitats present, then the federal action agency has no further ESA obligation under Section 7(a)(2) and consultation is concluded. If a species is present, then the federal action agency must determine whether the project may affect a listed species. If so, consultation is required. If the action agency determines (and the USFWS agrees) that the project does not adversely affect any listed species, then the consultation (informal to this point) is concluded and the decision is put in writing.

If the federal action agency determines that a project may adversely affect a listed species or designated critical habitat, formal consultation is required. The consultation is required to be completed within 90 days and then the biological opinion must be completed within 45 days. The determination of whether or not the proposed action would be likely to jeopardize the species or adversely modify its critical habitat is contained in the biological opinion. If a jeopardy or adverse modification determination is made, the biological opinion must identify any reasonable and prudent alternatives that could allow the project to be implemented (USFWS 2002).

The NPS and Reclamation have initiated formal consultation with the USFWS. A biological opinion for SCOP will be issued prior to issuance of the ROD.

7.3.2 National Historic Preservation Act, Section 106

The NHPA, as amended (16 USC 470 et seq.) and the ARPA, as amended (16 USC 470aa-mm) require federal agencies to assess potential effects federal actions may have on districts, sites, buildings, structures, or objects included, or eligible to be included, in the NRHP.

It is federal policy to avoid or minimize adverse effects to cultural resources when planning, constructing, and/or assisting a federal project. In some cases, it is impossible to avoid disturbance or destruction of cultural resources in order to implement an approved project. In

such instances, it is federal policy to recover the information embodied in those resources through historical and archaeological study before the project begins.

Section 106 of the NHPA mandates that consultation be conducted with other agencies such as the SHPO, Tribal Historic Preservation Officer, and/or the Advisory Council on Historic Preservation before proceeding with projects that may adversely affect cultural resources. Consultation with SHPO and the Advisory Council on Historic Preservation has been completed. A Programmatic Agreement has been initiated that ensures the required mitigation measures are implemented to minimize or eliminate the potential impact to cultural resources. In addition, Section 101(d)(6)(B) of NHPA requires consultation with Native American tribes that attach religious and cultural significance to historic properties, which are called TCPs. The federal agency must make a reasonable and good faith effort to identify such Native American tribes and invite them to be consulting parties.

Analysis for cultural resources would be required and would include a site records search and consultation with Native Americans to develop an inventory of potentially affected cultural resources including TCPs. Where sensitive cultural resources are known or have a high potential to occur, this information will be submitted to the SHPO/Tribal Historic Preservation Officer to initiate Section 106 consultation with the Advisory Council on Historic Preservation (SHPO 1998). The requirements described in the previous paragraphs have been met and the Section 106 consultation has been completed for SCOP. A Programmatic Agreement has been initiated that ensures the required mitigation measures are implemented to minimize or eliminate the potential impact to cultural resources.

7.4 Public Participation

The CEQ regulations require that "agencies shall make diligent efforts to involve the public in preparing and implementing their NEPA procedures" (40 CFR 1506.6). Scoping is the first opportunity in the NEPA process for the public to provide input regarding a proposed action. Comments and suggestions received as a result of the scoping process are used to prepare the Draft and Final EIS.

Additionally, public involvement occurs throughout the NEPA process. A common method for soliciting public input is to form a committee as discussed in Section 1.6.2. Public input is also solicited when the Draft EIS is made available for public and agency review and comment. Comments regarding the Draft EIS are addressed in the Final EIS.

7.4.1 Scoping

The CEQ Regulations for Implementing the Procedural Provisions of NEPA, 40 CFR 1501.7, states that:

> There shall be an early and open process for determining the scope of issues to be addressed and for identifying the significant issues related to a proposed action. This process shall be termed scoping. As soon as practicable after its decision to prepare an environmental impact statement and before the scoping process the lead agency shall publish a notice of intent in the *Federal Register*.

The NOI to prepare an EIS for the SCOP was published in the *Federal Register*/Vol. 67, No. 144 on July 26, 2002 (Appendix A). The NOI contains:

- A brief description of the proposed project;
- The location, date, and time of the scoping meetings;
- Mailing addresses for submittal of written comments; and
- The deadline for submittal of comments.

Notices were also published in local and regional newspapers including the Las Vegas *Review Journal*, Henderson *Home News*, *Arizona Republic*, *Desert Sun*, Los Angeles *Times*, and San Diego *Union-Tribune*. Postcards were mailed to residents in southern Nevada, Arizona, and California notifying them of the scoping meetings. The information provided in the newspaper notices and on the postcards included the meeting locations, dates, and times as well as a brief description of the proposed project.

Scoping meetings were conducted to give the public an opportunity to review the possible project alternatives, identify significant environmental and other issues, and to provide comments and suggestions on the proposed SCOP for consideration in the associated EIS. Appendix B contains the comments that were received during the scoping process.

Scoping meetings were held in eight locations in Nevada, Arizona, and California. The meeting dates and locations are presented in Section 1.6.1.

7.4.2 Clean Water Coalition Citizens Advisory Committee

On December 5, 2002, the governing board of the CWC established the CWCCAC to gather public input on water- and wastewater-related issues impacting the southern Nevada watershed and parts of the lower Colorado River. On December 19, 2002, the CWC Board appointed members to serve on the CWCCAC. The objectives of the CWCCAC and the process used are described in Section 1.6.2.

The CWCCAC is part of the larger public input procedure required in any EIS. The CWCCAC interfaced with the public and provided an opportunity for open discussion and public participation in the overall process. After evaluation of the issues, the CWCCAC formulated potential solutions and made critical recommendations to the CWC Board regarding the alternatives that should be carried forward in the EIS. The CWCCAC ultimately assisted with the development of alternatives that would be analyzed in this EIS.

7.4.3 Draft EIS Public Hearings

The CEQ regulations (40 CFR 1503.1) invite the public to review and comment on the Draft EIS. An NOA was published by the NPS/Reclamation in the *Federal Register* on October 5, 2005 (Vol. 70, No.192) and by the EPA on October 7, 2005 (Vol. 70, No. 194) announcing the availability of the Draft EIS for public review and comment. A copy of the NOA is presented in Appendix A.

The public notice announcing the hearings was published in the following newspapers on the following dates.

- Henderson *Home News*: September 29 and October 13, 2005.
- Las Vegas *Review Journal*: October 2 and 16, 2005.
- Kingman *Daily Miner*, Arizona Republic, LA *Times*, San Diego *Tribune*, and *Desert Sun*: October 9 and 23, 2005.

The information provided in the newspaper notices included the meeting locations, dates, and times as well as a brief description of the proposed project.

Public hearings were held in nine locations in Nevada, Arizona, and California. The meeting dates and locations are presented in Section 1.6.4. The public hearings were conducted to give the public an opportunity to comment on the potential environmental impacts described in the Draft EIS. A court recorder was in attendance at most of the meetings to record comments received from members of the public.

Written comments were accepted at the public hearings, via email, and U.S. mail. The official close of the comment period was December 7, 2005. The EPA and others were granted an extension to comment to December 22, 2005, and comments were accepted through January 30, 2006. Section 1503.4 of the CEQ Regulations requires that comments be considered and responses be provided in the Final EIS. All comments received and the associated responses are provided in Appendix L, Comments and Responses, of this Final EIS.

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Chapter 8

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Chapter 9

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9.1 Regulation, Order, Law

American Indian Religious Freedom Act of 1978 (as amended). 42 USC 1996 et seq. PL 95-341.

Archaeological Resources Protection Act of 1979 (as amended). 16 USC 470aa-470mm. 93 Stat. 721; 43 CFR 7; PL 96-65.

Bald Eagle Protection Act of 1940 (as amended). 16 USC 668 a-d. PL 86-70 (73 Stat. 143), PL 87-884 (76 Stat. 1346), PL 92-535 (86 Stat. 1064), and PL 95-161 (92 Stat. 3114).

Clean Air Act of 1970 (as amended in 1977 and 1990). 42 USC 7401 et seq. PL 91-604; 42 USC 1857h-7 et seq.

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), commonly known as Superfund (as amended) 42 USC 103. Enacted December 11, 1980.

Council on Environmental Quality (CEQ). Regulations for Implementing the National Environmental Policy Act. 1993. 40 CFR 1500 through 1508.

Departmental Responsibilities for Indian Trust Resources. 1993. Secretarial Order 3175.

Determination of Attainment by the Applicable Attainment Date for the Carbon Monoxide National Ambient Air Quality Standard Within the Las Vegas Valley Nonattainment Area, Clark County, NV; Determination Regarding Applicability of Certain Clean Air Act Requirements, Rules and Regulations, Page 31353-31354. Federal Register 31353 June 1, 2005 (Volume 70, Number 104).

Determining conformity of Federal Actions to State or Federal implementation plans. Applicability. 40 CFR 93.153.

Endangered Species Act of 1973 (as amended). 16 USC 1531 et seq. PL 93-205.

Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations. 1994. Executive Order 12898.

Federal Register. 1994. Endangered and Threatened Wildlife and Plants; Determination of Critical Habitat for the Colorado River Endangered Fishes: Razorback Sucker, Colorado Squawfish, Humpback Chub, and Bonytail Chub. U.S. Fish and Wildlife Service Federal Register Notice. March 24.

Federal Water Pollution Control Act of 1972 (Clean Water Act of 1977) (as amended) 33 USC 1251-1387. PL 92-500.

Floodplain Management. 1977. Executive Order 11988.

Guidelines for Specification of Disposal Sites for Dredged or Fill Material. 1977. 40 CFR 230.3.

Invasive Species. 1999. Executive Order 13112.

Lake Mead National Recreation Area, Enabling Legislation. 1946. 88th Cong. 653d session. PL 88-639. Listing of Relict Frog. 2002. Federal Register 40657, Vol. 67.

Migratory Bird Treaty Act of 1918. 16 USC 703-711.

Mining Law of 1872. 30 USC 22-24, 26-28, 29-30, 33-35, 37, 39-42, and 47.

National Emission Standards for Hazardous Air Pollutants for Source Categories; Offsite-Waste and Recovery Operations. 40 CFR 60-63.

National Environmental Policy Act of 1969 (NEPA) (as amended). 42 USC 4321 et seq. PL 91-190.

National Historic Preservation Act of 1966 (as amended). 16 USC 470a et seq. 80 Stat. 915; PL 89-665.

National Park Service Organic Act of 1916. 16 USC 1.

National Primary Drinking Water Regulations. 42 USC 300g; 40 CFR 143.

National Register of Historic Places. 36 CFR 60.4.

Native American Graves Protection and Repatriation Act of 1990. 25 USC 3001-30013. 104 Stat. 3042; 43 CFR 10; PL 101-601.

Noise Control Act of 1972 (as amended). 42 USC 4901. PL 92-574.

Oxides of nitrogen, carbon monoxide, hydrocarbon, and particulate matter exhaust emission standards. 1999. 40 CFR 89.112.

Protection and Accommodation of Access to "Indian Sacred Sites". 1996. Executive Order 13007.

Protection and Enhancement of Environmental Quality. 1977. Executive Order 11514.

Protection of Historic Properties Act. 1986. Advisory Council on Historic Preservation. 36 CFR 800.

Protection of Wetlands. 1977. Executive Order 11990.

Resource Conservation and Recovery Act of 1976 (RCRA). 24 USC 6901 et seq.

Rivers and Harbors Act of 1938 as amended. 33USC 540.

Safe Drinking Water Act of 1974 (as amended). 42 USC 300f et seq. PL 93-523.

Southern Nevada Public Land Management Act of 1998 (SNPLMA). PL 105-263.

Superfund Amendments and Reauthorization Act (SARA) of 1986. Amendment to CERCLA, enacted October 17 (100 Stat. 1613). PL 99-499.

Waters of the United States (definition). 33 CFR 228.3.

State Codes and Statutes:

California Code of Regulations. Title 14 California Code of Regulations Chapter 3, Appendix G.

Historic Preservation and Archaeology: Protection of Indian Burial Sites. NRS 383.150-383.190.

Nevada Administrative Code (NAC). Chapter 445A.118-445A.225. Water Pollution Control Standards for Water Quality.

Nevada Revised Statutes (NRS) 503.597 and 503.650. 2003. Introduction or removal of aquatic life or wildlife: Approval required; investigation; regulations (503.597). Collection or shipping of wildlife for scientific or educational purposes; fee for permit (503.650).

State of Nevada Antiquities Law. 1959. NRS 382-195-227.

Water Controls. Standards for Water Quality. NAC Ch. 445A. 118-445A. 225.

County and City Codes

City of Henderson (COH). 1988. City of Henderson Municipal Code, Chapter 8.84, Noise.

_____. 1989. City of Henderson Municipal Code, Chapter 19.9.7, Operational Performance Standards.

Health and Safety. Noise Regulations. City of Las Vegas Municipal Code Title 9.

Public Peace and Safety. Noise Regulations. City of Henderson Municipal Code Title 8.

Site Environmental Standards, Noise. Clark County Unified Development Code Title 30. Part 68.20.

9.2 General

ACRE. 2003. Integrity Evaluation and NRHP Reevaluation of Railroads Associated with Construction of Hoover Dam. Reclamation Report No. LC-NV-97-02-01D. Associated Cultural Resource Experts, Littleton, Colorado.

Albrecht, B. and P.B. Holden. 2005. Razorback sucker studies on Lake Mead, Nevada. 2004-2005 Annual Report. Prepared for the Department of Resources, Southern Nevada Water Authority, by BIO-WEST, Logan, Utah. PR-960-1.

Alcorn, J.R. 1988. The Birds of Nevada. Fairview West Publishing, Fallon, Nevada. 418 pp.

Amelung, Falk, John W. Bell, Howard A. Zebker, Randell J. Laczniak. 1999. Sensing the ups and downs of Las Vegas: InSAR reveals structural control of land subsidence and

aquifer-system deformation. Geology, Volume 27, No. 6. June. http://www.geodesy.miami.edu/~amelung/pubs/ 1999_vegas/vegas.html. Accessed April 2004.

Anderson, B.W. and R.D. Ohmart. 1985. Habitat Use by Clapper Rails in the Lower Colorado River Valley. Condor 87:116-126.

Bedinger, M.S., K.A. Sargent, and W.H. Langer. 1989. Studies of Geology and Hydrology in the Basin and Range Province, Southwestern U.S., for Isolation of High-level Radioactive Waste-Characterization of the Death Valley region, Nevada and California. USGS Professional Paper 1370 F.49 p.

Bell, J.W. and E.I. Smith. 1980. Geological Map of the Henderson Quadrangle, Clark County, Nevada. Nevada Bureau of Mines and Geology. Map 67, Scale 1:24,000.

Benke, R.J. and D.E. Benson. 1983. Endangered and Threatened Fishes of the Colorado River Basin. Cooperative Extension Service Bulletin 503a, Colorado State University, Fort Collins, CO.

Bevans, H.E., S.L. Goodbred, J.F. Miesner, S.A. Watkins, T.S. Gross, N.D. Denslow, and T. Schoeb. 1996. Synthetic organic compounds and carp endocrinology and histology in Las Vegas Wash and Las Vegas and Callville bays of Lake Mead, Nevada, 1992 and 1995. USGS, National Water Quality Assessment Program, Water Resources Investigation Report 96-4266, Denver, CO.

Black & Veatch. 2003. Construction Noise Assessment, SCOP Clark County, Nevada. Prepared for the CWC. July 17.

_____. 2004a. Effluent Interceptor Preliminary Design Report. Prepared for the CWC. March.

_____. 2004b. SCOP Process Assessment. Prepared for the CWC. March 4.

_____. 2004c. Preliminary Water Quality Modeling Results. Technical assistance provided by Flow Science, Inc. Prepared for the CWC.

_____. 2004d. Lake Conveyance System Conceptual Engineering Report. Prepared for the CWC. March 24.

_____. 2005a. Final Las Vegas Wash Modeling Report. Prepared for the CWC.

_____. 2005b. Final Lake Mead Modeling Report. Technical assistance provided by Flow Science, Inc. Prepared for the CWC. August.

_____. 2006. Personal communications via email between Jeff McMullen, Black & Veatch, and Billye Sisler, PBS&J, regarding the Process Improvements Alternative's use of microfiltration/ultrafiltration membranes. August.

BMZ. 2000. Environmental Handbook Documentation on Monitoring and Evaluating Environmental Impacts, Environmental Brief, Limiting the Number of Pathogens in

Service Water and Wastewater. Accessed on May 11, 2005 at www.gtz.de/ecosan/download/BMZ-environment.

Boyles, Michael. 2004. Personal communication via e-mail from Michael Boyles, NPS, to Carrie Stewart, PBS&J. November 8.

_____. 2005. Information received in the NPS comments on the Preliminary Draft EIS #2. January.

_____. 2006. Information received from the NPS in the Biological Assessment Meeting held on April 27, 2006.

Bradford, R.H. and B.R. Vlach. 1995. Razorback sucker habitat assessment indices for the Lower Colorado River. Report prepared for Reclamation. Cooperative agreement no. 3-FC-34-08243. 39 pp.

Bradley, Glen W. and James E. Deacon. 1965. The Biotic Communities of Southern Nevada. Preprint No. 9. Desert Research Institute. Reno, NV.

Brooks, Richard H. and Daniel O. Larson. 1975. Prehistoric and Historic Research Along the Navajo-McCullough Transmission Line Right-of-way. Report No. 4-2-1. Harry Reid Center for Environmental Studies, UNLV.

Brown, B.T. 1988. Breeding ecology of a willow flycatcher population in Grand Canyon, Arizona. Western Birds 19:25-33.

Browning, M.R. 1993. Comments on the taxonomy of *Empidonax traillii* (willow flycatcher). Western Birds 24:241-257.

Bureau of Labor Statistics. 2004. Household Data Annual Averages - Employment Status Statistics of the Civilian Non-Institutional Population, 1939 to Date. Available at http://www.bls.gov/cps/cps_over.htm#available. Accessed on March 3, 2004.

Burt, W.H. and R.P. Grossenheider. 1976. A Field Guide to the Mammals of North America North of Mexico. Houghton Mifflin Company, Boston, MA. 294 pp.

Calgon Carbon Engineered Solutions. 2003. UV Oxidation and Disinfection Papers and Abstracts. Accessed on May 11, 2005 at www.solventseparation.com/cheviron/tech/support.

Chow, Judith C., John G. Watson, Mark C. Green, Douglas H. Lowenthal, David W. DuBois, Steven D.Kohl, Richard T. Egami, John Gillies, C. Fred Rogers, Clifton A. Frazier and William Cates. 1999. Middle- and Neighborhood-Scale Variations of PM_{10} Source Contributions in Las Vegas, Nevada. Journal of the Air & Waste Management Association, Volume 49, pp. 641-654. June.

City of Henderson (COH). 2002a. Water Quality Data for the Las Vegas Wash at Northshore Road.

_____. 2002b. Neighborhood Planning Areas (map). http://www.ci.henderson.nv.us/planning/maps/planarea.pdf. October.

_____. 2002c. Future Development Plan (map). http://www.ci.henderson.nv.us/planning/maps/landuse.pdf. Revised October.

_____. 2002d. Community Development Existing Zoning and ROI.Zoning (2 maps). http://www.ci.henderson.nv.us/planning/maps/zoning.pdf. Revised October.

_____. 2004. Personal communication between Tim Smith, Operations Manager WRF, with PBS&J employee L. Bowdidge. August 6.

City of Henderson, City of Las Vegas, City of North Las Vegas, Clark County Sanitation District, Las Vegas Valley Water District. 2000. Area Wide Reuse Study, Las Vegas Valley Study Area. Prepared by Black & Veatch. July.

City of Las Vegas (CLV). 2004. City of Las Vegas Effluent Amounts through June, 2004. Prepared for the CLV WPCF.

Cizdziel, James and Xiaoping Zhou. 2005. Sources and Concentrations of Mercury and Selenium in Compartments within The Las Vegas Wash During a Period of Rapid Change. *Environmental Monitoring and Assessment* (2005) 107: 81–99

Clark County. 1983. Clark County Comprehensive Master Plan. Clark County Department of Comprehensive Planning.

_____. 1995. The Clark County Wetlands Park Master Plan. Clark County Parks and Recreation. July.

_____. 1999. Sunrise Manor Land Use Plan. Adopted April 7, 1999. Clark County Department of Comprehensive Planning. Advanced Planning Division. http://www.co.clark.nv.us/comprehensive_planning/Advanced/CommunityPlanning/PDF/SunrisePlan_1999.pdf. April.

_____. 2000a. Clark County Multiple Species Habitat Conversation Plan and Environmental Impact Statement for Issuance of a Permit to Allow Incidental Take of 79 Species in Clark County, Nevada. September.

_____. 2000b. Whitney Land Use Plan. Adopted February 2, 2000. Effective April 3, 2000. Clark County Department of Comprehensive Planning. Advanced Planning Division. http://www.co.clark.nv.us/comprehensive_planning/Advanced/CommunityPlanning/PDF/WhitneyPlan_2000.pdf.

_____. 2001. PM_{10} State Implementation Plan. Clark County Department of Comprehensive Planning. June.

_____. 2002. Clark County Zoning Classification. Open Web Info Mapper. http://gisgate.co.clark.nv.us:8487/openweb/asp/openweb.asp.

_____. 2003a. Clark County Air Quality Regulations, Section 11 - Ambient Air Quality Standards, amended October 21, 2003.

_____. 2003b. Clark County residential permit information. Clark County Department of Building Permits and Inspections. http://www.co.clark.nv.us.htm. Accessed March 4, 2004.

_____. 2003c. Clark County Tax Rates, Fiscal Year 2003/2004. Clark County Assessor. http://www.co.clark.nv.us/ASSESSOR/Taxrated.htm. Accessed on March 4, 2004.

_____. 2003d. Clark County Unified Development Code. Title 30. http://www.co.clark.nv.us/Comprehensive_planning/Current/Title30/Title30_TOC.htm. August 7.

_____. 2003e. Clark County Demographics Summary - Twenty Largest Employers, Second Quarter, 2003. http://www.co.clark.nv.us/comprehensive planning/ advanced/ demographics/labormarketdata/20largestemployers.htm. Accessed March 4, 2004.

_____. 2003f. Taxbill Summary Report. Personal communication between Leslie Pierce, Clark County Treasurers Office, and Tabitha Racki, PBS&J. March 8.

_____. 2004a. Visitation to Clark County Wetlands Park in 2003. Electronic mail communication from Sue Francesconi, Recreation Specialist, Clark County Wetlands Park, to Kelly Shook, PBS&J. April 21.

_____. 2004b. Department of Air Quality Management, Monitoring Division. http://www.ccairquality.org. May.

Clark County Health District (CCHD). 1996. Draft Guideline on Air Dispersion Modeling. Air Pollution Control Division. January.

Clark County Parks and Community Services. 2002. Clark County Wetlands Park Trail Corridor and Guidelines Plan. Prepared by Fred Phillips Consulting, LLC. September 23.

Clark County Regional Flood Control District (CCRFCD). 2002. Las Vegas Valley Flood Control Master Plan Update. October 22.

Clark County School District. 2003. School Information. http://www.ccsd.net.htm. Accessed on March 4, 2004.

Clark County Water Reclamation District (CCWRD). 2004. Personal communication between Bill Shepherd, CCWRD Plant and Operations Manager and Lynn Bowdidge, PBS&J. August 6.

Clean Water Coalition (CWC). 2001. Alternate Discharge Study Implementation Plan. City of Henderson, City of Las Vegas, Clark County Sanitation District. January.

Clean Water Coalition Citizens Advisory Committee (CWCCAC). 2004. Recommendations Report. Final Report. Accepted by the CWC Management Board 19 February 2004.

Connaughton, James. 2002. Memorandum to Heads of Federal Agencies re: Cooperating agencies in implementing the procedural requirements of the NEPA. January 30.

Converse Consultants, Inc. 2002. Preliminary Geotechnical Data Report Proposed Effluent Interceptor – Tunnels. Technical Memorandum. October 10.

Countess, Richard, Wouldiam Barnard, Candis Claiborn, Dale Gillette, Douglas Latimer, Thompson Pace, and John Watson. 2001. Methodology for estimating fugitive windblown and mechanically resuspended road dust emissions applicable for regional scale air quality modeling. Final Report for Western Governor's Association contract no.30203-9. April.

Croft, Todd. 2004a. Perchlorate water quality monitoring data for the Las Vegas Wash at Northshore Road. NDEP, Bureau of Corrective Actions, Las Vegas Office. December 7.

_____. 2004b. Personal communication between Todd Croft, NDEP and Jeff Geller, PBS&J, regarding environmental protection issues in relation to perchlorate contamination in the groundwater. November 1.

Daron, Steven E. 1999. Las Vegas Bay Water Line, Lake Mead National Recreation Area, Clark County, Nevada. WACC Report No. 014-1999-LAME.

Davis, W.B. 1978. The Mammals of Texas. Texas Parks and Wildlife Department Bulletin 41. Austin, TX, 294 pp.

Donovan, D.J. 1996. Hydrostratigraphy and Allostratigraphy of the Cenozoic Alluvium in the Northwestern Part of Las Vegas Valley, Clark County, Nevada. Unpublished M.S. Thesis, Department of Geosciences, UNLV, 197 pp.

Eddleman, W.R. 1989. Biology of the Yuma clapper rail in the southwestern U.S. and northwestern Mexico. Final Report. Intra-agency Agreement No. 4-AA-30-02060. Wyoming Cooperative Research Unit, University of Wyoming, Laramie. 127 pp.

Ezzo, Joseph A. and Teresita Majewski. 1995. Prehistory, Protohistory, and Ethnography. In *A Class I Cultural Resources Survey for the Southern Nevada Water Authority Treatment and Transmission Facility, Clark County Nevada,* by Joseph A. Ezzo. Statistical Research Technical Series No. 55 Statistical Research. Tucson, AZ.

Federal Emergency Management Agency (FEMA). 2002. Flood Insurance Study for Unincorporated and Incorporated Clark County. September 27.

Ferraro, David D. 1975a. A Preliminary Report on an Additional Survey in the Las Vegas Wash, Clark County, Nevada, for Reclamation. Report No. 1-3-16. Nevada Archaeological Survey, UNLV.

_____. 1975b. Colorado River Basin Salinity Control Project Title II-Las Vegas Wash Unit-Nevada: Archaeological Research in the Las Vegas Wash for Reclamation, Lower Colorado Region, Boulder City, Nevada. Report No. 1-3-2, Nevada Archaeological Survey.

Ferraro, David, and Robert R. Ellis. 1982. Final Report: The Survey and Mitigation of Thirteen Archaeological Sites within the Las Vegas Wash Project. ARC Report 1-3-13. Archaeological Research Center, Museum of Natural History, UNLV.

Ferrier, G.J. and W.G. Bradley. 1970. Bighorn habitat evaluation in the Highland Range of Southern Nevada. Desert Bighorn Council Transcript. pp. 66-93.

Fowler, Catherine. 1999. Ethnohistory: Isabel Kelly's Data Relevant to the Southern Paiutes. In Cultural Resource Management Plan for the Las Vegas Springs Preserve, Clark County, NV. Gregory R. Seymour, pp 111-120. HRC Report 4-9-3.

Garside, L.J., R.H. Hess, K.L. Fleming, and B.S. Weimer. 1988. Oil and Gas Development in Nevada. Nevada Bureau of Mines and Geology Bulletin 104. Mackay School of Mines, University of Nevada, Reno.

Government of Canada. 2002. The Green Lane: [Backgrounder] -- N-Nitrosodimethylamine (NMDA). Accessed on May 11, 2005 at www.ec.gc.ca/Press/2002.

Grayson, Donald K. 1993. The Desert's Past, A Natural Prehistory of the Great Basin. Smithsonian Institution Press, WA.

Grinnell, J. and A.H. Miller. 1944. The distribution of the birds of California. Pacific Coast Avifauna 27.

Hardcastle, Jeff. 2002. Population Projections for Nevada and Nevada's Counties from 2002 to 2022. Nevada State Demographer's Office. University of NV, Reno. http://www.nsbdc.org/demographer/pubs/images/projections02.pdf.

Harmsen, S.C. 1991. Seismicity and focal mechanisms for the southern Great Basin of Nevada and California in 1990. USGS Open File Report 91-367.

Holden, P.B. 1994. Razorback sucker investigations in Lake Mead, 1994. Las Vegas: Southern Nevada Water Authority. Final Report, PR-470-1. BIO-West.

Holden, P.B., P.D. Abate, and J.B. Ruppert. 1997. Razorback Sucker Studies on Lake Mead, Nevada. 1996-1997 Annual Report. PR-578-1. September 10.

Holden, P.B., and T.L. Welker. 2003. Razorback Sucker Studies on Lake Mead, Nevada. 2002 - 2003 Annual Report. Prepared for the Department of Resources, Southern Nevada Water Authority, By BIO - WEST, Inc., Logan, UT. PR-578-7.

Holland, Jim. 2004. Personal communication from Jim Holland, NPS, in comments regarding the SCOP Preliminary Draft EIS. October.

Holland, R.F. 1986. Preliminary descriptions of the terrestrial natural communities of California. California Department of Fish and Game. Miscellaneous publication.

Houghton Mifflin Company. 2000. The American Heritage Dictionary of the English Language, Fourth Edition.

HRA, Inc. 2004. Archaeological Inventory of the Effluent Interceptor Pipeline Clark County, Nevada. Report for PBS&J, Report No. 01-15. September.

_____. 2005. Archaeological Inventory for the Systems Conveyance and Operation Program, Lake Conveyance System Pipeline, Clark County, Nevada. Report prepared for PBS&J, Report No. 01-15B. May.

Hubbard, J.P. 1987. The status of the willow flycatcher in New Mexico. Endangered Species Program, New Mexico Department of Game and Fish, Santa Fe, NM. 29 pp.

IMPLAN. 2001. IMPLAN Pro Version 2.0 Software. Minnesota Implan Group, Inc.

International Conference of Bldg. Officials. 1997. Uniform Building Code. Volumes I through III.

J.E. Edinger Associates, Inc. 2003. Lake Mohave Water Quality Model Project Report: Model Validation.

Jenkins, David. 2005. Phosphorus Removal Optimization Study. Prepared by David Jenkins, Professor in the Graduate School, University of California, Berkley. Prepared for the Metropolitan Water District of Southern California.

Johnson, J.E., M.G. Pardew, and M.M. Lyttle. 1993. Predator recognition and avoidance by larval razorback sucker and northern hog sucker. Transactions of the American Fisheries Society 122:1139-1145.

Johnson, J.E. and R.T. Hines. 1999. Effect of suspended sediment on vulnerability of young razorback suckers to predation. Transactions of the American Fisheries Society 128:648-655.

Jones, Bruce A. 1991. A Class III Cultural Resources Survey of a 120-Acre Quarry in Clark County, Nevada. Report No. BR #28, Statistical Research, Tucson, AZ.

Kennedy/Jenks Consultants and Tri-State Surveying. 2003. Technical Memorandum-Title and Right of Way. Prepared for the CWC. September 19.

King, Yolanda. 2003. Personal communication between Yolanda King, Clark County Finance Department and Chris Moore, PBS&J. March 14.

LaBounty, J.F. and M.J. Horn. 1997. The influence of drainage from the Las Vegas Valley on the limnology of Boulder Basin, Lake Mead, Lake and Reservoir Management. Arizona-Nevada. Journal of Lake and Reservoir Management 13(2): 95-108.

LaBounty, J.F. and N.M. Burns, 2005. “Characterization of Boulder Basin, Lake Mead, Nevada-Arizona, USA – Based on Analysis of 34 Limnological Parameters”. Lake and Reserv. Manage. 21(3):277-307. Larson, P.P. 1977. Guide to the deserts of the southwest. Sierra Club Books, San Francisco, CA. 286 pp.

Las Vegas Valley Water District (LVVWD). 2004. Las Vegas Valley Water District Artificial Recharge Report, 2003 Year End Report. Report to the Nevada State Division of Water

Resources under Permit Numbers R-001, R-003, and R-012, and to the NDEP under Permit UIC Number NEV 87054, 16 pp., 8 Appendices.

Las Vegas Wash Coordination Committee (LVWCC). 2000. The Las Vegas Wash Comprehensive Adaptive Management Plan. SNWA. http://www.lvwash.org/thelvwcc/comp.html.

_____. 2002. Personal Communication. Letter (with attachments) from Seth Shanahan (LVWCC) to Kelly Shook (PBS&J) regarding the Biological Monitoring Programs in the Las Vegas Wash, Clark County, NV. December 3.

_____. 2003a. The Quality of our water. Erosion and Water Quality. Urban Runoff. http://www.lvwash.org/ - website accessed June 2003.

_____. 2003b. Las Vegas Wash Coordination Committee Invasive Species Management. http://www.lvwash.org/being_done/invasives/main.html.

Leising, J. F. 2003. Dye tracers help quantify flow at Las Vegas Wash. *Southwest Hydrol.* 2, 8–9.

Leising, J.F. 2004. Chemical Conditions in the Primary Producing Aquifers and Portions of the Shallow Groundwater System of the Las Vegas Valley in 2000. SNWA Report, 115 pp., 8 appendices.

Lemly, A. D. 1996. Selenium in Aquatic Organisms *in* W. N. Beyer, G. H. Heinz, and A. W. Redmon-Norwood, editors. Environmental Contaminants in Wildlife: Interpreting Tissue Concentrations. Pps 427-445, Lewis Publishers, Boca Raton, FL.

Lombardo, Walt. 2004. Personal communication between Walt Lombardo, Southern Division Director of the Nevada Division of Mines, and Lynn Bowdidge, PBS&J. February 24.

Longwell, C.R., E.H. Pampeyan, B. Bower, and R.J. Roberts. 1965. Geology and mineral deposits of Clark County, Nevada. Nevada Bureau of Mines and Geology Bulletin 62:218 pp.

Lorden, Gary. 2004. Error Analysis for ELCOM Model Predictions of Lake Mead Growing Season Averages of Chlorophyll a. October.

Maier, K.J., and A.W. Knight. 1994. Ecotoxicology of selenium in freshwater systems. Reviews in Environmental Contaminants and Toxicology 134:31-48.

Manci, K.M., D.N. Gladwin, R. Villella, and M.G. Cavendish. 1988. Effects of aircraft noise and sonic booms on domestic animals and wildlife: A literature synthesis. USFWS. National Ecology Research Center, Ft. Collins, CO NERC-88/29. 88 pp.

Marshall, Zane. 2004. Personal communication between Zane Marshall, SNWA, and Kelly Shook, PBS&J, regarding the year 2004 data results for Yuma clapper rail, yellow-billed cuckoo, and southwestern willow flycatcher surveys conducted along Las Vegas Wash, NV. November 8.

McKernan, R.L. and G.T. Braden. 1999. Status, distribution, and habitat affinities of the southwestern willow flycatcher along the lower Colorado River. Year 3-1998. Report to USFWS and Reclamation. Prepared by the SBCM, Redlands, CA. 71 pp. plus appendices.

_____. 2000. Status, distribution, and habitat affinities of the southwestern willow flycatcher along the lower Colorado River. Year 4-1999. Report to USFWS and Reclamation. Prepared by the SBCM, Redlands, CA. 83 pp. plus appendices.

_____. 2001a. Status, distribution, and habitat affinities of the southwestern willow flycatcher along the lower Colorado River. Year 5-2000. Report to USFWS and Reclamation. Prepared by the SBCM, Redlands, CA. 86 pp. plus appendices.

_____. 2001b. The status of the Yuma clapper rail and yellow-billed cuckoo along portions of the Virgin River, Muddy River, and Las Vegas Wash, Southern Nevada, 2000. Unpublished report for the USFWS and SNWA, Las Vegas, NV. 19pp.

_____. 2002. Status, distribution, and habitat affinities of the southwestern willow flycatcher along the lower Colorado River. Year 6-2001. Report to USFWS and Reclamation. Prepared by the SBCM, Redlands, CA. 59 pp. plus appendices.

McKernan, Robert L. and Karen J. Carter. 2002. The Status of Yuma Clapper Rail and Yellow-billed Cuckoo Along Portions of Virgin River, Muddy River, and Las Vegas Wash, Southern Nevada, 2001. Report prepared for USFWS and SNWA, Las Vegas, NV. February.

Metropolitan Water District of Southern California (MWD). 2001. Colorado River Watershed Sanitary Survey—2000 Update. May.

MICRA, Inc. 1998. Webster's Revised Unabridged Dictionary. February 3.

Miller, C.E., L.M. Turk, and H.D. Foth. 1966. Fundamentals of Soil Science. John Wiley & Sons, NY.

Minckley, W. L. 1973. *Fishes of Arizona.* Arizona Game and Fish Department, Phoenix, AZ.

Minckley, C.O. and M. Thorson. 2002. Interim report for bonytail brookstock collections from Lake Mohave AZ-NV. Prepared for National Fish and Wildlife Foundation and Lower Colorado River Multi-Species. 16pp. Conservation Program. Interim Conservation Plan Funding, 2000. Project 2000-0304-006.

Minckley, W.L. and James E. Deacon. 1991. Battle Against Extinction, Native Fish Management in the American West. University of Arizona Press, Tucson, AZ.

Monson and Sumner. 1981. The desert bighorn: Its life history, ecology and management. University of Arizona Press. Tucson, AZ. 370 pp.

Montgomery Watson. 1997a. Las Vegas Valley 208 Water Quality Management Plan Amendment. Clark County Department of Comprehensive Planning.

http://www.co.clark.nv.us/comprehensive_ planning/Environmental/WaterQuality/208Water/Amendment/208Amendment.htm.

_____. 1997b. Las Vegas Valley Watershed/Wastewater Needs Assessment Study.

Mozingo, H.N. and M. Williams. 1980. Threatened and Endangered Plants of Nevada. Illustrated manual. Published by the USFWS and BLM.

Mozingo, Hugh N. 1987. Shrubs of the Great Basin: natural history. Reno, NV: University of Nevada Press. 342 pp.

Myrick, David F. 1963. Railroads of Nevada and Eastern California, Vol.2, The Southern Roads. Howell-North Books, Berkeley, CA.

National Park Service (NPS). 1986. Final Environmental Impact Statements and General Management Plan for the Lake Mead National Recreation. Area, Arizona-Nevada. Volume I – General Management Plan and Alternatives. July.

_____. 1998. Guidelines for Evaluation and Documenting Traditional Cultural Properties. National Register Bulletin 38:1. URL: http://www.cr.nps.gov/nr/publications/bulletins/nrb38/INDEX.htm.

_____. 1999. Lake Mead National Recreation Area Resource Management Plan. On file at LMNRA, NV.

_____. 2000. Director's Order 12: Conservation Planning, Environmental Impact Analysis, and Decision Making. Washington DC.

_____. 2001a. *Management Policies.* Washington, DC. DOI.

_____. 2001b. Las Vegas Wash Stabilization Project Environmental Assessment. Prepared by Tetra Tech, Inc. July.

_____. 2001c. Lake Mead National Recreation Area Strategic Plan, 2000 – 2005. On file at LMNRA, NV.

_____. 2002. The Lake Mead National Recreation Area Lake Management Plan and Final Environmental Impact Statement. December 2002.

_____. 2003a. Information extracted from LMNRA Web page. http://www.nps.gov/lame.

_____. 2003b. Lake Mead National Recreation Area Visitor and Visitor Use Statistics Report for 2003.

_____. 2003c. Construction of the River Mountains Loop Trail within Lake Mead National Recreation Area Environmental Assessment. LMNRA, Clark County, NV. November.

_____. 2004a. Guide to Scuba Diving. LMNRA website. http://www.nps.gov/lame/scuba.html. Accessed on March 19, 2004.

_____. 2004b. Lake Mead National Recreation Area, Superintendent's Compendium of Designations, Closures, permit Requirements and Other Restrictions Imposed Under Discretionary Authority. http://www.nps.gov/lame/Compendium012804.pdf. January 28.

NatureServe. 2003. Natural Heritage Biodiversity Conservation Data Center. http://www.natureserve.org/explorer/.

Nevada Department of Taxation. 2003. Nevada Sales and Use Tax. http://www.tax.state.nv.us. Accessed on March 4, 2004.

Nevada Department of Transportation (NDOT). 2002. The Annual Traffic Report. http://nevadadot.com/reports_pubs/traffic_report/2002. Accessed in March 2004.

Nevada Department of Wildlife (NDOW). 2004. Federal Aid Job Progress Reports F-20-39. Lake Mead Southern Region. Statewide Fisheries Management.

Nevada Development Authority. 2003 Government Taxation and Revenue Information. http://www.nevadadevelopment.org/taxes.cfm. Accessed on March 8, 2004.

Nevada Division of Environmental Protection (NDEP) 1987. Las Vegas Wash and Lake Mead Proposed Water Quality Standards: Revisions and Rationales. May.

_____. 1989. Maximum Daily Loads and Waste Load Allocations for Las Vegas Bay: Rationale and Calculations. May.

_____. 2002. Data obtained from Bureau of Air Quality. www.state.nv.us/ndep/baq. January.

_____. 2003a. Total Maximum Daily Load Fact Sheet. Bureau of Water Quality Planning. http://ndep.nv.gov/bwqp.factsheet.pdf - website. Accessed June.

_____. 2003b. Draft Evaluation of Total Maximum Daily Loads and Associated Water Quality Standards Attainment for the Las Vegas Wash, Las Vegas Bay and Lake Mead. Bureau of Water Quality Planning. Department of Conservation and Natural Resource. March.

_____. 2004a. Rationale for Proposed Revisions to the Nevada Water Pollution Control Regulations NAC 445A.195 – NAC 445A.197 Las Vegas Bay and Lake Mead. Prepared by NDEP, Bureau of Water Quality Planning. October.

_____. 2004b. Nevada's 2004 303(d) Impaired Waters List. Bureau of Water Quality Planning. October. http://ndep.nv.gov/bwqp/303list.pdf.

_____. 2004c. 2004 Solid Waste Management Plan. Bureau of Waste Management. Website accessed on May 10, 2006. www.ndep.nv.gov/bwm/swmp2004/swp04.html.

_____. 2005. Comment provided by NDEP regarding the SCOP Draft EIS. December.

Nevada Earthquake Safety Council. 1998. Guidelines for Evaluating Potential Surface Fault Rupture/Land Subsidence Hazards in Nevada. http://www.nbmg.unr.edu/nesc/guidelines.htm.

Nevada Natural Heritage Program (NNHP). 2002. List of Sensitive Taxa Recorded Near the Effluent Interceptor Project Area. Department of Conservation and Natural Resources, Carson City, NV. February 19.

NNHP Website. 2003. Database information on special status species of Nevada. Department of Conservation and Natural Resources. http://www.state.nv.us/nvnhp/home.htm.

Nevada State Demographer. 2004. Certified 2001 to 2003 Estimated Population of Nevada's Counties, Cities and Towns with 2000 and prior Estimates Based on Census 2000 for 1986 to 2000. URL: www.nsbdc.org/demographer. Accessed August 9, 2004.

Niles, W.E., P.J. Leary, J.S. Holland, and F.H. Landau. 1995. Occurrence and distribution of *Astragalus geyeri var. triquetrus* (three-cornered milkvetch) and *Eriogonum viscidulum* (sticky buckwheat) in Lake Mead National Recreation Area and adjacent regions of Nevada and Arizona.

Ninyo & Moore. 2004. Phase I Environmental Assessment SCOP Effluent Interceptor Alignment, Las Vegas, NV. April 15.

Park, Allen S. 1986. Construction of Hoover Dam. In *The Story of the Hoover Dam*, pp.66-71. Nevada Publications.

PBS&J. 2002. Biological Assessment prepared for the Clark County Wetlands Park Sunrise Trailhead Project, Clark County, NV. August.

Philpott, W. 1997. Summaries of the life histories of California bat species. U.S. Forest Service. Sierra National Forest, Pineridge Ranger Station. 30 pp. Unpublished Document.

Rafferty, Kevin. 1992. A Cultural Resource Inventory of a Proposed Sewer Line Right-of-way for the Lake Las Vegas Joint Venture near Henderson, Clark County, Nevada. Report No. 5-2195 (P). Harry Reid Center for Environmental Studies, UNLV.

Red Rock Audubon Society. 2002. Bird List of the Las Vegas Wash. Compiled by Carolyn Titus. April.

Reed Construction Data, Eugene R. Spencer, Senior Editor. 2004. RSMeans Heavy Construction Cost Data 2004 18th Annual Edition. RSMeans Construction Publishers and Consultants. ISSN 0893-5602.

Riddel, Mary, and R. Kieth Schwer. 2003. Population Forecasts, Long-term Projections for Clark County, Nevada, 2003 - 2035. January 10.

Ritenour, Dorothy. 1979. Las Vegas Wash: Historic Report. HRC Report No. 1-3-11. Harry Reid Center for Environmental Studies, UNLV.

Roberts, Heidi, and Claudia C. Woodman. 1999. A Summary of Archaeological Investigations for the Lake Las Vegas Land Exchange, Clark County, Nevada. BLM Report # 5-2384, HRA, Inc. Archaeological Report No. 99-04. HRA, Inc., Las Vegas, NV.

Roberts, Heidi, and Richard V.N. Ahlstrom (editors). 2000a. Fragile Past: Archaeological Investigations in Clark County Wetlands Park, Nevada. HRA, Inc. Archaeological Report No. 00-03. HRA, Inc., Las Vegas, NV.

_____. 2000b. From Campus to Corporation: Contract Archaeology in the American Southwest.

Rogers, A.M. and W.H.K. Lee. 1976. Seismic study of earthquakes in the Lake Mead, Nevada-Arizona region. Bulletin of the Seismological Society of America 66:1657-1681.

Rogers, A.M., S.C. Harmsen, E.J. Corbett, K.F. Priestley, and D.M. DePolo. 1991. The Seismicity of Nevada and some Adjacent Parts of the Great Basin in Slemmons, D.B. et al. eds., Neotectonics of North America: Geological Society of America, Decade Map, vol. 1, pp. 153-184.

Rowlands, P.G., H. Johnson, E. Ritter, and A. Endo. 1982. The Mojave desert in: Reference handbook on the deserts of North America. G.L. Bender (ed.). Greenwood Press. Westport, Connecticut, and London, England.

San Bernardino County Museum (SBCM). 2004. Paleontologic Resources Assessment and Treatment Plan (Draft), Las Vegas Valley Disposal Boundary EIS Las Vegas, Clark County, NV. February.

San Joaquin Valley Unified Air Pollution Control District. 2000. URBEMIS7G for Windows Computer Program User's Guide Version 5.1.0 – Emissions Estimation for Land Use Development Projects. Prepared by Jones and Stokes, Sacramento, CA. October.

Schroedl, Alan R. 1991. Paleo-Indian Occupation in the Eastern Great Basin and Northern Colorado Plateau. Utah Archaeology 1(1): 1-15.

Schweigert, Kurt. 2001a. IMACS Site Form for 26CK6247, Old Lake Highway. Associated Cultural Report Experts for CH2MHill Boulder City Bypass.

_____. 2001b. IMACS Site Form for 26CK6249, Southern California Edison North Transmission Line. Associated Cultural Report Experts for CH2M Hill Boulder City Bypass.

_____. 2005. Personal communication between Kurt Schweigert and Chris Harper, HRA, Inc. regarding the eligibility of Site 26CK6247. August.

Seymour, Gregory. 1997. A Re-evaluation of Lower Colorado Buff Ware Ceramics: Redefining the Patayan in Southern Nevada. Unpublished Masters thesis, UNLV.

Seymour, Gregory R., and Lynn E. Hatzenbuehler. 1995. Cultural Resource Overview for the Clark County Wetlands Park Master Plan, Clark County, Nevada. SWCA Archaeological Report No. 95-14. HRC Misc. Report No. 59.

Sheley, R.L., J.K., Petroff, and Borman. 1999. Biology and Management of Noxious Rangeland Weeds. Introduction (Pages 1-3) Oregon State University Press. Corvallis, OR. 438 pp.

Sherwin, R. 1998. Presentation to the Western Bat Working Group Workshop. February 9-13. Reno, NV.

Sjoberg, J.C. 1995. Historical distribution and current status of the razorback sucker in Lake Mead, Nevada-Arizona. Proceeding of the Desert Fishes Council 26:24-27.

Sogge, M.K., S.J. Marshall, Sferra, and T.J. Tibbitts, T.J. 1997. A southwestern willow flycatcher natural history summary and survey protocol. Technical Report NPS/NAUCPRS/ NRTR97/12. Colorado Plateau Research Station, Northern Arizona University, Flagstaff, AZ. 39 pp.

Soil Conservation Service. 1985. Soil Survey of Las Vegas Valley Area Nevada Part of Clark County. U.S. Department of Agriculture. July.

Southern Nevada Regional Planning Coalition (SNRPC). 2003. Regional Trails Plan and Map. http://www.snrpc.org/RegionalTrails.htm.

Southern Nevada Water Authority (SNWA). 1996. Treatment and Transmission Facility Final Environmental Impact Statement. Clark County, NV.

_____. 2002. Water level measurements in the vicinity of the Proposed Effluent Interceptor.

_____. 2004. Drought Plan. February.

_____. 2006a. Southern Nevada Water Authority's website. http://snwa.com. Accessed April 7, 2006.

_____. 2006b. Personal Contact via e-mail between Seth Shanahan (SNWA) and Billye Sisler (PBS&J). June.

State Historic Preservation Office (SHPO). 1998. Guidelines for Section 106 Submissions to the Nevada State Historic Preservation Office. Nevada Department of Cultural Affairs, State Historic Preservation Office. http://dmla.clan.lib.nv.us/docs/shpo/guide/guide.htm. Accessed February.

State of Nevada. 2003. Nevada Labor Force Statistics. Nevada Department of Employment, Training, and Rehabilitation. http://detr.state.nv.us/lmi/. Accessed March 3, 2004.

Stebbins, R.C. 1985. A Field Guide to Western Reptiles and Amphibians. Houghton Mifflin Company. Boston, NY.

Stevens, Joseph E. 1988. *Hoover Dam: An American Adventure.* University of Oklahoma Press, Norman.

Stoffle, Richard W., and Henry F. Dobyns. 1983. Nuvagantu: Nevada Indians Comment on the Intermountain Power Project. Cultural Resource Series No. 7. BLM, Phoenix, AZ.

Stumm-Zollinger E and GM Fair. 1965. Biodegradation of steroid hormones. *J Water Pollut Control Fed* 37 (11):1506-1510.

SWCA, Inc. 1998. Survey for southwestern willow flycatchers along Las Vegas Wash, Clark County Wetlands Park, Nevada. Final Report to Clark County Department of Parks & Recreation and Victory Valley Land Company L.P. November.

_____. 1999. Survey for southwestern willow flycatchers along Las Vegas Wash, Clark County, NV. Final Report to the SNWA. September.

_____. 2000a. Programmatic Biological Assessment for Clark County Wetland Park Master Plan Las Vegas, Nevada. December.

_____. 2000b. Survey for southwestern willow flycatchers along Las Vegas Wash, Clark County, Nevada. Final Report to the SNWA. September.

_____. 2001. Survey for Southwestern Willow Flycatchers along Las Vegas Wash, Clark County, Nevada. December.

_____. 2002. Survey for Yuma Clapper Rails, Yellow-billed Cuckoos, and Southwestern Willow Flycatchers along Las Vegas Wash, Clark County, Nevada. December.

_____. 2003. Survey for Yuma Clapper Rails, Yellow-billed Cuckoos, and Southwestern willow Flycatchers along Las Vegas Wash, Clark County, Nevada. November.

_____. 2004. Biological Assessment Clark County Wetlands Park, Clark County, Nevada. January.

_____. 2006. Survey for Southwestern Willow Flycatchers in 2005 along Las Vegas Wash, Clark County, Nevada. January.

Terres, J.K. 1980. The Audubon Society encyclopedia of North American birds. New York, NY. Alfred A. Knopf, Inc. 1,109 pp.

Tomlinson, R.D. and R.L. Todd 1973. Distribution of two western clapper rail races as determined by responses to taped calls. Condor 75:177-183.

Transportation Research Board (TRB). 1980. Interim Materials on Highway Capacity, Transportation Research Circular Number 212. January.

_____. 1985. Highway Capacity Manual, Special Report 209.

Turner, Kent. 2004. Information received in the NPS comments on the Preliminary Draft EIS #1 in November 2004 regarding revenue generated from recreation and concessionaires at the LMNRA. November.

Tuttle, P.L., and E.L.Orsak. 2002. Las Vegas Wash water quality and implications to fish and wildlife. Report to US Fish and Wildlife Service, Southern Nevada Field Office. November 1, 2002.

Unitt, P. 1987. *Empidonax traillii extimus*: An endangered subspecies. Western Birds 18:137 162.

_____. 1997. Winter range of *Empidonax traillii extimus* as documented by existing museum collections. Report to Reclamation, Phoenix, AZ.

U.S. Bureau of Economic Analysis (BEA). 2004. Forms CA05, CA05N, CA25, CA25N. URL: http://www.bea.gov/bea/reagional. Accessed August 10, 2004.

U.S. Bureau of Land Management (BLM). 1986a. Visual Resource Management (VRM) Guidelines. DOI.

_____. 1986b. Visual Resource Contrast Rating. BLM Manual Handbook 8431-1.

_____. 1998. Proposed Las Vegas Resource Management Plan and Final Environmental Impact Statement. DOI, BLM, Las Vegas Field Office, NV. May.

_____. 2000. Sunrise Management Area Interim Management Plan and Environmental Assessment. EA # NV055-99-21. DOI, BLM, Las Vegas Field Office, NV. May.

U.S. Bureau of Reclamation (Reclamation). 1941. Boulder Canyon Project Final Report, Part IV, Bulletin 2, Boulder Dam. Reclamation, Denver, CO.

_____. 2000. Implementation Agreement, Inadvertent Overrun and Payback Policy, and Related Federal Actions: Final Environmental Impact Statement, Volume I, U.S. Department of Interior, Bureau of Reclamation, October.

_____. 2001. Las Vegas Wash Erosion Control Study. October.

_____. 2002. Las Vegas Wash Off-channel Wetlands, Draft Report. Reclamation, Lower Colorado Region. March.

_____. 2005. Comments received regarding the Boulder Islands North Alternative review. Commentor was Mr. Jim Gacey. May 26, 2005.

_____. 2006. Comments received regarding the SCOP Biological Assessment. Commentor was Mr. Jim Gacey. April 25.

U.S. Bureau of Reclamation and Clark County Department of Parks and Recreation. 1998. Final Program Environmental Impact Statement of the Clark County Wetlands Park. Prepared by Southwest Wetlands Consortium. December.

U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service, and the Metropolitan Water District of Southern California. 2004. Lower Colorado River Multi-Species Conservation Program. Final Progrommatic Environmental Impact Statement/Environmental Impact Report. December 17.

U.S. Census Bureau (USBOC). 1980. Census of Population and Housing Characteristics, Summary Tape Files 1 and 3. www.census.gov. Accessed on March 3, 2004.

_____. 1990. Census of Population and Housing Characteristics, Summary Tape Files 1 and 3. http://www.factfinder.census.gov/. Accessed on March 3, 2004.

_____. 1992. Economic Census - Clark County, NV. http://www.factfinder.census.gov/. Accessed on March 3, 2004.

_____. 1997. Economic Census - Clark County, NV. http://www.factfinder.census.gov/. Accessed on March 3, 2004.

_____. 2000a. Census of Population and Housing Characteristics, Summary Tape Files 1 and 3. www.census.gov. Accessed on March 3, 2004.

_____. 2000b. County Business Patterns - Clark County, NV. http://www.factfinder.census.gov/ Accessed on March 3, 2004.

_____. 2004. Poverty 2003. Poverty Thresholds. http://www.census.gov/hhes/poverty/threshld/thresh03.html. Accessed February 19, 2004.

U.S. Environmental Protection Agency (EPA). 1971. Community Noise, Document PB 207 124, December.

_____. 1995a. Compilation of Air Pollutant Emission Factors AP-42, Fifth Edition, Volume I: Stationary Point and Area Sources. Chapter 13.2.3 Heavy Construction. September.

_____. 1995b. SCREEN3 Model User's Guide, EPA-454/B-95-004. Research Triangle Park, NC.

_____. 1997. Emission Standards Reference Guide for Heavy-Duty and Nonroad Engines, EPA 420-F-97-014, Office of Air and Radiation, Research Triangle Park, NC. September.

_____. 1998. Exhaust Emission Factors for Nonroad Engine Modeling - Compression-Ignition. Report No. NR-009A, Office of Mobile Sources, Assessment and Modeling Division. Washington DC.

_____. 1999. Region 9 Perchlorate Update. June.

_____. 2003. Groundwater and Drinking Water. Perchlorate. http://www.epa.gov/safewater/ccl/perchlorate/perchlo.html. Accessed June.

_____. 2004a. National Ambient Air Quality Standards. Office of Air and Radiation. http://www.epa.gov/airtrends/non.html. May.

_____. 2004b. AIRData. Office of Air and Radiation. http://www.epa.gov/airsdata/adaqs.monvals. May.

_____. 2004c. PPCP's as Environmental Pollutants. http://www.epa.gov/nerlesd1/chemistry/pharma/about.htm. August.

_____. 2006. Water Quality Criteria. Accessed April 18, 2006. URL: http://www.epa.gov/waterscience/criteria/selenium/questions.htm

U.S. Federal Highway Administration. 2001. U.S. 93 Hoover Dam Bypass Project Final Environmental Impact Statement and Section 4(f) Evaluation Record of Decision. FHWA-AZNV-EIS 98-03-F. March.

U.S. Fish and Wildlife Service (USFWS). 1990. Endangered and Threatened Wildlife and Plants; Determination of Critical Habitat for the Colorado River Endangered Fishes: Razorback Sucker, Colorado Squawfish, Humpback Chub, and Bonytail Chub. Federal Register, March 21, 1994.

_____. 1992. Field survey protocol for any federal action (or non-federal action) that may occur within the range of the desert tortoise in Procedures for Endangered Species Act Compliance for the Mojave Desert Tortoise. Regions 1, 2, and 6.

_____. 1998. Razorback Sucker (*Xyrauchen texanus*) Recovery Plan. Denver, CO. 81pp.

_____. 2002. Razorback sucker (*Xyrauchen texanus*) Recovery Goals: amendment and supplement to the Razorback Sucker Recovery Plan. USFWS, Mountain-Prairie Region (6), Denver, CO.

_____. 2003. Letter correspondence: Federally listed species and species of concern that may occur within the proposed SCOP project area, Clark County, NV. February 12.

U. S. Geological Survey (USGS). 1978. Geologic Map of Nevada. Prepared in cooperation with Nevada Bureau of Mines and Geology.

_____. 2001. Superficial Geology and Distribution of Post-impoundment Sediment in Las Vegas Bay, Lake Mead. March.

University of Nevada, Las Vegas (UNLV). 1980. The limnology status of Lake Mead and Lake Mohave under present and future power plant operations of Hoover Dam, Lake Mead Limnological Research Center, University of Nevada, Las Vegas. Technical Report No. 1. January.

_____. 2002. Microbiological, limnological and nutrient evaluations of the Las Vegas Wash/Bay system, Department of Civil and Environmental Engineering Technical Report, UNLV. Las Vegas, NV.

_____. 2003a. Metropolitan Las Vegas Tourist Statistics. UNLV Center for Business and Economic Research. http://www.unlv.edu/Research_Center/cber/county.html. Accessed on March 4, 2004.

_____. 2003b. Current Clark County Economic Data. UNLV Center for Business and Economic Research. Historical economic data for metropolitan Las Vegas. http://www.unlv.edu/Research_Center/cber/county.html. Accessed on March 4, 2004.

_____. 2004. Population Forecasts, Long-term for Clark County, Nevada 2004 – 2035. Center for Business and Economic Research. http://www.co.clark.nv.us/comprehensive_planning/

advanced/Demographics/PopulationForecasts/Pop_Forecast_2002to2035.htm. Accessed August 4, 2004.

University of Nevada, Reno. 1996. Invasive Plants in Nevada: An Identification Handbook. Prepared by the University of Nevada, Reno, Cooperative Extension. 22 pp.

Vasek, F.C. and M.G. Barbour. 1977. Mojave desert scrub vegetation in: Terrestrial Vegetation of California. Barbour, M. G. and Major, J. (eds.). NY. John Wiley and Sons: 835–867.

Warner, R.E. and K.M. Hendrix, eds. 1984. California Riparian Systems: Ecology, Conservation, and Productive Management. University of California Press, Berkley, CA.

Warren, Elizabeth von Till. 1974. Armijo's Trace Revisited: A New Interpretation of the Impact of the Antonio Armijo Route of 1829-1830 on the Development of the Old Spanish Trail. Unpublished Master's thesis, Department of History, UNLV.

Welles, R.E. and F.B. Welles. 1961. The bighorn of Death Valley. U.S. National Park Service Fauna Series, No. 6. Washington, DC. 242 pp.

White, William G. 1996. A Cultural Resource Inventory of Lands Associated with the Henderson Landfill and Land Sale, Clark County, Nevada. Reclamation #22, Reclamation Report: LC-NV-96-2, Lower Colorado Regional Office, Boulder City, NV.

Whitman, Paul. 1988. Biology and conservation of the endangered interior least tern: a literature review. USFWS, Biological Report 88(3), 22 pp.

Woodman, Claudia, Heidi Roberts, and Richard V.N. Ahlstrom. 2001. Archaeological Investigations in the Western Portion of Clark County Wetlands Park, Nevada. With contributions by Gregory Seymour and David W. Valentime. HRA, Inc. Archaeological Report No. 00-08. HRA, Inc., Las Vegas, NV.

Woodman, Claudia, Richard V.N. Ahlstrom, and Heidi Roberts. 2002. Archaeological Investigations along the Northern Boundary of Clark County Wetlands Park, Clark County, Nevada. With contributions by Gregory Seymour and David W. Valentime. HRA, Inc. Archaeological Report No. 01-11. HRA, Inc., Las Vegas, NV.

9.3 References Consulted but not Cited in the Final EIS

Ahlstrom, Richard V.N., Suzanne Eskenazi, and Heidi Roberts. 2004. An Archaeological Survey for the Las Vegas Valley Disposal Boundary Environmental Impact Statement, Clark County, Nevada. HRA, Inc. Archaeological Report No. 03-15.

Allen, R.C. and D.L. Roden. 1978. Fish of Lake Mead and Lake Mohave. Nevada Department of Wildlife, Biological Bulletin No.7. 105 pp.

Arizona v. *California*, (376 U.S. 340 (1964); 439 U.S. 419 (1979); 466 U.S. 144, 145 (1984).

Black & Veatch. 2006a. Facility Questionnaire for the COH WRF. Prepared for the City of Henderson. April.

_____. 2006b. Cost estimate for Process Improvements Alternative in support of the SCOP Final EIS. May.

Colorado River Water Users Association (CRWUA). No date. Ten Tribes Partnership. URL: http://www.crwua.org/colorado_river/tentribes.htm

Daughton, Christian G. 2001. Pharmaceuticals and Personal Care Products in the Environment: Overarching Issues and Overview. Chapter 1 of Pharmaceuticals and Personal Care Products in the Environment Scientific and Regulatory Issues.

Daughton, Christian G. and Tammy L. Jones-Lepp, Editors. 2001. Pharmaceuticals and Personal Care Products in the Environment Scientific and Regulatory Issues. ACS Symposium Series 791.

Deuser, C. 2000. Personal communication between Curt Deuser, NPS Weed Specialist and Kelly Shook, PBS&J regarding known noxious weeds in the Las Vegas Valley, Clark County, NV. July 6.

Douglas, C.L. and K.J. Kinglsey. 1981. Bighorn habitat evaluation and management guidelines for the Grapevine Mountains, Death Valley National Monument. Cooperative National Parks Resources Studies Unit, Las Vegas, NV. Contribution No. 23, 29 pp.

Foe, C., and A.W. Knight. 1986. Selenium bioaccumulation, regulation, and toxicity in the green alga, *Selenastrum capricornutum*, and dietary toxicity of the contaminated alga to *Daphnia magna*. Proceedings of the First Symposium on Selenium in the Environment. California Agriculture Technology Institute, California State University, Fresno. Publ. No. CAT 1/860201. Pp. 77-88.

Haas, C.N., J.B. Rose and C.P. Gerba. 1999. Quantitative Microbial Analysis. John Wiley and Sons, NY.

Hamilton, S.J. 1999. Hypothesis of historical effects from selenium on endangered fish in the Colorado River Basin. Human and Ecological Risk Assessment 5(6):1153-1180.

Highway Research Board. 1965. Highway Capacity Manual. U.S. Department of Transportation. Special Report 87.

Ingersoll, C.G., F.J. Dwyer, and T.W. May. 1990. Toxicity of inorganic and organic selenium to *Daphnia magna* (Cladocera) and *Chironomus riparius* (Diptera). Environmental Toxicology and Chemistry 9:1171-1181.

Kiffney, P., and A.W. Knight. 1990. The toxicity and bioaccumulation of selenate, selenite, and seleno-L-methionine in the cyanobacterium *Anabaena flos-aquae*. Archives of Environmental Contaminates and Toxicology 19:488-494.

Kolpin, D.A., E.T. Furlong, M.T. Meyer, E.M. Thurman, S.D. Zaugg, L.B. Barber, and H.T. Buxton. 2002. Pharmaceuticals, hormones, and other organic waste contaminants in U.S. streams, 1999-2000: A national reconnaissance. Environmental Science and Technology 36:1202-1211.

Mack Trucks, Inc. 2004. Information provided to the Maryland Department of the Environment. Application for a permit to construct Eight Engine Test Cells. March.

Nash, J.P., D.E. Kime, L.T.M. Van der Ven, P.W. Wester, F. Brion, G. Maack, P. Stahischmidt-Allner, and C.R. Tyler. 2004. Long-term exposure to environmental concentrations of the pharmaceutical ethynylestradiol causes reproductive failure in fish. Environmental Health Perspectives 112:1725-1733.

National Park Service. 2003. Personal Communication between Nancy Hendricks, NPS, and Carrie Stewart, PBS&J, via e-mail. May 6.

Nevada Division of Environmental Protection. 2002. Nevada's 2002 303(d) Impaired Waters List. Bureau of Water Quality Planning. October. http://ndep.nv.gov/bwqp/303list.pdf.

New Source Performance Standards. 40 CFR 60.

O'Brien, J. 2000. Personal communication between John O'Brien, U.S. Department of Agriculture Vegetation Specialist and Kelly Shook, regarding known noxious weeds in the Las Vegas Valley, Clark County, NV. July 17.

Patino, R., S.L. Goodbred, R. Draugelis-Dale, C.E. Barry, J.S. Foott, M.R. Wainscott, T.S. Gross, and K.J. Covay. 2003. Morphometric and histopatholgical parameters of gonadal development in adult common carp from contaminated and reference sites in Lake Mead, Nevada. Journal of Aquatic Animal Health 15:55-68.

PBS&J and G.C. Wallace. 2002. Flood Control Master Plan Update of the Las Vegas Valley, Volumes 1 and 2. Prepared for CCRFCD. November.

Rafferty, D. 2000. Personal communication between Dawn Rafferty, Nevada Department of Agriculture Weed Specialist, and Kelly Shook, PBS&J regarding known noxious weeds in the Las Vegas Valley, Clark County, NV. July 18.

Skorupa, J.P, S.P. Morman, and J.S. Sefchick-Edwards. 1996. Guidelines for interpreting selenium exposures of biota associated with nonmarine aquatic habitats. U.S. Fish and Wildlife Service Staff Report, prepared for the National Irrigation Water Qualtiy Program. 74 pp.

Snyder, S.A., T.L. Keith, D.A. Verbrugge, E.M. Snyder, T.S. Gross, K. Kannan and J.P. Giesy. 1999. Analytical methods for detection of selected estrogenic compounds in aqueous mixtures. Environmental Science and Technology 33:2814-2830.

Snyder, Shane A., Kevin L. Kelly, Andrew H. Grange, G. Wayne Sovocool, Erin M. Snyder, John P. Giesy. 2001. Pharmaceuticals and Personal Care Products in the Waters of Lake Mead, Nevada. Chapter 7 in Pharmaceuticals and Personal Care Products in the Environment Scientific and Regulatory Issues. February 19.

State Historic Preservation Office. 2001. Concurrence Letter to Reclamation dated February 5.

Sumpter, J.P., and A.C. Johnson. 2005. Lessons from endocrine disruption and their application to other issues concerning trace organics in the aquatic environment. Environmental Science and Technology 39:4321-4332.

U.S. Bureau of Reclamation. 1990. National Environmental Policy Act Handbook. U.S. Department of Interior. October.

_____. 1992. Final Environmental Assessment of a Proposed Contract Between the U.S. Department of Interior and Colorado River Commission and the Southern Nevada Water Authority for the Remaining Nevada Allocation of Colorado River Water. February.

_____. 1994. Bureau of Reclamation Indian Trust Asset Policy and NEPA Implementing Procedures, August 31.

_____. 2000. Colorado River Interim Surplus Criteria Final Environmental Impact Statement. Lower Colorado Regional Office, Boulder City, NV.

_____. 2006. Development of Lower Colorado River Basin Shortage Guidelines & Coordinated Management Strategies for Lakes Powell and Mead
Under Low Reservoir Conditions, Scoping Summary Report.
http://www.usbr.gov/lc/region/programs/strategies/scopingreport/index.html. Accessed May 15, 2006.

U.S. Department of Interior (DOI). 1976. Federal Land Management and Policy Act of 1976. http://www.blm.gov/flpma/FLPMA.pdf.

U.S. Environmental Protection Agency. 1986. Ambient Water Quality Criteria for Bacteria – 1986. Office of Water Regulation and Standards. EPA 44015-84-002.

_____. 2002. AIRData. Office of Air and Radiation. www.epa.gov/air/data/. October.

_____. 2003. Total Maximum Daily Loads. TMDL Definition, What is a total maximum daily load (TMDL)? http://www.eta.gov/owow/tmdl/into.html. Accessed June.

_____. 2004d. Engine Manufacturers On Target to Meet More Stringent 2007 Clean-Diesel Regulations.
http://yosemite.epa.gov/opa/admpress.nsf/b1ab9f485b098972852562e7004dc686/2298962181981d7585256e4d00690cdc?opendocument. Accessed on March 20, 2006.

U.S. Fish and Wildlife Service. 1998. Endangered Species Act Consultation Handbook. Procedures for Conducting Section 7 Consultations and Conferences. May.

_____. 2002b. Bonytail (*Gila elegans*) Recovery Goals: amendment and supplement to the Bonytail Chub Recovery Plan. USFWS, Mountain-Prairie Region (6), Denver, CO.

_____. 2002c. Consultations with Federal Agencies. Section 7 of the Endangered Species Act. Division of Endangered Species. Document 703/358 2106. http://endangered.fws.gov/consultations/consultations.pdf. Accessed February. Winters v. United States of America, 207 U.S. 564 (1908).

Chapter 10

Libraries and Distribution List

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10.0 Libraries and Distribution List

The Draft and Final EIS was distributed to the elected officials, agencies, organizations, businesses, and individuals in the following sections. Copies of the Draft EIS were available for viewing at the libraries listed in Section 10.1. Copies of the Final EIS are available for viewing at the libraries listed in Section 10.1.

10.1 Libraries

Boulder City Library
701 Adams Blvd
Boulder City, NV 89005
702-293-1281

Clark County Community College
Learning Resource Center
3200 East Cheyenne Avenue
North Las Vegas, NV 89030

Clark County Library
1401 East Flamingo Rd
Las Vegas, NV 89119
702-507-3400

Green Valley Library
2797 N Green Valley Parkway
Henderson, NV 89014
702-507-3790

James I. Gibson Library
280 South Water Street
Henderson, NV 89015
702-565-8402

Las Vegas Public Library
833 Las Vegas Blvd North
Las Vegas, NV 89101
702-507-3500

Sahara West Library
9600 West Sahara Avenue
Las Vegas, NV 89117
702-507-3630

University of Nevada-Las Vegas
James R. Dickinson Library
4505 South Maryland Parkway
Las Vegas, NV 89154

Sunrise Public Library
5400 Harris Avenue
Las Vegas, NV 89110
702-507-3900

Moapa Valley Library
PO Box 397
350 North Moapa Valley Blvd
Overton, NV 89040
702-397-2690

Laughlin Library
PO Box 32225
2840 South Needles Hwy
Laughlin, NV 89029
702-298-1081

Searchlight Library
PO Box 98
200 Michael Wendell Way
702-297-1442

Mesquite Library
121 West First North
Mesquite, NV 89027
702-346-5224

ARIZONA

Burton Barr Central Library
1221 North Central Avenue
Phoenix, AZ 85004
602-262-4636

Meadview Community Library
PO Box 187
149 Meadview Blvd
Meadview, AZ 86444
928-564-2535

Mohave County Library
3269 North Burbank
Kingman, AZ 86401
928-692-2665

Tempe Public Library
3500 South Rural Rd
Tempe, AZ 85282
480-350-5500

University of Arizona Library
Government Documents Dept
1510 East University
Tucson, AZ 85720
520-524-3885

CALIFORNIA

Environmental Services Library
9601 Ridgehaven Ct, Ste 130
San Diego, CA 92123
858-573-1213

San Diego Public Library
820 E St.
San Diego, CA 92101-6478
(619) 236-5800

Palm Springs Public Library
300 South Sunrise Way
Palm Springs, CA 92262
760-323-8298

UTAH

Washington County Library
50 South Main Street
St. George, UT 84770
435-634-5737

10.2 Distribution List

10.2.1 Federal Agencies

U.S. Army Corps of Engineers

U.S. Bureau of Indian Affairs

U.S. Bureau of Land Management

U.S. Geological Survey

U.S. Department of Transportation, Federal Highway Administration

U.S. Fish & Wildlife Service

U.S. Bureau of Reclamation

U.S. Bureau of Reclamation - Lower Colorado Dams Facilities Office

U.S. Environmental Protection Agency

Federal Energy Regulatory Commission

National Park Service

U.S. Forest Service, Toiyabi National Forest

U.S. Natural Resources Conservation Service

10.2.2 Native American Organizations

Aha Macav Culture Society

Chemehuevi Tribal Council

Colorado River Indian Tribal Museum

Colorado River Indian Tribes

Fort McDowell Mohave-Apache Indian Community

Fort Mojave Tribe

Havasupai Tribe

Hopi Cultural Preservation Office

Hopi Tribe

Hualapai Tribe

Kaibab Paiute Tribe

Las Vegas Indian Center

Las Vegas Paiute Tribe

Moapa Paiute Tribe

Navajo Nation

Pahrump Paiute Tribe

Pueblo of Zuni Tribe

Salt River Pima-Maricopa Indian Community

Yavapai Tribe

10.2.3 State of Nevada

Bureau of Health Protection Services

Colorado River Commission of Nevada

Conservation District of Southern Nevada

Department of Administration

Department of Conservation & Natural Resources

Department of Transportation

Division of Forestry, Las Vegas

Division of Parks, Carson City

Nevada Division of Environmental Protection

Nevada Department of Wildlife

Nevada State Clearinghouse

Nevada State Historic Preservation Office

State of Nevada Land Use Planning Advisory Committee

Valley of Fire State Park

10.2.4 State of Arizona

Arizona Department of Environmental Quality

Arizona Department of Water Resources

Arizona Municipal Water Users Association

Arizona Game and Fish Department

Arizona State Clearinghouse

Central Arizona Water Conservancy District

Office of the Governor, Clean Colorado River Alliance

10.2.5 State of California

Colorado River Board of California

California State Clearinghouse

Metropolitan Water District of Southern California

10.2.6 State of Utah

Department of Natural Resources

10.2.7 County Agencies

Clark County, Nevada

Clark County Air Quality and Environmental Management

Clark County Community and Economic Development

Clark County Comprehensive Planning

Clark County Conservation District

Clark County Commissioners

Clark County Manager

Clark County Health District

Clark County Parks & Community Services

Clark County Planning Commission

Clark County Regional Flood Control District

Clark County Water Reclamation District

Southern Nevada Regional Transportation Commisssion

Mohave County, Arizona

Mohave County Building

10.2.8 City Agencies

ARIZONA

City of Phoenix Water Services Department

City of Tuscon

NEVADA

Boulder City

Boulder City Chamber of Commerce

Boulder City Council

Boulder City Community Development & Planning

Boulder City Manager

City of Henderson

City of Henderson Water Reclamation Facility

City of Henderson Manager

City of Henderson Community Development

City of Henderson Public Works

City of Henderson Utilities

City of Las Vegas

City of Las Vegas Parks & Leisure Activities

City of Las Vegas Community Planning and Development

City of Las Vegas Department of Public Works

City of Las Vegas Environmental Division City Council

Las Vegas Chamber of Commerce

City of Las Vegas Manager

City of North Las Vegas

North Las Vegas City Council

City of North Las Vegas Parks & Recreation

City of North Las Vegas Economic Development Office

City of North Las Vegas Planning and Zoning Division

City of North Las Vegas Resource and Facilities Services

City of North Las Vegas Manager

City of Mesquite

City of Mesquite

10.2.9 Schools and Colleges

Community College of Southern Nevada

University of Nevada Las Vegas

University of Arizona

Colorado State University

10.2.10 Non-governmental Organizations

Applied Analysis

AZ-New Mexico Chapter American Fisheries

Boy Scout Troup 69

Citizen Alert

Defenders of Wildlife

Desert Big Horn Council-Foundation for North American Sheep

Desert Tortoise Council

Dry Dock Boat Sales

Earth First

East Las Vegas Citizens Advisory Council

Environmental Defense Fund

Environmental Forum

Fraternity of the Desert Bighorn

Friends of Nevada Wilderness

Friends of the Desert Wetlands Park

Grand Canyon Trust

Lake Las Vegas Resort

Las Vegas Jeep Club

Las Vegas Bay Harbor Inc.

MGD Technologies, Inc.

Mule Deer Foundation

Nature Conservancy

Nevada Conservation Forum

Nevada Conservation League

Nevada Environmental Coalition

Nevada Wildlife Federation

Partners in Parks

Red Rock Audubon Society

Sierra Club

Society Environmental Review

Southern Nevada Clean Communities

Southern Nevada Environmental Forum

Southern Nevada Water Authority-Las Vegas Wash Works

Southern Nevada Water Authority

Wilderness Society

10.2.11 U.S. National Park Service Concessionaires

Black Canyon/Willow Beach River Adventures

Callville Bay Resort

Cottonwood Cove Resort

Echo Bay Resort

Lake Mead Ferry Service

Lake Mead Resort

Lake Mead RV Village

Lake Mojave Resort

Lakeshore Trailer Village

Las Vegas Bay Marina

Las Vegas Boat Harbor

Overton Beach Marina

Temple Bar Resort

Willow Beach Harbor

10.2.12 Area Media – Newspapers

Henderson *Home News*/Boulder City *News*

Las Vegas Review Journal

Los Angeles *Times*

San Diego Union-Tribune

Arizona Daily Sun

The Arizona *Tribune*

Arizona Republic

The Desert Sun

10.2.13 Private Individuals

ARIZONA

Tantone, Frank
Greeley and Hansen

Don Day

Martin Koppel

Robert S. Lynch

NEVADA

Buschman, Ernest
Sun City McDonald Ranch

Clark, Bob
Seven Crown Resorts

Cox, Norma
Water Quality Citizens Advisory Committee

Crowley, Susan
Kerr McGee

Culp, Gordon

Dixon, Earle
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Harry Reid Center

Gibson, Jeff
American Pacific Corp.

Graber, Daniel
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James, Dave
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UNLV Dept of Civil & Environmental Engineering

William B. Leonard

Marchant, Wayne
Water Quality Citizens Advisory Committee

Matthews, Kenneth

MWH Americas, Inc.

Robertson, Jack

Russell, Pat

Sahu, Ron
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Shirley, Susan
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Young, Chris,
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Iris Bernikow

James Bergman

Grace Potort

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Tom Woodall

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Aguero, Jeremy

Brown, Larry
City of Las Vegas Councilman

Burris, Earl

Campbell, Bob
The Campbell Company

Evans, Ken
Las Vegas Chamber of Commerce

Forkos, Marcia
Sierra Club

Garbarino, Dave

Goff, Jim
Water Quality Citizens Advisory Committee

Gripentog, Betty
Las Vegas Bay Marina

Harris, Jeff
Clark County Parks & Community Services

Hill, Steve
Silver State Materials

Hollander, Robert
Arizona Water Users Association

Johnson, Walt

Kirk, Steve
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Longford Homes

Palencia, Leslie
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Sanchez, Tony
Las Vegas Chamber of Commerce

Scroggins, Brian

Sous, Nadir
Nevada Division of Environmental Protection

Martin, Rod
NAIOP

Maxfield, Chip
Clark County Commissioner

Stewart, Dan
Landwell Company

Turner (Holmberg), Marcia

Turner, Tom
Nevada Taxpayers Association

van Ee, Jeff
Nevada Wildlife Federation

Vilardo, Carole

Weber, Steve
Lake Las Vegas

Wojcik, Ed
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Lloyd George Federal Bldg.
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Las Vegas, NV 89101

Reid, Harry -U.S. Senator
Lloyd D. George Bldg.
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Las Vegas, NV 89101

Berkley, Shelley-U.S. House of Representatives
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Gibbons, Jim -U.S. House of Representatives
600 Las Vegas Blvd. South, Suite 680
Las Vegas, NV 89101

Porter, Jon-U.S. House of Representatives
2501 North Green Valley Parkway
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Las Vegas, NV 89101

Montando, Michael -City of N. Las Vegas Mayor
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Gibson, James -City of Henderson Mayor
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Chapter 11

Glossary

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11.0 Glossary

100-year frequency flood. A flood event of such magnitude that it occurs, on average, every 100 years. This equates to a 1-percent probability of occurring in any given year.

Acre-foot. A measure of water volume. The amount of water it would take to cover one acre of land to a depth of 1 ft; 325,851 gallons; 43,560 cubic feet.

Airshed. An area consisting of one hydrographic area. The Las Vegas Valley is in hydrographic area 212. The designation of an airshed is used for air quality planning purposes.

Alluvial fan. A broad, conical-shaped deposit of sediment typically found at the edge of mountain ranges, dissected by channels and composed of coarse-grained material, including sand, gravel, cobbles and boulders.

Alluvium. Any stream-laid sediment deposit.

Ambient. Surrounding or background conditions in the absence of an identifiable source.

Ambient air. That portion of the atmosphere, outside of buildings, to which the general public has access.

Ambient Air Quality Standards. Standards established on a state or federal level that define the limits for airborne concentrations of designated criteria pollutants (nitrogen dioxide, sulfur dioxide, carbon monoxide, particulate matter with aerodynamic diameters less than 10 microns [PM_{10}], ozone, and lead) to protect public health with an adequate margin of safety (primary standards) and to protect public welfare, including plant and animal life, visibility, and materials (secondary standards).

Aquifer. A body of rock that contains enough saturated permeable material to transmit groundwater and to yield significant quantities of groundwater to wells and springs.

Artesian. Refers to groundwater under sufficient hydrostatic head to rise above the aquifer containing it.

"at grade". On the same level.

Atlatls. A wooden device used to throw long, stone-tipped darts.

Attainment area. A region that meets the NAAQS for a criteria pollutant under the CAA.

Baseline. The initial environmental conditions against which the environmental consequences of various alternatives are evaluated.

Braided washes. A wash in which water flows in several dividing and reuniting channels resembling the strands of a braid, the cause of division being the obstruction by sediment deposited in the wash.

Candidate species. Species for which the USFWS has on file sufficient information on biological vulnerability and threat(s) to support the issuance of a proposed rule to list but issuance of the proposed rule is precluded.

Census block. Cluster of blocks within the same census tract. Census blocks do not cross county or census tract boundaries and generally contain between 250 and 550 housing.

Chat. Small stones.

Conductivity. Conductivity is an index of how easy it is for electricity to flow. Therefore, the higher the concentration of dissolved ions, like sodium and chloride, the higher the conductivity. In other words, higher total dissolved solids means higher conductivity, and vice versa. This means that the more sodium and chorine contained in water the more electricity is carried, and the higher the conductivity.

Conservative substance. Non-decaying substance.

Criteria pollutants. The CAA required the EPA to set air quality standards for common and widespread pollutants after preparing criteria documents summarizing scientific knowledge on their health effects. Today there are standards for six criteria pollutants: sulfur dioxide, carbon monoxide, particulate matter less than 10 micrometers in diameter (PM_{10}), nitrogen dioxide, ozone, and lead.

Cumulative impact. Cumulative impact is the environmental impact resulting from the incremental impact from a particular activity when added to other past, present, or future activities. Cumulative impacts may be individually insignificant, but collectively, the individually insignificant activities may become significant.

Day-night average sound level. A-weighted SPLs averaged over a 24-hour period with 10 dBA added for events occurring between 10 p.m. and 7 a.m.

Decibel. A standard unit of measuring SPLs based on a reference sound pressure of 0.0002 dynes per square centimeter. This is the smallest sound a human can hear.

Decibel, A-weighted. Adjusted unit of sound measurement that corresponds to the relative sensitivity of the human ear at specified frequency levels. This represents the loudness as perceived by humans.

Designated Uses. Designated Uses of a water body are those uses that should be attained by the waterbody. Designated Uses include, but are not limited to, drinking water, water-based recreation, aquatic life, and agricultural and industrial water supplies.

Diagnostic remains. "Diagnostic" refers to the usefulness of the fossil with regard to obtaining information of scientific worth.

Direct effects. Beneficial or harmful impacts that are caused by an action and occur at the same time and place.

Direct impact. Effects resulting solely from the proposed alternative(s).

Effluent. A fluid discharge into the environment. Conventional treatment processes include secondary and tertiary treatment. Secondary treatment is defined here to include removal of organic loading, and may also include biological removal of phosphorus and ammonia. Tertiary treatment includes chemical addition followed by conventional filtration. Effluent receives disinfection prior to discharge to the Las Vegas Wash.

Endangered species. A plant or animal species that is threatened with extinction or serious depletion in its range and is formally listed as such by the USFWS.

Environmental Impact Statement. A detailed written statement that helps public officials make decisions that are based on understanding of environmental consequences and to take actions that protect, restore, and enhance the environment.

Ephemeral. Lasting only a brief period of time.

Ephemeral stream. A stream or portion of a stream that flows only in direct response to precipitation.

Epilimnion. The upper, warmer water overlying the thermocline of a lake.

Equivalent sound level. A single number representing the fluctuating sound level in decibels over a specified period of time. The average of a fluctuating level of sound energy.

Erosion Control Structures. Flood control features located in the Las Vegas Wash designed to control erosion, and used in the overall stabilization of the banks along the Las Vegas Wash.

Evapotranspiration. The loss of water from the soil both by evaporation and by transpiration from the plants growing there.

Fecal coliform. The coliform bacteria group consists of mostly harmless bacteria that live in soil, water, and the digestive system of animals. Fecal coliform bacteria, which belong to this group, are present in large numbers in the feces and intestinal tracts of humans and other warm-blooded animals, and can enter water bodies from human and animal waste. Their presence indicates fecal contamination.

Fossiliferous. Containing fossils.

Fugitive dust. Particulate matter composed of soil. Fugitive dust may include emissions from haul roads, wind erosion of exposed soil surfaces, and other activities in which soil is either removed or redistributed.

Geologic. Any natural process acting as a dynamic physical force on the earth; i.e. faulting, erosion, and mountain-building resulting in rock formations.

Gneiss. A banded or foliated metamorphic rock, usually of the same composition as granite.

Groundwater. Subsurface water within the zone of saturation.

Groundwater recharge. Water that infiltrates the land surface and is not lost to evaporation or consumed by plants can percolate downward and replenish the groundwater aquifers. This deep percolation is called recharge.

Hafted. To attach a shaft or handle to a projectile or knife blade. To provide with a handle.

Hazardous waste. Wastes that are designated as hazardous by the EPA or state regulations. Hazardous waste, defined under the RCRA, is waste from production or operation activities that poses a potential hazard to human health or the environment when improperly treated, stored, or disposed. Hazardous wastes that appear on special EPA lists or possess at least one of the four following characteristics: ignitability, corrosivity, reactivity, and toxicity.

Headcuts. Sections of a channel that are much steeper than the segments of the channel upstream and downstream, and in many cases the headcuts become vertical drops or waterfalls in the channel.

Human environment. The natural and physical environment and the relationship of people with the environment.

Hydric soils. Soils that are saturated to the surface sometime during the growing season.

Hydrographic area. Nevada has been divided into 14 hydrographic regions or basins, which are now used by the Nevada Division of Water Resources, Department of Conservation and Natural Resources, and the USGS to compile information pertaining to water resources and water use. These regions are also further subdivided into 232 *Hydrographic Areas.*

Hydrology. A science dealing with the properties, distribution, and circulation of water on and below the earth's surface and in the atmosphere.

Hydrophytic vegetation. The sum total of macrophytic plant life that occurs in areas where the frequency and duration of inundation or soil saturation produce permanently or periodically saturated soils of sufficient duration to exert a controlling influence on the plant species present.

Hypolimnion. The part of a lake below the thermocline made up of water that is stagnant and of essentially uniform temperature except during the period of overturn.

Ichnites. Fossilized animal trackways.

Induced impact. Changes in spending from households as income increases or decreases due to the changes in production.

Impact. The terms "impacts" and "effects" are synonymous as used in the NEPA. Impacts may be beneficial or adverse, and may apply to the natural, aesthetic, historic, cultural, and socioeconomic resources of the installation and the surrounding communities. Where applicable, impacts may be classified as direct or indirect.

Impairment. An action constitutes an impairment when its impacts "harm the integrity of park resources or values, including the opportunities that otherwise would be present for the enjoyment of those resources and values".

Indirect impact. An indirect impact is caused by a proposed activity but is later in time or farther removed in distance, but still reasonably foreseeable. Indirect impacts may include land use changes or population density changes and the related effects these changes will have on air, water, and other natural or social systems.

Infiltration. Water that falls on the land surface that does not runoff but percolates into the ground. Some of this water evaporates, some is used by plants, and some percolates downward to the groundwater.

Infrastructure. Utilities and other physical support systems needed to operate a pipeline.

Isothermal. Relating to an equality of temperature.

Intaglio. An engraving or incised figure in stone or other hard material depressed below the surface of the material so that an impression from the design yields and image in relief.

Intermittent stream. A stream that flows only at certain times when it receives water from springs or from a surface source.

Lacustrine. Produced by or belonging to lakes.

Lambing. Giving birth to a lamb

Locatable minerals. Traditional "hard rock" minerals such as gold, silver, lead, copper, zinc, and industrial minerals such as fluorspar, barite, and high-calcium limestone.

Long-term impacts. Long-term impacts are neither temporary nor reversible. They may occur either during the construction or operational phases of an activity. For example, the construction of a new building may create long-term impacts during both the construction and operational phases. Draining of a wetland for the construction of a new building will create long-term and permanent impacts on biological resources. Likewise, once operational, the new building may create additional long-term impacts such as increased population density, waste generation, etc.

Metalimnion. A layer in a thermally stratified body of water that separates an upper warmer lighter oxygen-rich zone form a lower colder heavier oxygen-poor zone.

Mitigation. Mitigation generally includes: avoiding the impact altogether by stopping or modifying the proposed action; minimizing impacts by limiting the degree or magnitude of the action and its implementation; rectifying the impact by repairing, rehabilitating, or restoring the affected environment; reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; compensating for the impact by replacing or providing substitute resources or environments.

National Ambient Air Quality Standards. Section 109 of the CAA requires the EPA to set nationwide standards for widespread air pollutants. Currently, six pollutants are regulated: sulfur dioxide, carbon monoxide, PM_{10}, nitrogen dioxide, ozone, and lead.

Nitrates. Decomposers, which include fungi and bacteria, use these nitrogen-containing substances for energy, by breaking them down in respiration. They release the nitrogen into the

soil as ammonia compounds. Nitrifying bacteria use the ammonia compounds in respiration, releasing nitrites into the soil. Nitrite bacteria use the nitrites in respiration, releasing nitrates into the soil.

Nitrogen fixation. The conversion of nitrogen gas to forms of nitrogen that can be utilized by plants.

No impact. "No impact" implies that a particular activity creates neither a direct nor indirect impact, does not have long- or short-term implications, and is neither beneficial nor negative.

Noise. Any sound that is undesirable because it interferes with speech and hearing or is intense enough to damage hearing.

Nonattainment area. An area that has been designated by the EPA or the appropriate state air quality agency as exceeding one or more national or state AAQS.

Non-conservative substance. Decaying or biologically processed substance.

Non-point source. Source of pollution generally attributed to urban runoff from irrigating landscapes and golf courses, draining pools to streets, washing vehicles in streets, and hosing down driveways.

Nonpotable. Water that is unsafe or unpalatable to drink because it contains pollutants, contaminants, minerals, or infective agents.

Off-road vehicle. Any motorized vehicle designated for cross-country travel over any type of natural terrain.

Ozone (ground level). A major ingredient in smog. Ozone is produced from reactions of hydrocarbons and nitrogen oxides in the presence of sunlight and heat.

Particulate. Fine liquid or solid particles such as dust, smoke, mist, fumes, or smog, found in air or emissions.

Perchlorate. Perchlorate is an anion that originates as a contaminant in ground water and surface waters when the salts of ammonium, potassium, magnesium, or sodium dissolve in water. One major source of contamination is the manufacture or improper disposal of ammonium perchlorate that is used as the primary component in solid propellant for rockets, missiles, and fireworks.

Point Source. Any discernible, confined, and discrete conveyance, including, but not limited to any pipe, ditch, channel, tunnel, or conduit from which pollutants are or may be discharged. This term does not include return flows from irrigated agriculture.

Radionuclides. Radioactive particles, man-made or natural, having a distinct atomic weight number. Can have a long life as soil or water pollutants.

Record of Decision. A public document that explains which alternative will be selected for the area of concern.

Region of Influence. The geographical area to be addressed as the baseline from which to identify and evaluate environmental changes resulting from the proposed alternatives. The region of influence may vary for each resource area.

Retrieval Shaft. Termination shaft for jack-and-bore and tunneling activities.

Riparian. The banks of a body of water.

Riprap. A loose assemblage of broken stones erected in water or on soft ground as a foundation.

Ruderal. Weedy and commonly introduced plants growing where the vegetational cover has been disturbed.

Rutting. (Rut) Mating season for deer.

Salable minerals. Common variety mineral materials such as sand, gravel, cinders, and building stone that are sold on a permit basis.

Scope. The range of actions, alternatives, and impacts to be considered in an environmental impact statement.

Secchi depth. A measure of the water transparency in a lake

Seiche. An oscillation of the lake surface that varies in period from a few minutes to several hours.

Sheet flow. A smooth flow at relatively slow velocity in which the fluid elements follow paths that are straight and are parallel to the channel walls.

Sherd. Fragments of pottery vessels found on sites and in refuse deposits where pottery-making peoples have lived.

Short-term impacts. Short-term impacts are temporary and either direct or indirect. Short-term impacts usually occur during the construction phase of the activity.

Significance. Significance requires consideration of the context and intensity of the impact or effect, under consideration. Significance can vary in relation to the context of the proposed action. Both short- and long-term effects may be relevant. Impacts may also be evaluated in terms of their intensity or severity.

Slickens. Slickens consists of accumulations of fine-textured material such as that separated in ore-mill operations. It is largely freshly ground rock that commonly has undergone chemical treatment during milling process.

Stratigraphic. Division of geology dealing with the definition and description of rocks and soils, especially sedimentary rocks.

Subsurface. A zone below the surface of the earth whose geologic features are principally layers of rock that have been tilted or faulted and are interpreted on the basis of drill hole records and

geophysical (seismic or rock vibration) evidence. Generally, it is all rock and solid materials lying beneath the earth's surface.

Sulfates. A combination of sulfur and oxygen and are a part of naturally occurring minerals in some soil and rock formations that contain groundwater.

Thermocline. A layer in a thermally stratified body of water that separates an upper warmer lighter oxygen-rich zone form a lower colder heavier oxygen-poor zone.

Threatened species. A species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

Total Dissolved Solids. Solids in water that can pass through a filter. Total dissolved solids are a measure of the amount of material dissolved in water. This material can include carbonate, bicarbonate, chloride, sulfate, phosphate, nitrate, calcium, magnesium, sodium, organic ions, and other ions.

Total Maximum Daily Load. Total maximum daily loads are established when a water body is not in compliance with water quality standards. Total maximum daily loads are established to bring the water body into compliance. The maximum amount of pollutant(s) that can be discharged while still meeting water quality standards.

Total suspended solids. The amount of solids suspended in water, whether mineral (e.g., soil particles) or organic (e.g., algae).

Traditional Cultural Property. A location that is valued by some group, such as an ethnic group, because it is a place of cultural patrimony and an important place in the traditional cultural landscape.

Tributary. Any stream or wash that contributes water to another stream or wash.

Unemployment rate. The unemployment rate represents the number unemployed as a percent of the labor force.

Verdin. A very small yellow-headed titmouse (*Auriparus flaviceps*) found from Texas to California and southward.

Viewshed. The landscape that can be directly seen under favorable atmospheric conditions from a viewpoint or along a transportation corridor.

Waste load allocations. A calculation of a quantity of waste that can be discharged into a stream at a given location on a given date without violating the state's water quality standards.

Waters of the U.S. "Water such as intrastate lakes, rivers, streams (including intermittent streams)."

Watershed. A region or area bounded peripherally by a water parting and draining ultimately to a particular body of water.

Water Quality Criteria. The set of conditions to be met in order to attain designated uses. Water quality criteria are usually expressed quantitatively such as scientific measurements of pollutant concentrations, toxicity, or temperature.

Wetlands. An area that is regularly saturated by surface water or groundwater and subsequently supports vegetation that is adopted for life in saturated soil conditions. To qualify as a USACE jurisdictional wetland, it must have hydric soil, be saturated to the surface sometime during the growing season, and contain wetland plant species.

Working Shaft. Beginning location and main working area for tunneling activities.

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