Chapter 2.0

Description of the Alternatives

2.0 Description of the Alternatives

Chapter 2.0 contains the descriptions of the alternatives that are being evaluated. Four alternatives are evaluated in this EIS: Boulder Islands North Alternative, Boulder Islands South Alternative, Las Vegas Bay Alternative, and the No-Action Alternative (no pipeline). Three of the alternatives analyzed 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 will be presented once under the Boulder Islands South Alternative then a reference to that section will be used in the EI impacts discussions for the Las Vegas Bay Alternative. The series of pipelines and diffusers that would comprise the three action 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 permit 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 Section 2.5 and 2.6 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, 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 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.

Current, conventional treatment processes and plant optimization would be used to meet the requirements set by the NDEP through the NPDES permitting program. Total phosphorus from the combined effluent of the treatment facilities would continue to be treated to 0.2 mg/L, and optimization of the plants would continue to be implemented when current treatment processes alone could not treat wastewater to levels needed to meet water quality objectives. Combined total phosphorus would be treated to levels below 0.2 mg/L during plant optimization. Additions

Table 2.1-1 Wastewater Discharge Projections.[1]

Annual Average Flow (mgd)								
	Flow Increase Rate (%)[2]	1997	2010	2020	2027	2030	2035	2050
CLV WPCF	2.13	47	72	96	111	117	128	160
CCWRD CP	1.97	72	98	117	131	137	147	176
COH WRF	0.87	14	25	34	40	43	47	60
Total		133	198	247	282	297	322	396
Peak Month (mgd)								
	Peaking Factor	1997	2010	2020	2027	2030	2035	2050
CLV WPCF	1.16	55	87	111	129	136	149	186
CCWRD CP	1.15	83	112	135	151	157	169	202
COH WRF	1.08	15	27	37	43	46	51	65
Total		153	226	283	323	339	368	453
Peak Day (mgd)								
	Peaking Factor	1997	2010	2020	2027	2030	2035	2050
CLV WPCF	1.33	63	99	128	148	156	170	213
CCWRD CP	1.40	101	137	164	183	192	205	247
COH WRF	1.30	18	33	44	52	55	61	77
Total		182	269	336	383	403	436	537
Peak Hour (mgd)								
	Peaking Factor	1997	2010	2020	2027	2030	2035	2050
CLV WPCF	1.50	71	112	144	167	176	192	240
CCWRD CP	1.60	115	156	188	210	219	235	282
COH WRF[3]	1.30	18	33	44	52	55	61	77
Total		204	301	376	429	450	488	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.

or modifications to treatment facilities would be implemented at the existing levels of treatment while accommodating the anticipated increase in effluent quantity.

As flows increase in the future, effluent loadings of total phosphorus 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 includes chemical addition followed by conventional filtration to further remove phosphorus. 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 biological nutrient removal (BNR) capabilities may include, but are not limited to:

- Maximizing the volatile fatty acids in biological phosphorus removal 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.

A description of the existing facilities at the three wastewater treatment plants is provided in the following sections.

2.1.1 City of Las Vegas

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. The WPCF's current annual average capacity is 78.3 mgd (120.5 cfs). The WPCF is being expanded to accommodate the Year 2015 flows, which are projected to be an average of 91 mgd (140 cfs) annually (Black & Veatch 2004a). The CLV facility delivered 2.4 mgd (3.9 cfs) of treated reuse water to customers in 2003 (CLV 2004).

The CLV treatment facilities use chemical addition for phosphorus removal and include influent screening, grit removal, primary clarifiers, trickling filters, secondary clarifiers, and the activated sludge process for carbon and ammonia removal. Flow is routed to the nitrification influent pump station. Processes downstream of this station include activated sludge with nitrification, final clarifiers, filter influent pumping, filtration, chlorination, and dechlorination (COH et al. 2000, Black & Veatch 2004b). In addition, BNR is achieved by using anaerobic, anoxic, and aerobic activated sludge basins (Black & Veatch 2004b).

Tertiary treatment at the CLV WPCF consists of effluent filters, which treat clarified effluent from secondary treatment. The filtration system is designed for direct filtration whereby the

secondary effluent will be dosed with alum and polymer and applied directly to the filters for enhanced removal of phosphorus and particulates.

2.1.2 Clark County Water Reclamation District

The CCWRD discharges treated effluent to the Las Vegas Wash in two locations. The Advanced Wastewater Treatment (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.

The CP is considered the main plant where the majority of the treatment occurs. The AWT functions as a peaking facility for tertiary treatment and disinfection using ultraviolet light. The CCWRD's preliminary, primary, and secondary treatment facilities (the Secondary Plant, the CP, and the AWT) have an annual average capacity of 110 mgd (169.4 cfs). The next CCWRD expansion is planned to increase the total plant capacity to 130 mgd (200.2 cfs). The CCWRD delivered 5.35 mgd (8.2 cfs) of treated reuse water to customers in 2003 (CCWRD 2004).

The CCWRD's Secondary Plant includes bar screens, grit basins, primary clarifiers, and primary sludge thickeners. The 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).

Treatment is currently divided between two trains, with the activated sludge process constituting the main treatment for the removal of carbon, ammonia, and phosphorus. The train also includes provisions for chemical addition for precipitation of phosphorus in the primaries and at the filters. The AWT facilities would be phased out once the new biological treatment basins are constructed. The new basins would be divided into aerobic, anoxic, and anaerobic zones and would emphasize biological phosphorus removal. Tertiary treatment at the CCWRD consists of new effluent filters, which treat the clarified effluent from secondary treatment. The system is designed for direct filtration in which the secondary effluent will be dosed with coagulant and polymer and applied directly to the filters for enhanced removal of phosphorus and particulates. If very low concentrations of effluent phosphorus must be achieved through chemical precipitation in the future, the solids concentration onto the filters may exceed the reasonable threshold for direct filtration, and an intermediate flocculation and sedimentation process may be required ahead of the filters (Black & Veatch 2004b).

2.1.3 City of Henderson

The COH WRF is expanding to increase the annual average capacity to 29.9 mgd (46 cfs) in order to treat the flows projected through the year 2016. 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 COH WRF includes preliminary, secondary, and tertiary liquid stream treatment. Preliminary treatment includes flow measurement, three mechanical bar screens, two aerated grit basins, and three screw lift pumps. Secondary treatment includes two parallel oxidation ditches,

three secondary clarifiers, and a return activation sludge/waste activated sludge pumping station. Tertiary treatment for phosphorus removal is achieved by alum coagulation in the solids contact clarifiers and filtration prior to disinfection with sodium hypochlorite. The oxidation ditches are equipped with mechanical surface aerators and fine bubble diffused aerators. Ferric chloride can be added at the secondary clarifier flow splitter structure for coagulation and phosphorous precipitation (COH et al. 2000).

2.2 Boulder Islands North Alternative, Preferred Alternative

The Boulder Islands North Alternative includes 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.

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 North Alternative is divided into two main pipeline segments, the EI-Alignment A and the Boulder Islands North Lake Conveyance System (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 AMSWTP, Boulder Islands North Diffuser pipeline (BINDP), and a diffuser.

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 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.

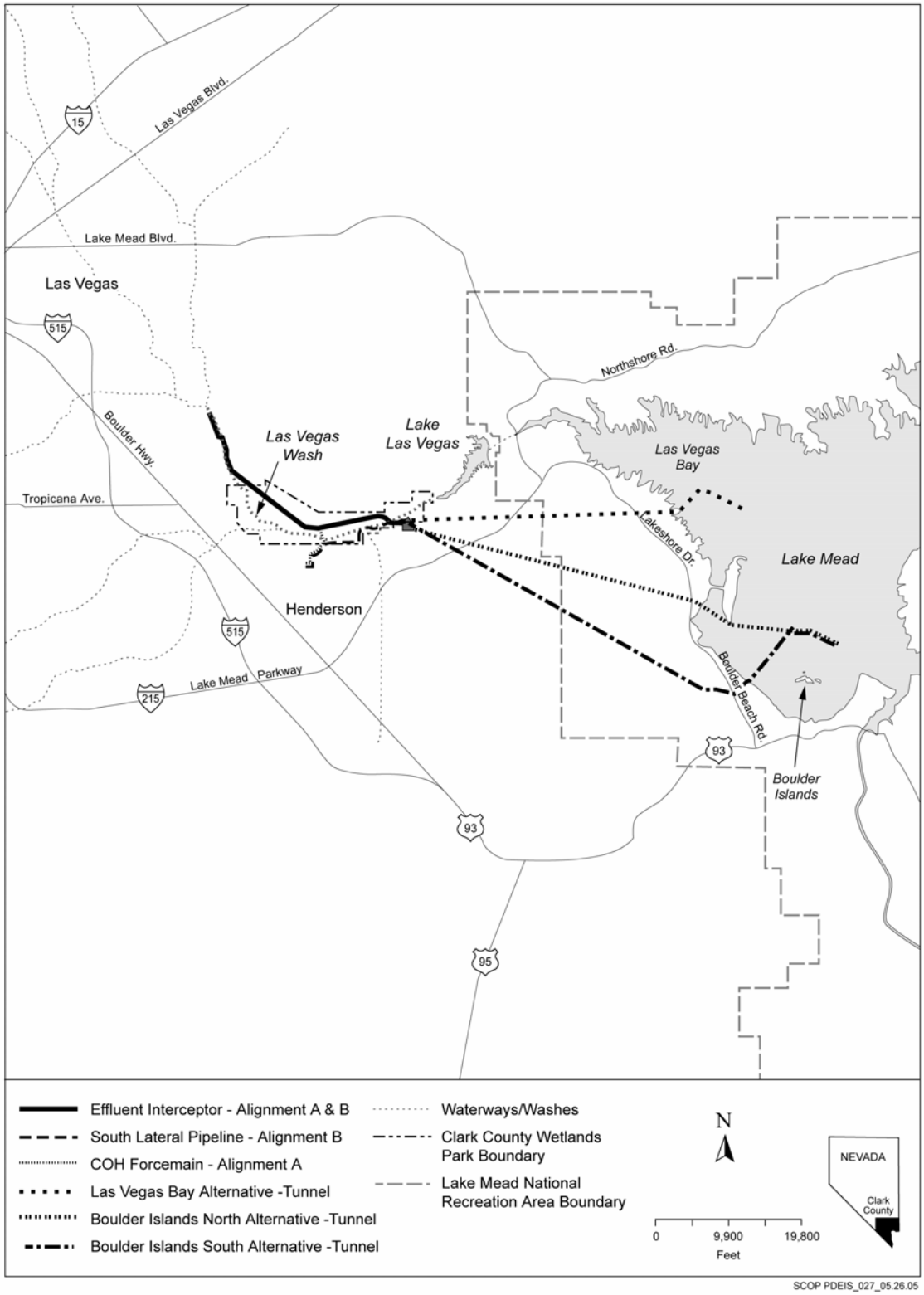

Figure 2.2-1 Alternatives.

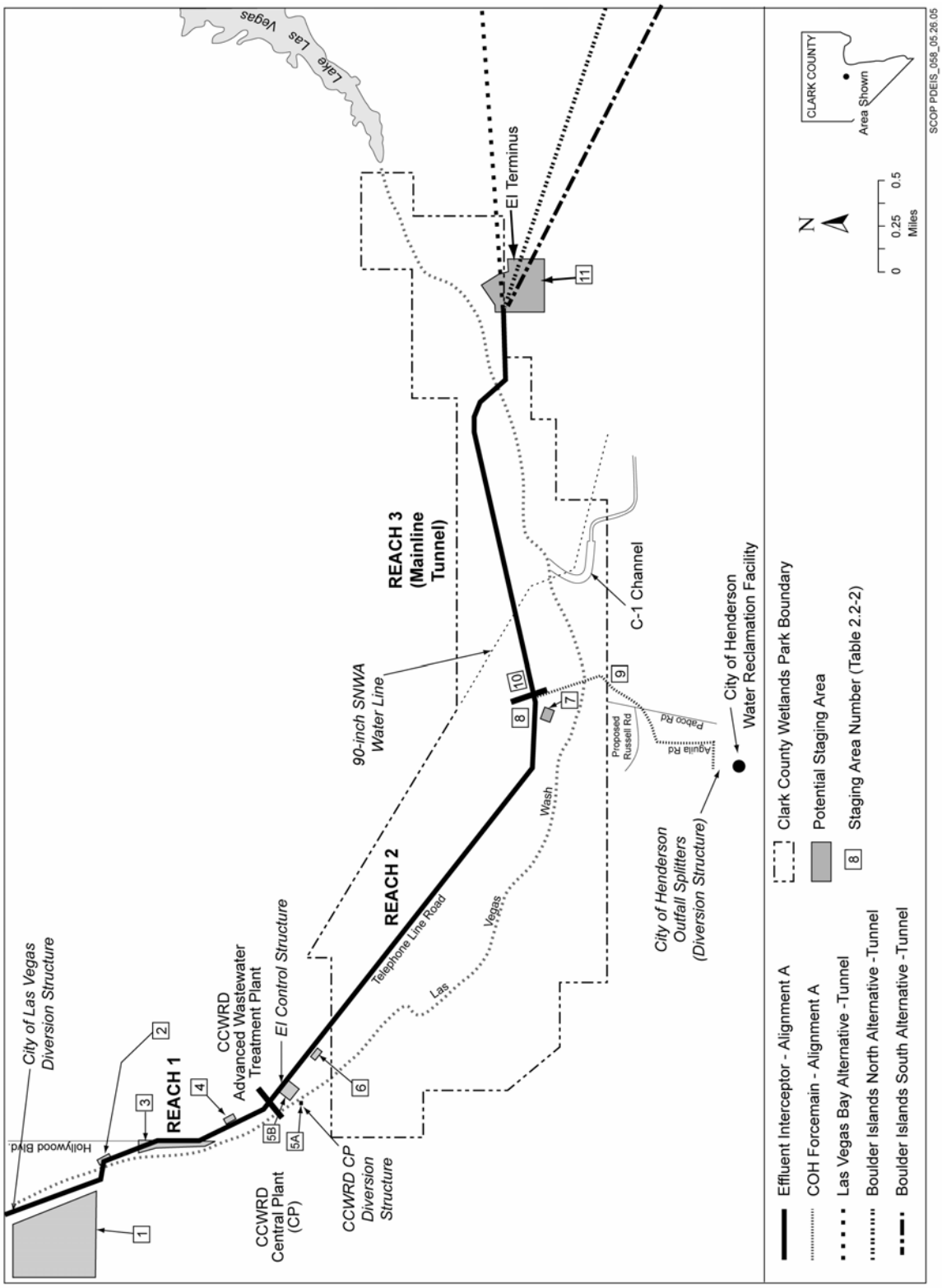

Figure 2.2-2 Effluent Interceptor – Alignment A and Ancillary Facilities.

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

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) 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 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/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 of the SCOP pipeline. The descriptions of the EI-Alignment A ancillary facilities and structures follow.

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.

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.

COH 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 EI 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). A construction 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 (Figure 2.2-3).

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.

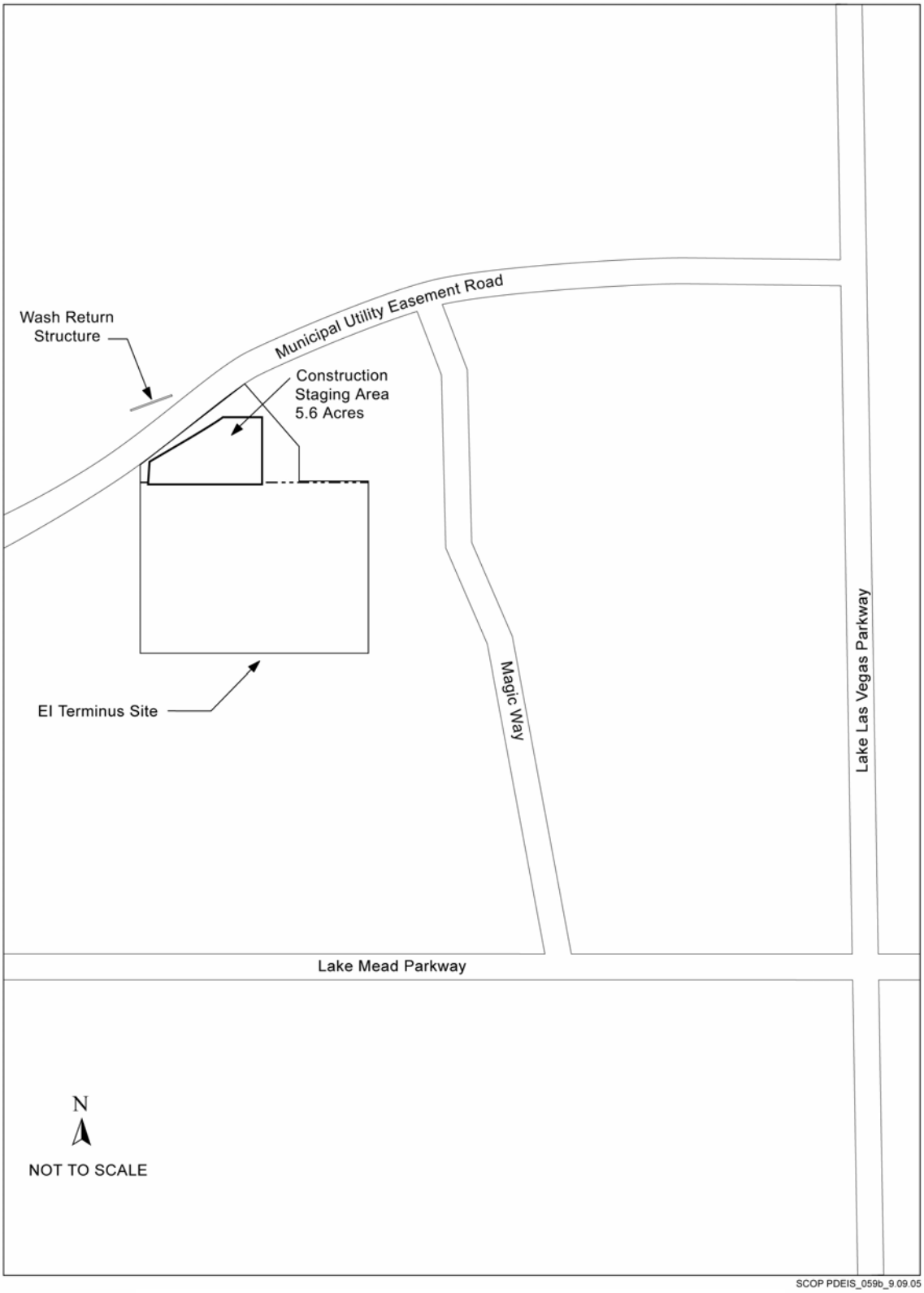

Figure 2.2-3 Effluent Interceptor - Alignment A Terminus Site.

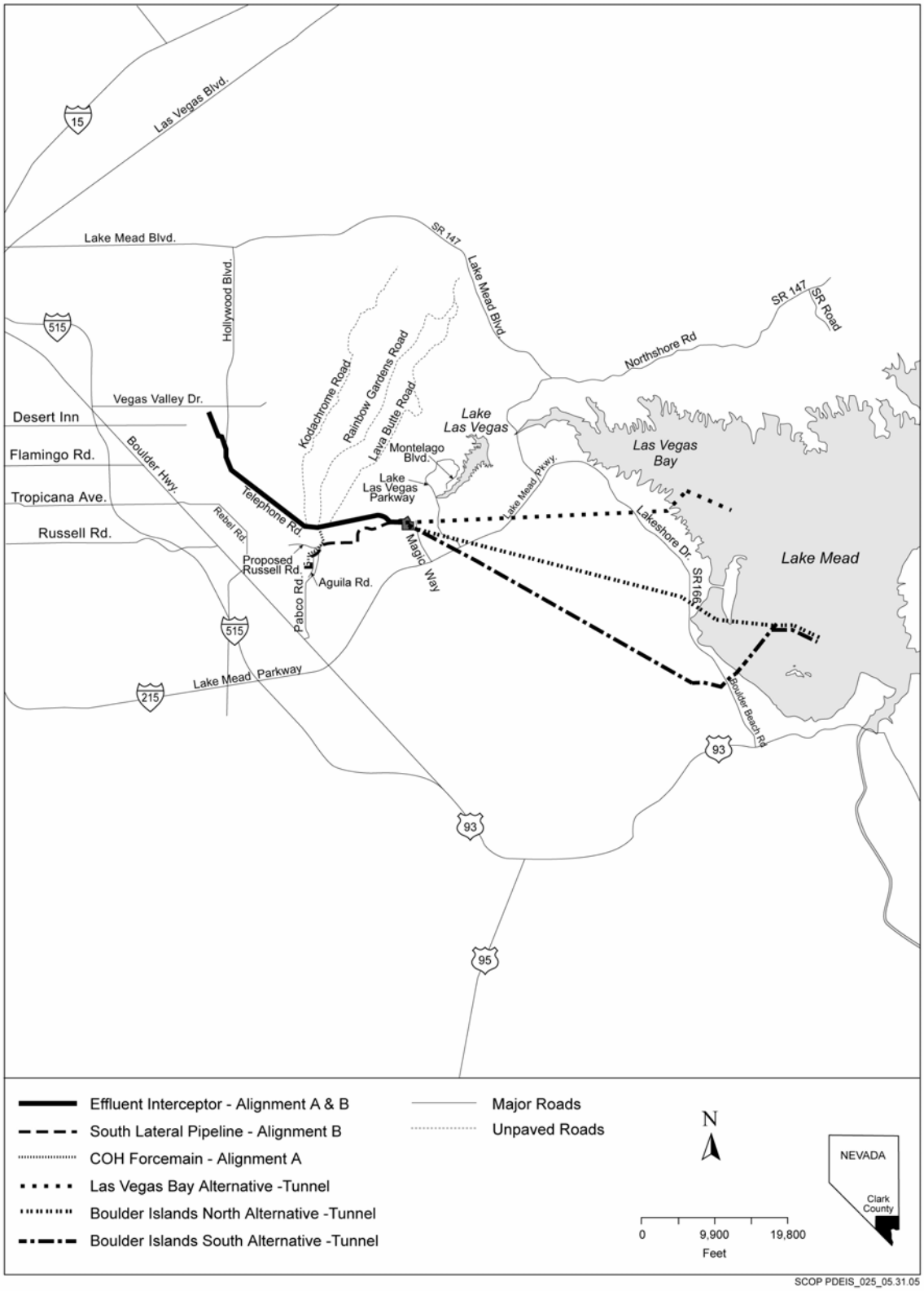

Figure 2.2-4 Maintenance and Access Roads.

2.2.1.4 Design Flow

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 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.

2.2.1.5 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. Tunneling would be required at the locations listed in Table 2.2-1.

2.2.1.6 Spoils and Backfill 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. Restoration of the project site would be completed in accordance with a project-specific Reclamation-approved restoration plan.

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 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.

2.2.1.7 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. 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 operation and maintenance 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 action alternatives, a SCOP Adaptive Management Plan (AMP) would be designed and implemented. The SCOP 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. 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 North River Mountains Tunnel No. 3 (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 staged at the EI Terminus site. The NRMT3-East working shaft would be 60 ft (18 m) deep. The activities for the eastern segment of the NRMT3 would be staged at the NRMT3-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 2.2-7).

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 Hydroelectric/PRS (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). 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 the bottom of Lake Mead with anchors and tie downs to hold the pipeline in place off the bottom. The pipeline would be designed to allow extension of the pipe if needed, based on changing lake conditions.

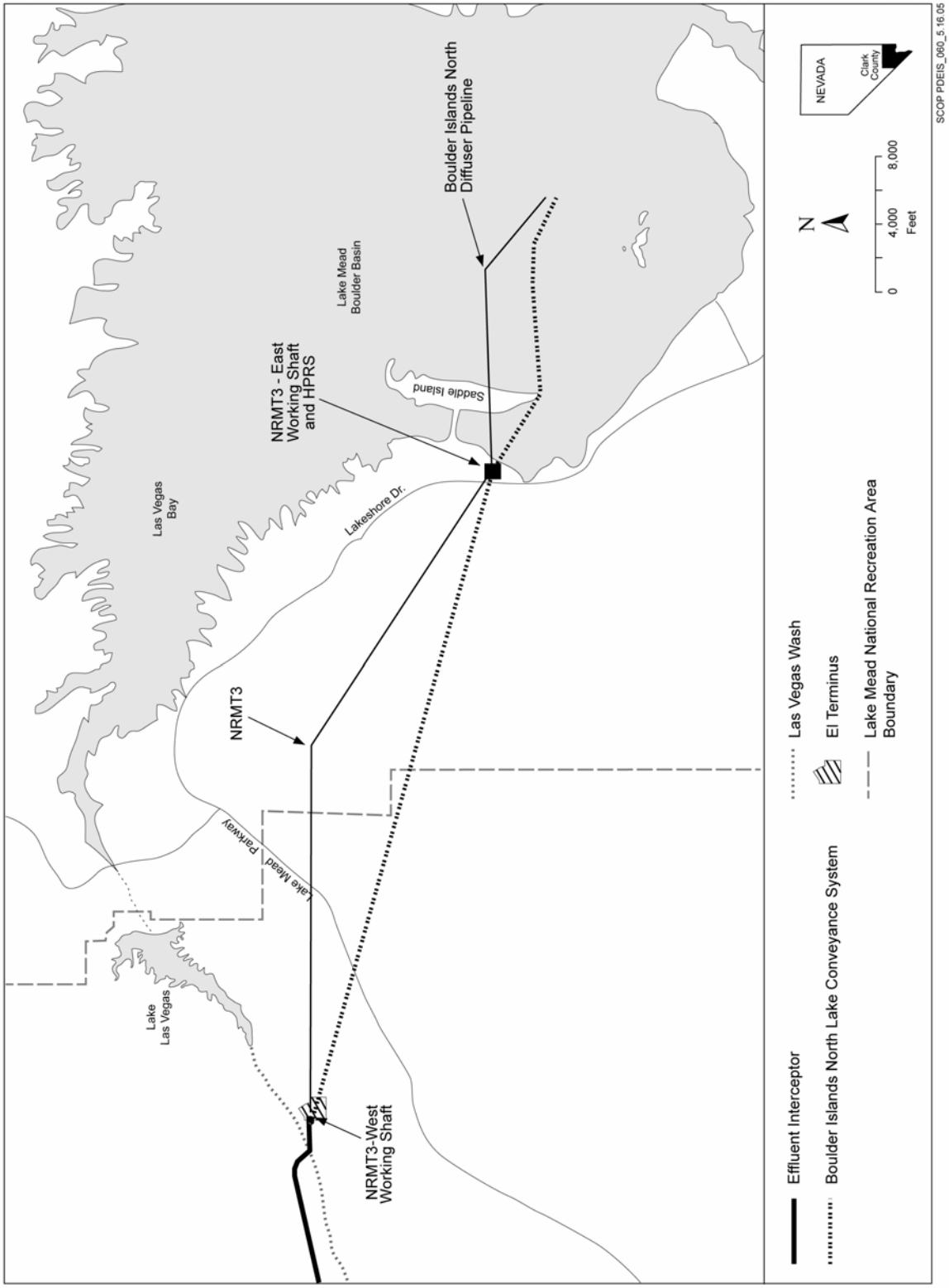

Figure 2.2-5 Boulder Islands North Lake Conveyance System.

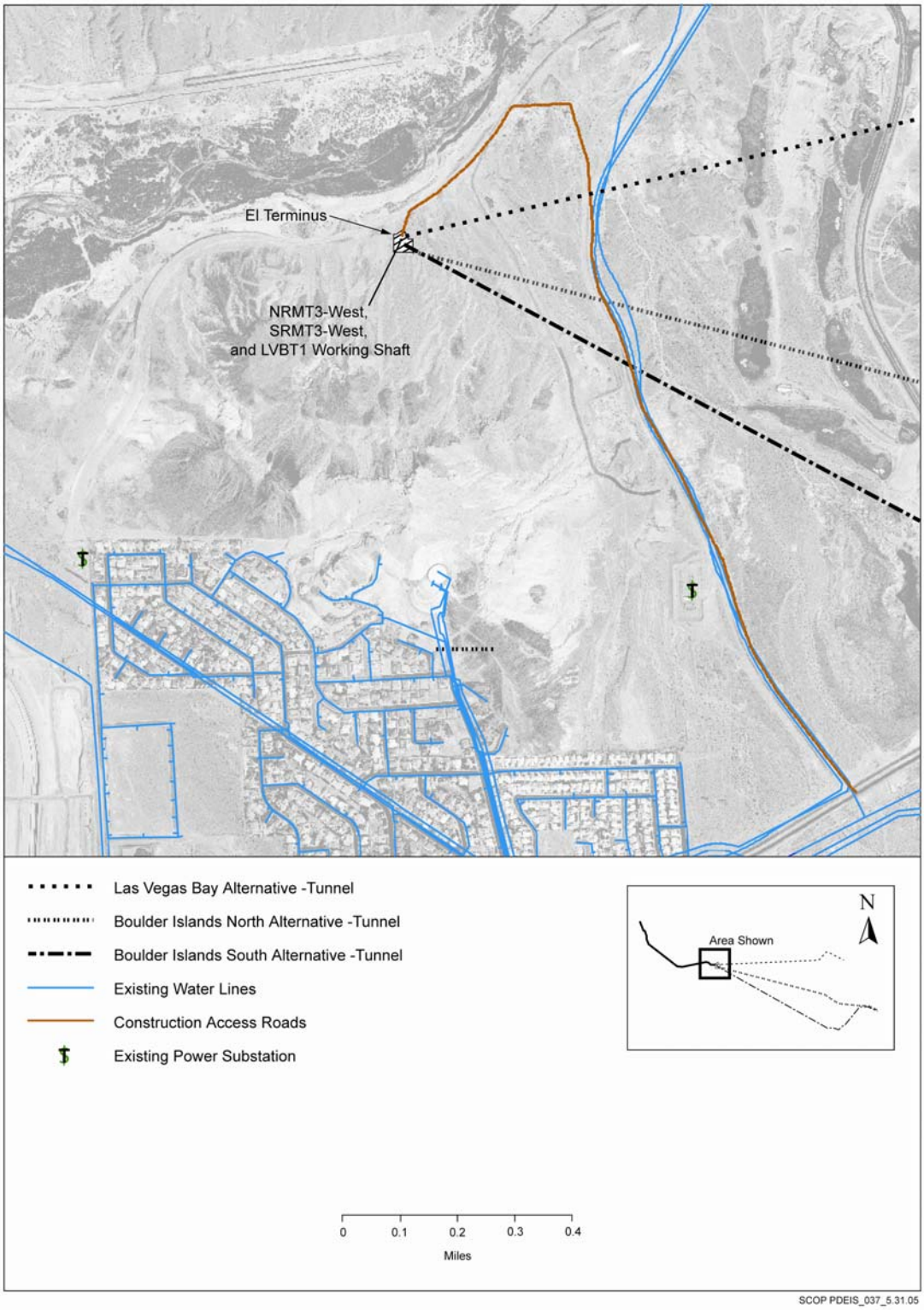

Figure 2.2-6 NRMT3-West, SRMT3-West, and LVBT1 Working Shaft.

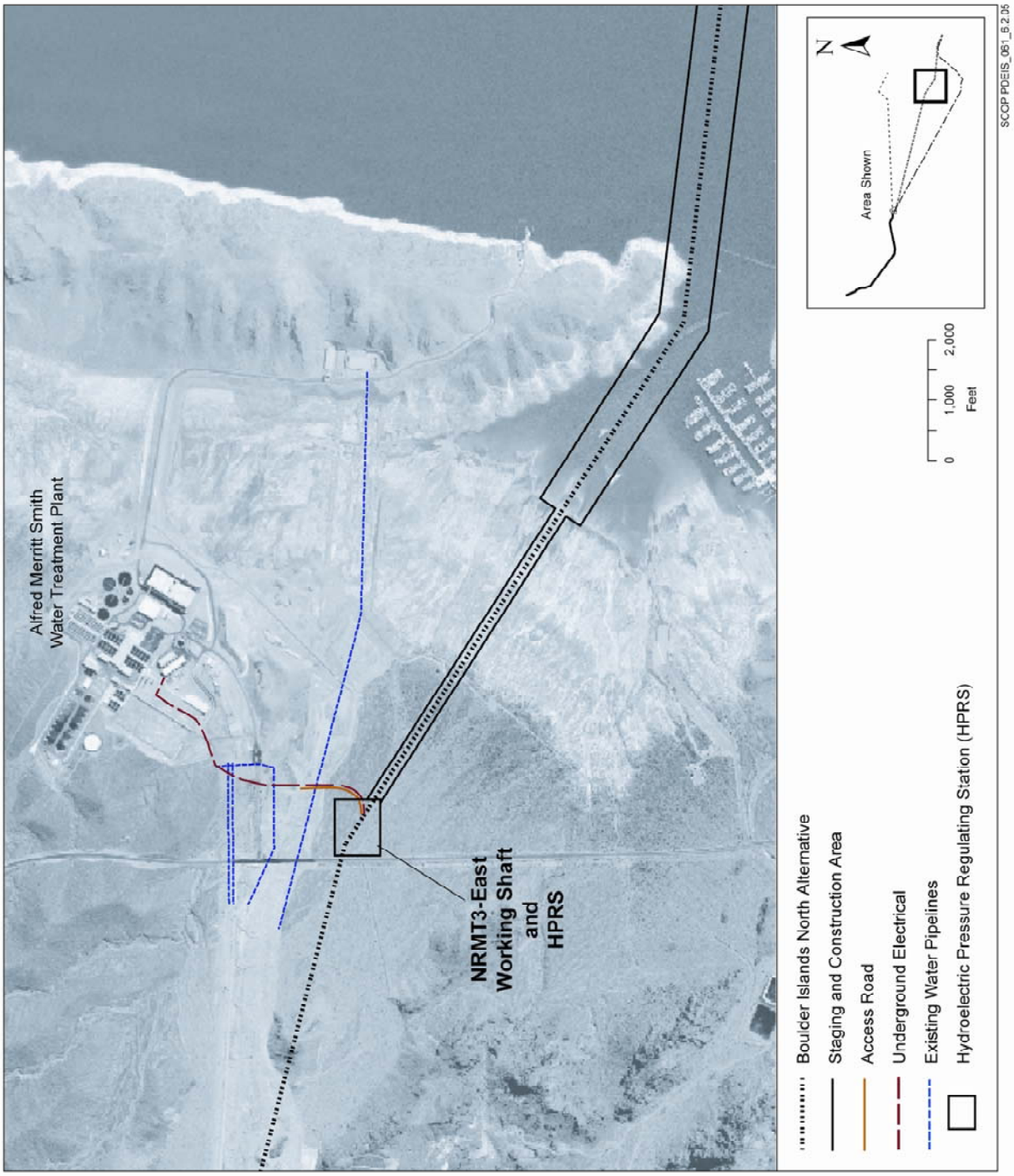

Figure 2.2-7 NRMT3-East Working Shaft and Hydroelectric/Pressure Regulating Station.

2.2.2.2 Ancillary Facilities and Structures

Ancillary facilities and structures for the Boulder Islands North LCS would be required for the operation and maintenance 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, 10 to 15 megawatts (mW) of hydroelectric power would be generated with year 2050 flows. The power would be delivered to the AMSWTP via an underground transmission line. The transmission line alignment is shown on Figure 2.2-7. 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 constructed in a partially below-grade structure with an earthened cover and surrounding berm to shield the structure from LMNRA visitors. 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 AMSWTP 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.

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. Disturbed areas would be restored in accordance with a project-specific Reclamation- or NPS-approved restoration plan.

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.

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 curtains would be a permeable geotextile fabric that is suspended from buoys

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 • Surface restoration	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 • Surface restoration	67	Same as NRMT3 – West
Boulder Islands North Diffuser Pipeline (BINDP)	• Mobilization • Dredging • Subaqueous pipeline construction • Surface restoration	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 • Materials - Pipe - Shaft lining and backfill - Grout - Pipe and Pipe embedment materials for connection to EI (at EI Terminus)	• 3 months • Once during mobilization and once during demobilization • 35 months • 3 months • 12 months • 31 months	• 20 per day • 10 (delivered then retrieved) • 20 per day • 50 per day • 50 per day • 50 per day
NRMT3-East	• Equipment - Miscellaneous - Construction trailers • Materials - Pipe - Shaft lining and backfill - Grout - Pipe and Pipe embedment materials for connection to Boulder Islands Outfall Pipeline	• 3 months • Once during mobilization and once during demobilization • 35 months • 3 months • 12 months • 31 months	• 20 per day • 10 (delivered then retrieved) • 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

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,

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. Restoration would be conducted along the shoreline and near-shore environment from barges.

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.

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 truckload.

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.

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 2.2-9.

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 increase 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. The PRS is required for operation of the hydroelectric units in case of a power loss from the grid. 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. 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 SCOP AMP.

As part of the Boulder Islands North Alternative, a SCOP AMP would be designed and implemented. The SCOP AMP would address concerns limited to the effects that may result from the discharge of highly treated effluent into Lake Mead in the vicinity of the Boulder Islands.

The CWC has conducted extensive water-quality modeling of the Boulder Basin to: provide, to the extent possible, information regarding possible changes to water quality resulting from the proposed alternative discharge locations; promote understanding of the conditions in Boulder Basin and the possible changes that may occur; and to identify methods for protection of the water quality. Although studies, and water-quality modeling and analyses support the feasibility and appropriateness of the proposed discharge location, as with any resource action within the environment, a level of uncertainty remains. The models are state of the art, and they indicate that all existing water-quality standards would continue to be met, and existing water quality protected. However, uncertainty exists regarding the performance of the system, the ranges of variability of water-quality constituents, and the potential to exceed water-quality standards. The modeling, as described in Section 4.1 and Appendix D, was based upon extensive collection of baseline water-quality data in the Boulder Basin. The concept of adaptive management is based upon the recognized need for operational flexibility to respond to future monitoring, research findings, and varying resource conditions. It is recognized that there is the need to establish a long-term adaptive management program to allow for the project measures to be adjusted over time based on the results of an active monitoring and evaluation program. This approach provides a greater measure of certainty that objectives for protecting natural and recreational resources and public health are achieved over the long term.

The dynamic nature of Lake Mead means that conditions change, often through actions that are unpredictable (droughts or floods) and actions that are standard operating protocols (operations of Hoover Dam). The environmental integrity of Lake Mead is dependent not only on the characteristics of the discharged effluent, but also on other non-effluent characteristics and stressors within the Lake itself and actions implemented throughout the Lake Mead watershed and beyond. The SCOP AMP would not be designed to accommodate the impacts from these outlying characteristics and stressors, but would be designed to be compatible with the continuous monitoring and possible development of future actions designed to mitigate impacts from these outlying areas. The SCOP AMP would address:

- Maximization of the system's operational flexibility;
- Establishment of objectives regarding protection of natural resources and water quality;
- Management of flows to meet water quality and recreational requirements;
- Management of flows to optimize basin water quality for drinking water protection, and natural resource and recreational requirements;
- Protection and maximization of return flow credits;
- Adjustment of treatment levels at the water reclamation facilities;
- Adjustment of effluent delivery between the Las Vegas Wash and the Boulder Islands depending on Lake conditions, depths, seasonal conditions, and other variables that could impact water quality in the Boulder Basin and through Hoover Dam;
- Monitoring of water-quality parameters based on federal and state water-quality standards and the objectives of the SCOP AMP;
- Establishment of target parameter-concentration ranges, based on the SCOP AMP objectives that would require action;
- Establishment of guidelines for the resolution of uncertainty within the operational system.

Methods to maximize the system's operational flexibility would be identified in the SCOP AMP. The methods may involve: the operation of the diffuser to control the depth of effluent and increased mixing; the potential to vary the directional release, both horizontal and vertical, through the Boulder Islands diffuser; the ability to modify the amount of effluent released to the Las Vegas Wash; and the improvement of treatment processes at the plants.

Current, conventional treatment processes are able to treat total phosphorus to a concentration of 0.2 mg/L. Optimization of the plants would enable treatment of combined total phosphorus to levels less than 0.2 mg/L if necessary to meet water-quality standards and SCOP AMP objectives. Plant optimization could be implemented with minimal capital construction activities and time delays. A description of current, conventional treatment processes and plant optimization is presented in Section 2.1.

The primary objective of the SCOP AMP is to protect the existing high water quality within Lake Mead, by meeting existing water-quality standards. A primary indicator of the existing high water quality and aesthetic values is meeting the current water-quality standards for chlorophyll *a* in the Boulder Basin. The water quality standard states that the mean chlorophyll *a* during the growing season (April 1-September 30) must not exceed 5 µg/L in the open water of Boulder

Basin. Additional objectives for the protection of natural resources and water quality would be established and the methods to meet these objectives would be identified.

The Boulder Basin has been one of the most intensively monitored water bodies in the country since the 1960s. That monitoring provides an extensive baseline of water-quality parameters related to the state standards. This monitoring would continue and be incorporated into the SCOP AMP, which would include a monitoring plan that:

- Identifies the water-quality parameters to be monitored such as, but not limited to, phosphorus and nitrogen;
- Identifies the parameters in sediments to be monitored such as, but not limited to, metals;
- Identifies monitoring locations, which may include locations to determine non-effluent related contributions to water-quality in Boulder Basin as well as locations that may include, but are not limited to, upstream and downstream of Hoover Dam, and within the diffuser mixing zone;
- Incorporates monitoring of conditions and water-quality parameters in the Las Vegas Wash;
- Identifies the frequency of sampling and analysis; and
- Complies with established quality control/quality assurance procedures.

The process would begin with the identification and documentation of baseline conditions. Sampling and analysis of water quality would be monitored regularly for parameters identified by NDEP and NPS. In conjunction with the CWA anti-degradation requirements and the NPS non-impairment guidelines, the objectives would include that lake waters:

- Be fishable and swimmable,
- Support viable wildlife populations, and
- Maintain their high-quality recreational setting through maintaining existing high water quality.

A growing concern for water bodies worldwide relates to what are broadly referred to as emerging contaminants of concern. These include pharmaceuticals, residues from personal care products such as soaps and shampoos, and compounds that can evoke hormonal responses in fish and wildlife, generally referred to as endocrine disruptors. These compounds are not currently regulated by EPA or NDEP. The science related to their cause and effect within the environment is not fully established. Lake Mead has seen extensive monitoring to date for a broad spectrum of these chemicals. While many have been found in the Lake within detection limits, little is currently understood about the potential for long-term effects upon wildlife at the current levels of detection. The SCOP AMP would monitor for these compounds, and coordinate with other efforts for research into their potential impacts upon fish and wildlife. Should significant impacts be noted, or should these compounds become regulated, treatment processes can be adjusted in response. The SCOP AMP would include periodic evaluation of the science related to these compounds, as well as emerging treatment technologies. Additional information about pharmaceuticals and personal care products in Lake Mead is presented in Appendix K.

The results of the monitoring 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.

Additionally, monitoring results may indicate that plant optimization or further treatment is needed.

The NDEP has statutory authority to issue and regulate the water quality aspects of an adaptive management plan. As such, the SCOP AMP, including monitoring and sampling to meet water quality requirements and NPS guidelines for non-impairment would be subject to the approval of the NDEP and NPS, respectively.

The management of the SCOP AMP would be conducted through a tiered management approach. The first tier, the Core Management Team, would have the primary responsibility to oversee the operations, monitoring, and annual review of the CWC SCOP facilities. The Core Management Team would be the decision-making body for the SCOP AMP. The CWC, NPS, Reclamation, and SNWA would comprise the Core Management Team. The second tier, the Advisory Team, would provide technical expertise as needed. Agencies that may comprise the Advisory Team include the U.S. Fish and Wildlife Service (USFWS), U.S. Geological Service (USGS), NDEP, and Nevada Division of Wildlife (NDOW). Additional agencies may also be members of the Advisory Team. The third tier would involve agencies and individuals that have an interest in Lake Mead. These agencies and individuals would be kept informed and would participate through meetings that are open to the public such as the Lake Mead Water Quality Forum and the LVWCC meetings.

The data obtained from implementing the SCOP AMP would be evaluated annually to assess whether the objectives are being met and to determine whether management actions are required. The data collected and managed through the monitoring and evaluation program would provide a scientific basis for such evaluation. Data collected through the SCOP AMP would be incorporated into the existing water-quality modeling conducted for the SCOP project, and evaluated for confirmation and calibration of modeling predictions. The SCOP AMP would incorporate science and research conducted by other agencies and programs within LMNRA, as well as other scientific findings elsewhere. The SCOP AMP process would provide for professional, scientific reviews to ascertain the effectiveness of existing operations in meeting SCOP AMP goals and objectives, including periodic outside review.

The SCOP AMP would be re-evaluated every 5 years to assess whether the objectives are being met. The SCOP AMP would then be modified, if necessary, to address inefficiencies, new contaminants of concern, or changes in Lake conditions.

2.3 Boulder Islands South Alternative

The Boulder Islands South Alternative includes 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.

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.

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.

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

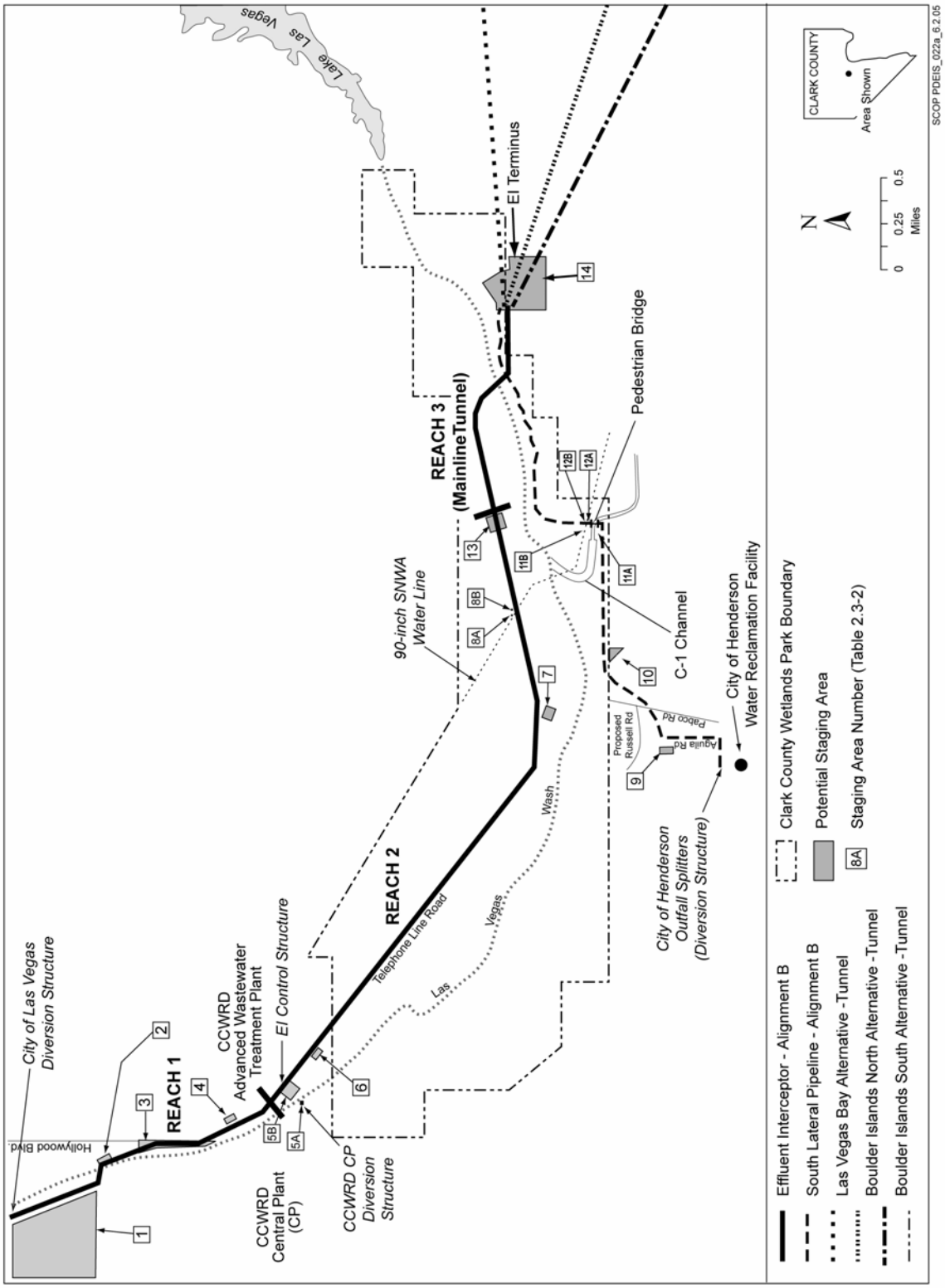

Figure 2.3-1 Effluent Interceptor – Alignment B and Ancillary Facilities.

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.

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.

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

2.3.1.1.4 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 operation and maintenance 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 EI 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.

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

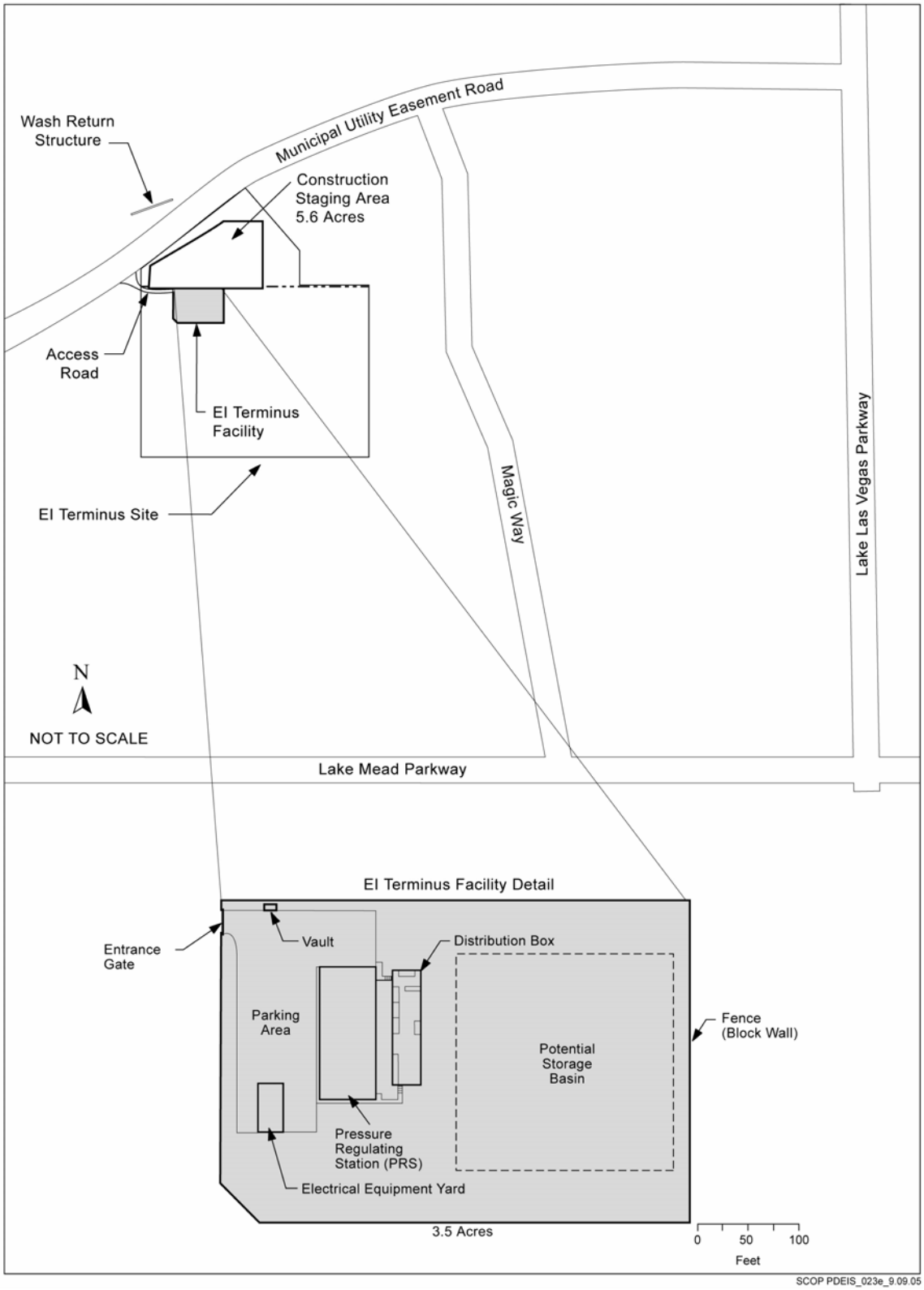

Figure 2.3-2 Effluent Interceptor - Alignment B Terminus Facility.

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).

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

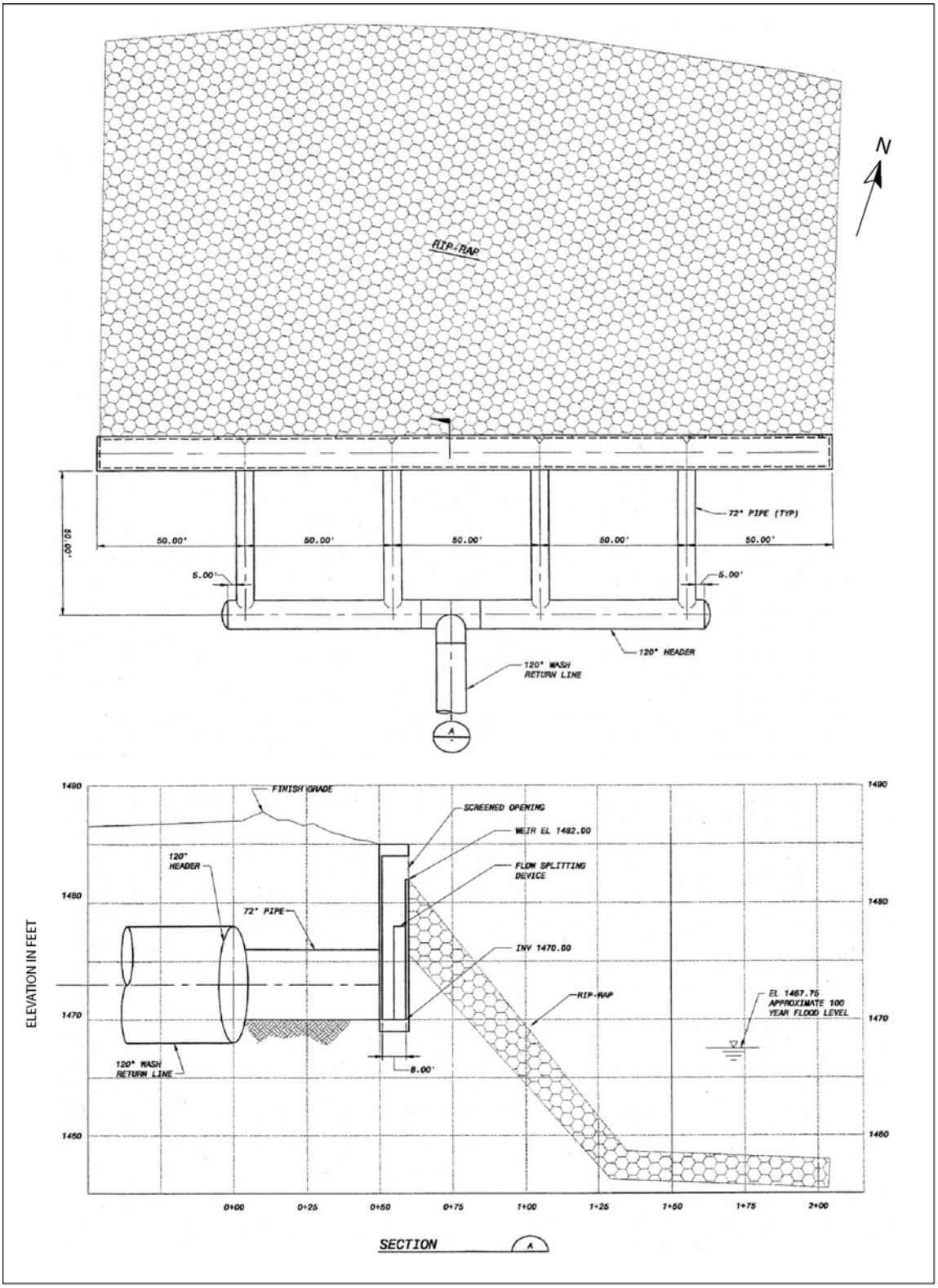

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Figure 2.3-3 Wash Return Structure.

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 Design Flow

The design for the EI-Alignment B, South Lateral Pipeline, and related facilities would be the same as described for EI-Alignment A in Section 2.2.1.4.

2.3.1.5 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 2.2.1.5. 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. Tunneling would be required at the locations listed in Table 2.3-1.

2.3.1.6 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. Restoration of the project site would be completed in accordance with a project-specific Reclamation-approved restoration plan.

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.

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.

2.3.1.7 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. 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 operation and maintenance 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 SCOP AMP would be designed and implemented. The SCOP 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 South River Mountains Tunnel No. 3 (SRMT3), the Boulder Islands South Outfall Pipeline (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 2.3-5).

2.3.2.1.2 Boulder Islands South Outfall Pipeline

The BISOP would begin at the SRMT3-East working shaft located on NPS land and would proceed in a southeasterly then northeasterly direction to the PRS. The BISOP would be approximately 8,000 ft (2,438 m) long. The segment of the BISOP between the SRMT3-East working shaft and the PRS would closely follow the profile of the terrain in this area.

The BISOP would be installed using a cut-and-cover construction technique except where it goes beneath Lakeshore Drive, the Boulder City Lateral, and the historic railroad grade via short tunnels. The pipeline would be installed in a trench approximately 20 ft (6 m) deep with a minimum cover of 8 ft (2 m). The BISOP would have a 12 ft (4 m) diameter.

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

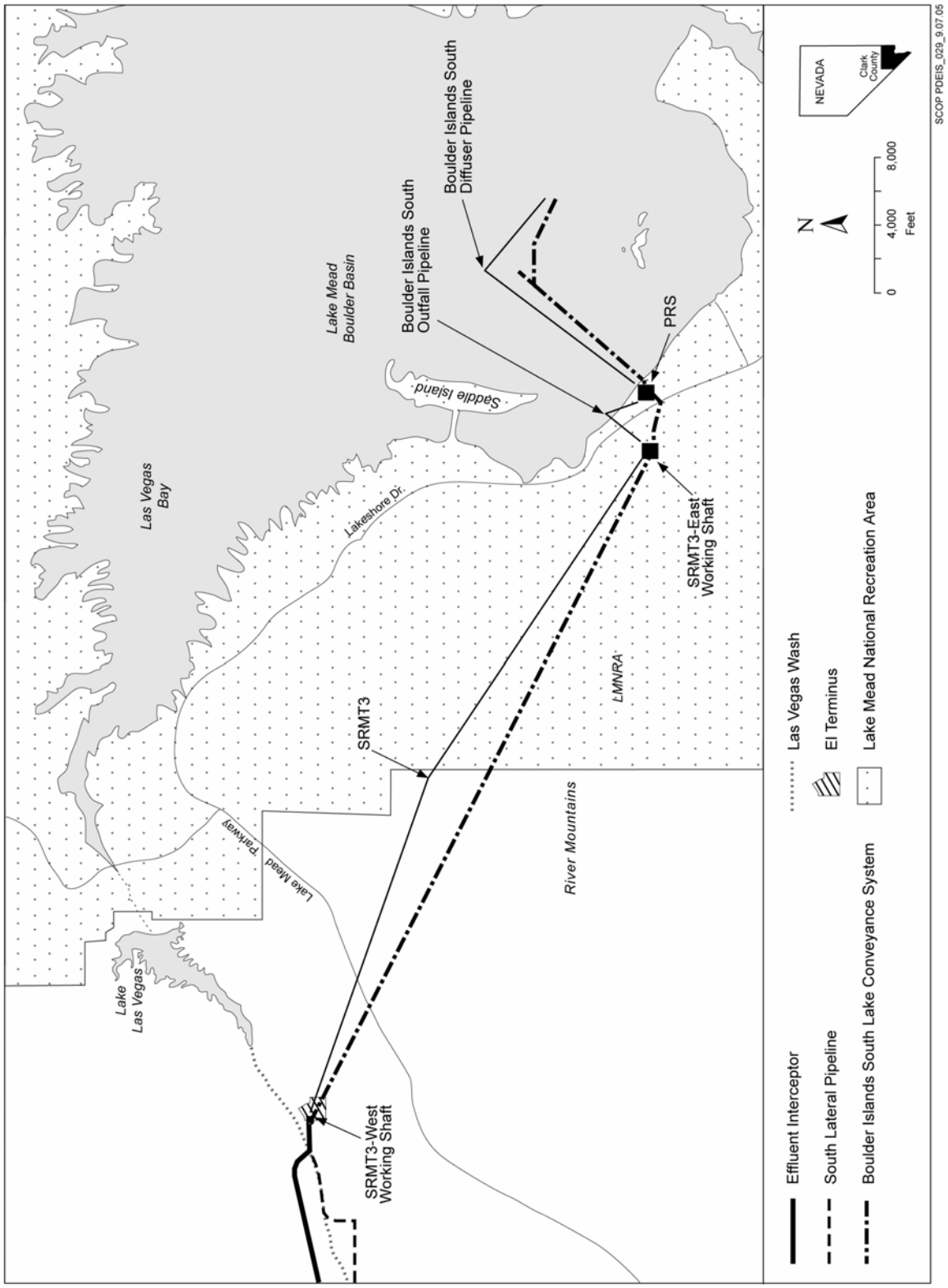

Figure 2.3-4 Boulder Islands South Lake Conveyance System.

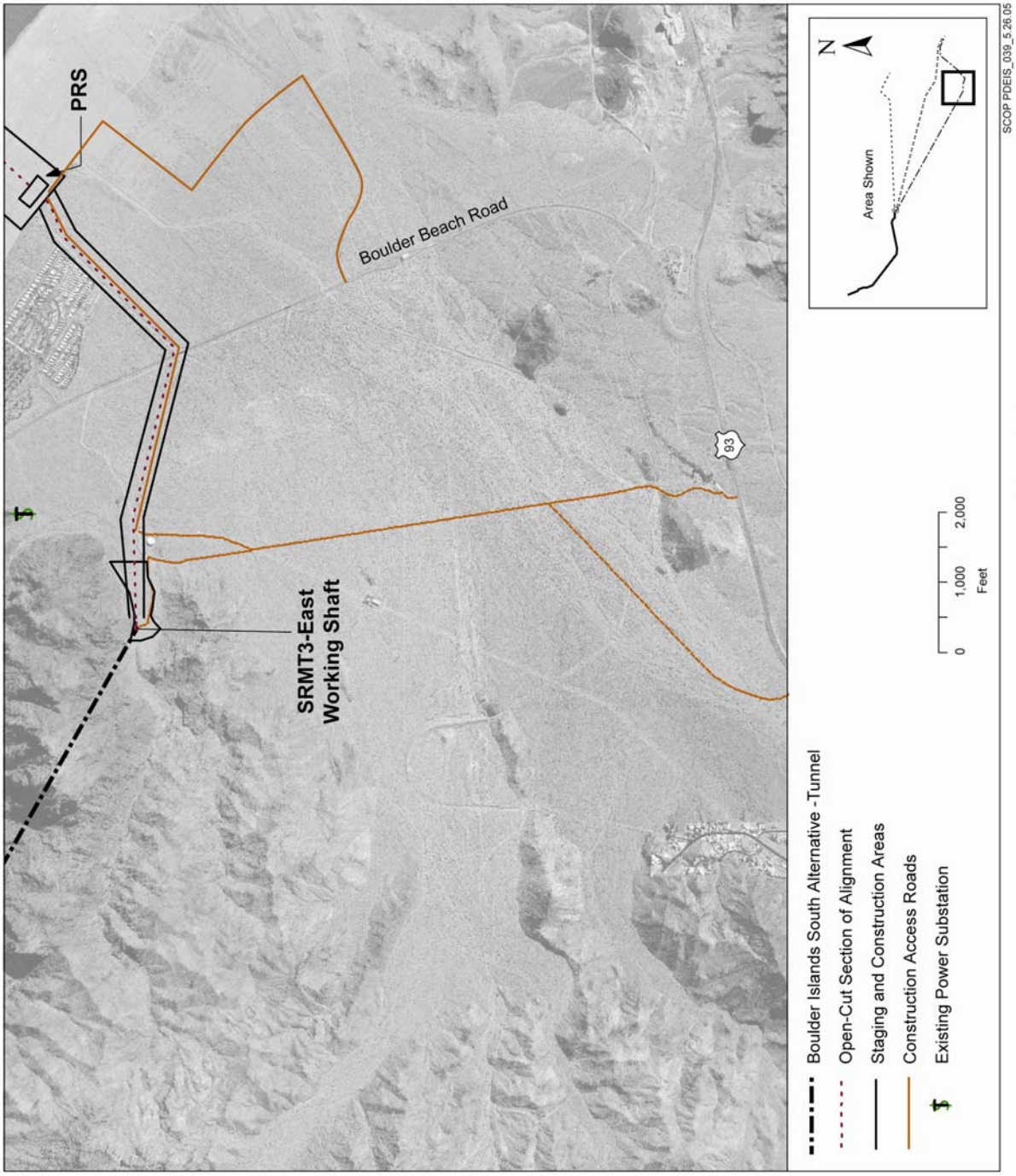

Figure 2.3-5 SRMT3-East Working Shaft.

(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.

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 the Lake bottom with anchors and tie downs to hold the pipeline in place off the bottom. 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 operation and maintenance 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 2.3-5).

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 (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.

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. Disturbed areas would be restored in accordance with a project-specific Reclamation- or NPS-approved restoration plan.

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.

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.

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.

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 • Surface restoration	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 • Surface restoration	67	Same as SRMT3 – West
Boulder Islands South Outfall Pipeline (BISOP)	• Mobilization • Pipeline construction • Highway crossing & tunnel construction • PRS construction • Surface restoration	16[1]	Same as SRMT3 – West (without the tunnel-boring machine)
Boulder Islands South Diffuser Pipeline (BISDP)	• Mobilization • Dredging • Subaqueous pipeline construction • Surface restoration	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 • Materials - Pipe - Shaft lining and backfill - Grout - Pipe and Pipe embedment materials for connection to EI (at EI Terminus)	• 3 months • Once during mobilization and once during demobilization • 35 months • 3 months • 12 months • 31 months	• 20 per day • 10 (delivered then retrieved) • 20 per day • 50 per day • 50 per day • 50 per day
SRMT3-East	• Equipment - Miscellaneous - Construction trailers • Materials - Pipe - Shaft lining and backfill - Grout - Pipe and Pipe embedment materials for connection to BISOP	• 3 months • Once during mobilization and once during demobilization • 35 months • 3 months • 12 months • 31 months	• 20 per day • 10 (delivered then retrieved) • 20 per day • 50 per day • 50 per day • 50 per day
BISOP	• Equipment - Miscellaneous • Materials - Pipe - Backfill	• 3 months • 12 months (during two winter seasons) • 3 months	• 20 per day • 20 per day • 50 per day
BISDP	• Equipment - Miscellaneous • Materials - Pipe	• 3 months • 31 months	• 20 per day • 50 per day

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.

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.

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 SCOP 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.

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, Effluent Interceptor – 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 Las Vegas Bay Tunnel-Phase 1 (LVBT1), Las Vegas Bay Tunnel-Phase 2 (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

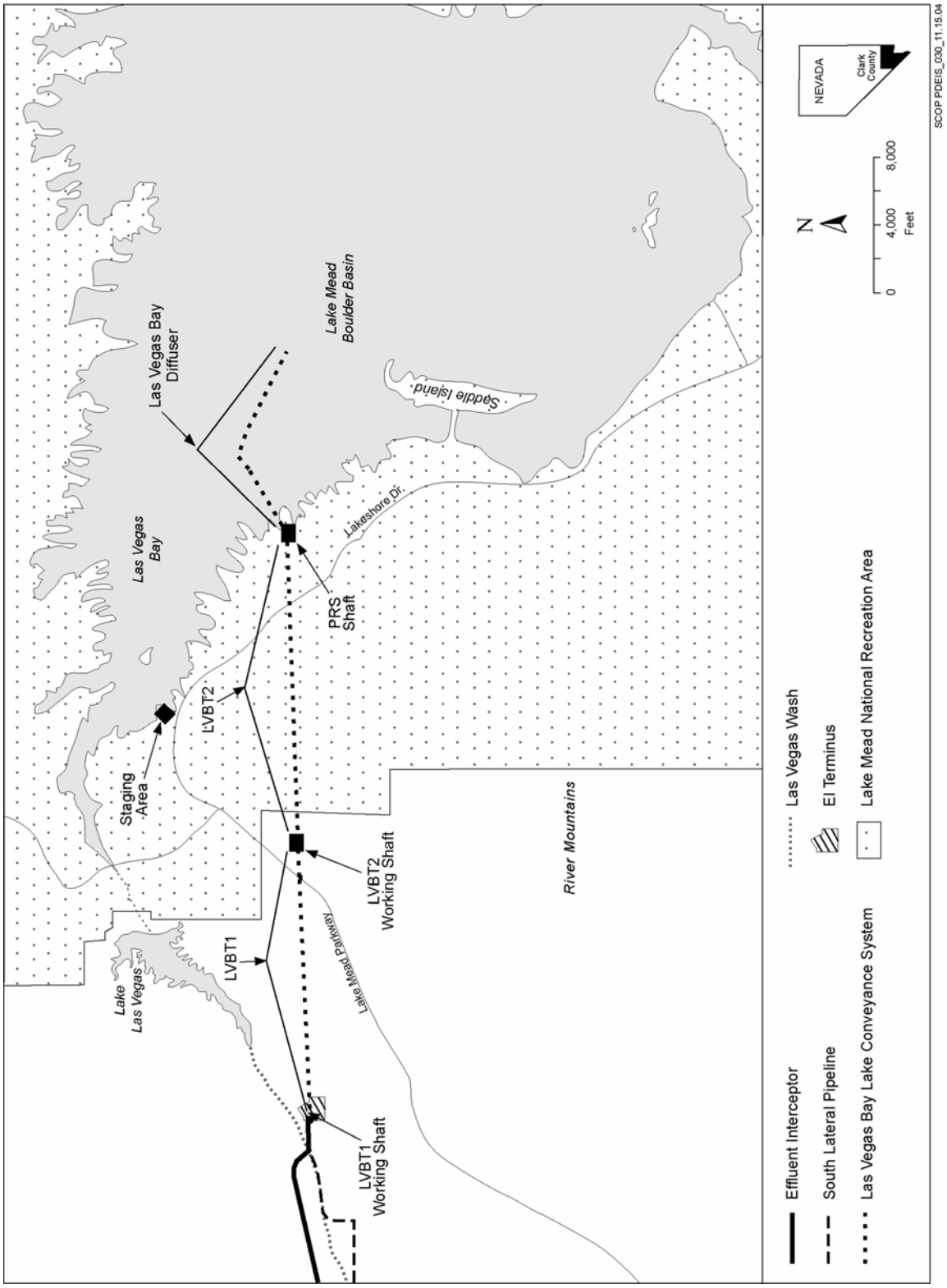

Figure 2.4-1 Las Vegas Bay Lake Conveyance System.

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 operation and maintenance of the pipeline. The Las Vegas Bay LCS ancillary facilities and structures are described in this section.

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 would be located approximately 4,000 ft (1,219 m) and 2,500 ft (762 m) from the nearest shoreline in the

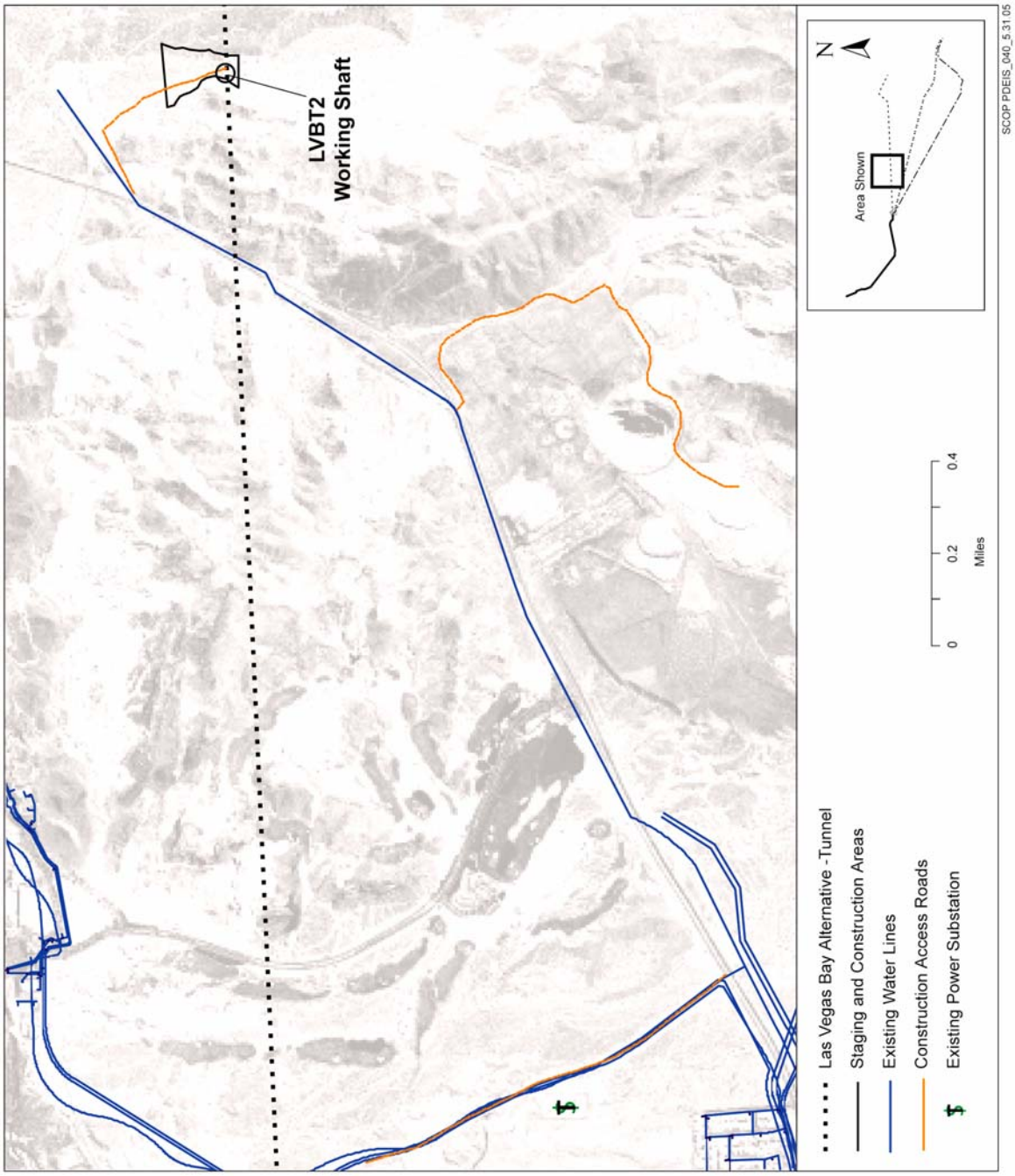

Figure 2.4-2 LVBT2 Working Shaft.

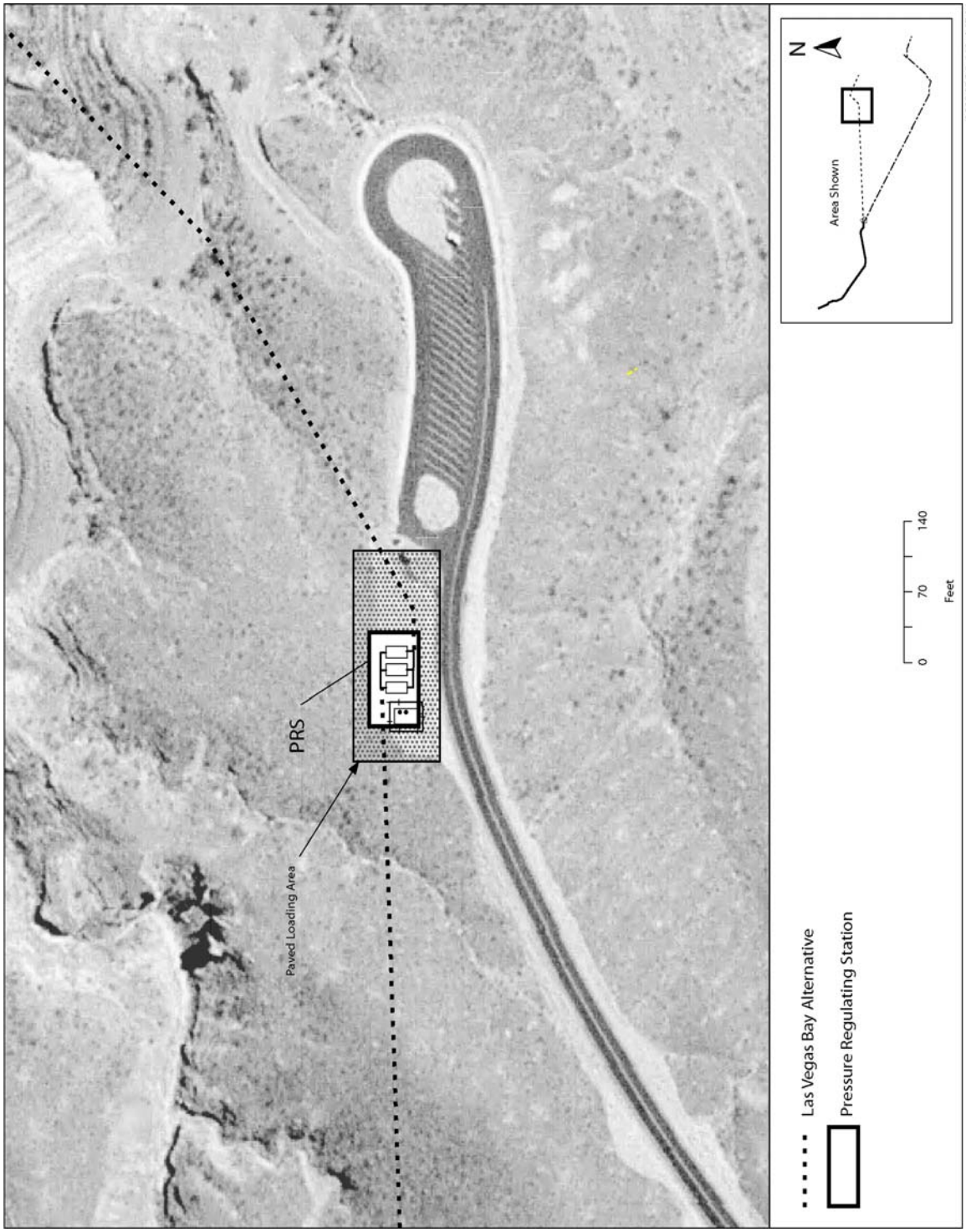

Figure 2.4-3 Las Vegas Bay Pressure Regulating Station.

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.

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.

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. Restoration would be conducted along the shoreline and near-shore environment from barges.

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 • Surface restoration	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 • Surface restoration	64	Same as LVBT1
Las Vegas Bay Diffuser Section	• Mobilization • Pipeline Construction • Dredging • Subaqueous pipeline construction • Surface restoration	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 - Construction trailers • Materials - Pipe - Shaft lining and backfill - Grout - Pipe and pipe embedment materials for connection to EI (at EI Terminus)	• 3 months • Once during mobilization and once during demobilization • 35 months • 3 months • 12 months • 31 months	• 20 per day • 10 (delivered then retrieved) • 20 per day • 50 per day • 50 per day • 50 per day
LVBT2	• Equipment - Miscellaneous - Construction trailers • Materials - Pipe - Shaft lining and backfill - Grout - Pipe and pipe embedment materials for connection to Las Vegas Bay Diffuser Section	• 3 months • Once during mobilization and once during demobilization • 35 months • 3 months • 12 months • 31 months	• 20 per day • 10 (delivered then retrieved) • 20 per day • 50 per day • 50 per day • 50 per day
Las Vegas Bay Diffuser Section	• Equipment - Miscellaneous • Materials - Pipe - Backfill	• 6 months • 12 months • 6 months	• 20 per day • 20 per day • 50 per day

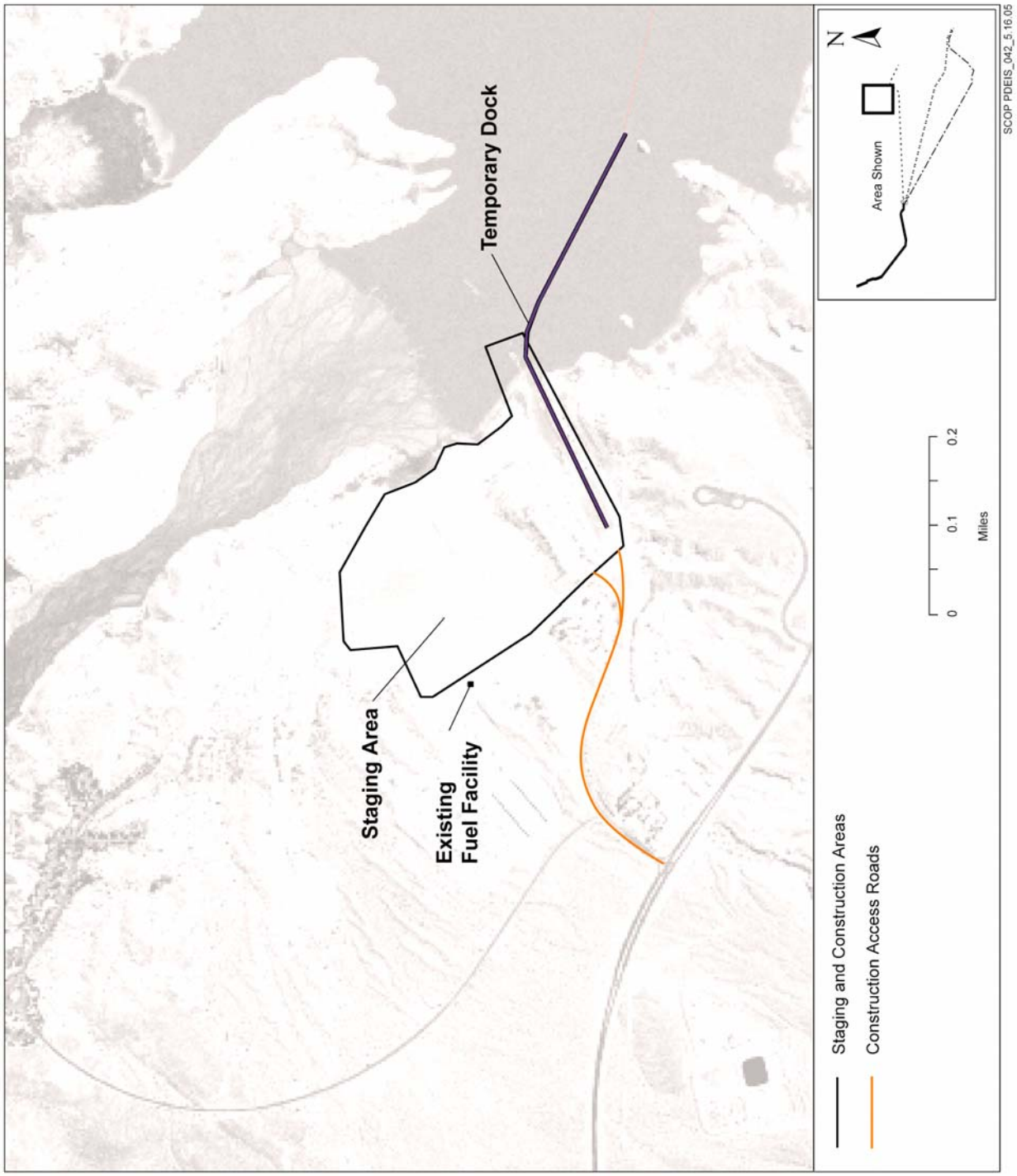

Figure 2.4-4 Old Marina Staging Area.

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. Restoration of the project site would be completed in accordance with a project-specific NPS-approved restoration plan.

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 SCOP AMP are provided in Section 2.2.2.6.

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.

2.5 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 2.5-1 presents the timeline of events that resulted in the development of 11 alternatives that were studied in the Alternate Discharge Study.

Table 2.5-1 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.

2.5.1 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 2.6 were identified during the stakeholder interviews or were issues developed by the Alternate Discharge Study Team. 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.

2.5.2 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,
- 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.

2.6 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 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
- Leave discharge "As Is" but improve the Las Vegas Wash to handle the additional flow.

2.6.1 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.

2.6.1.1 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 2.6-1. 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.

2.6.1.1.1 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 2.6-1). 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.

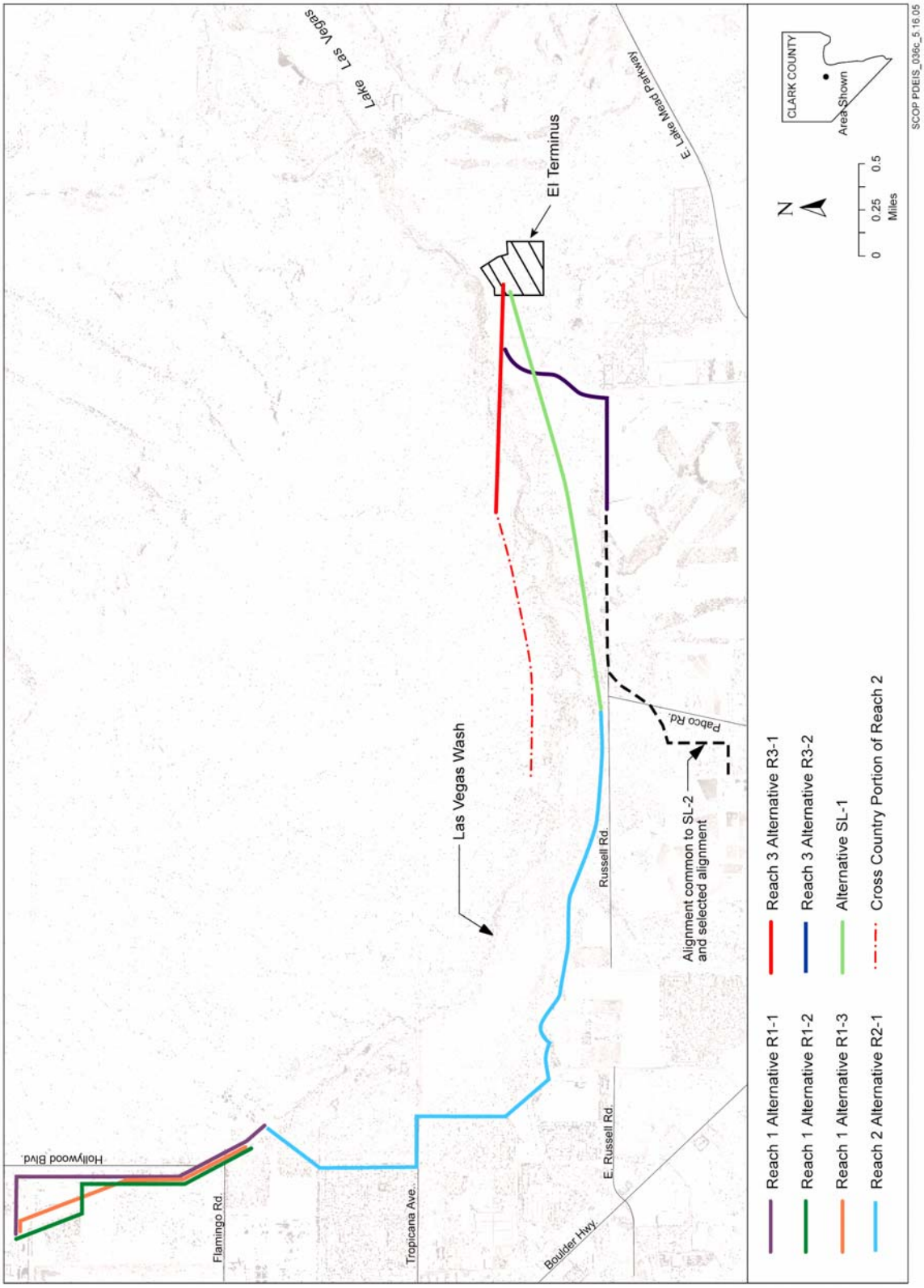

Figure 2.6-1 Effluent Interceptor Alignments Eliminated.

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.

2.6.1.1.2 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 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.

2.6.1.1.3 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.

2.6.1.2 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.

2.6.1.2.1 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.

2.6.1.2.2 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 2.6-1). 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.

2.6.1.3 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 2.6-1.

2.6.1.3.1 Alternative R3-1

Alternative R3-1 would consist of a tunnel alignment that crosses under the Las Vegas Wash at an oblique angle (Figure 2.6-1). 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.

2.6.1.3.2 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 2.6-1). 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.

2.6.1.4 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 2.6-1 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.

2.6.2 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.
- 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.

2.6.3 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 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.

2.6.4 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.

2.6.5 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.

2.6.6 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:

- 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.

2.6.7 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 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.

2.6.8 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 2.6-2). 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 total phosphorus 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 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

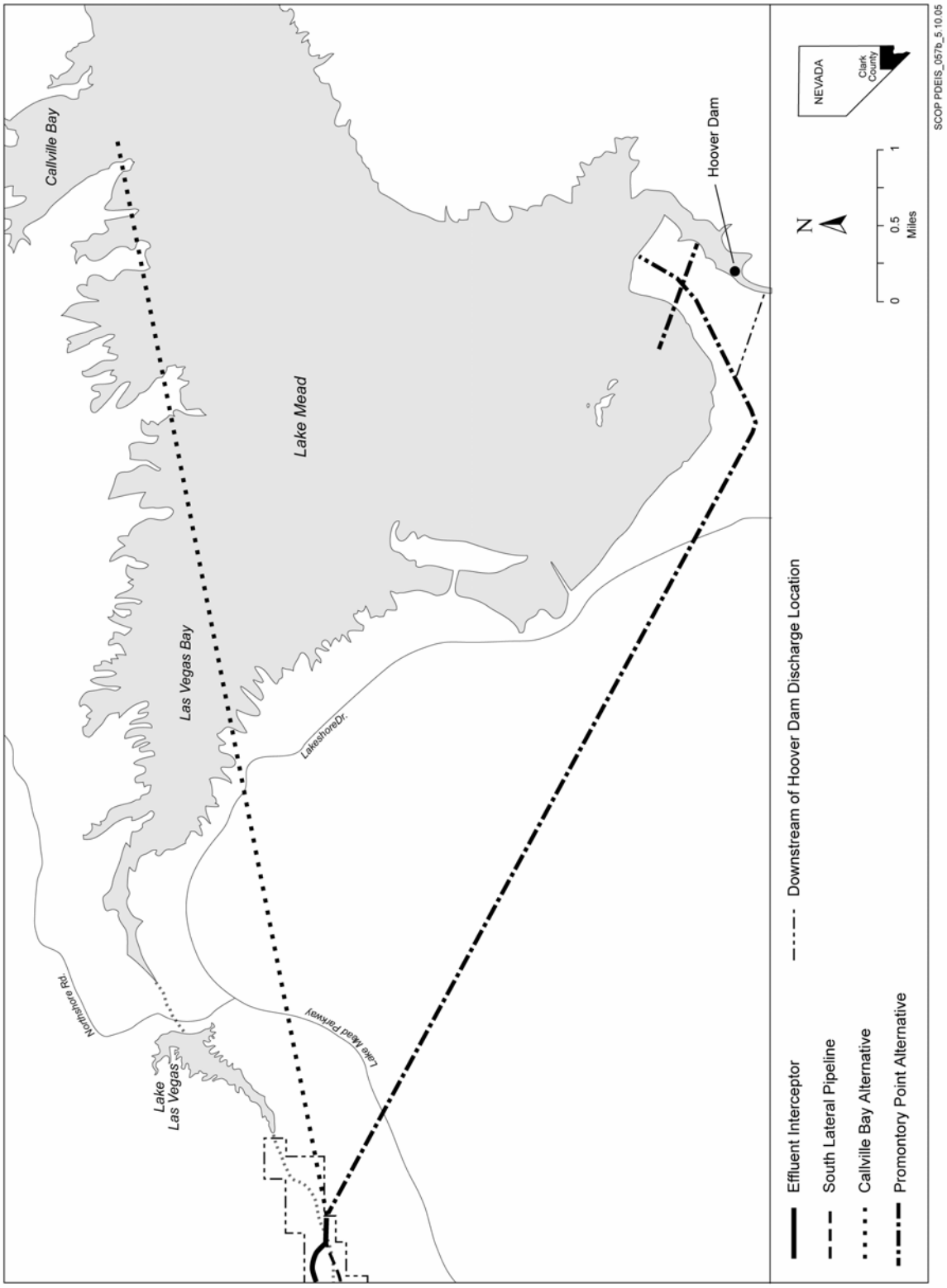

Figure 2.6-2 Lake Conveyance System Alternatives Eliminated.

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* (2002a) 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.

2.6.9 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 2.6-2). 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 2.6.8). 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.

2.6.10 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 2.6-2). 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.

2.6.11 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 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 will permit high standards of living and a wide sharing of life’s amenities, 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 action 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.

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 may be used by the AMSWTP. The generation of hydroelectric power is considered an environmentally responsible action and a beneficial impact of the Boulder Islands North Alternative.

2.8 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, and Las Vegas Bay Alternative. Table 2.8-1 provides a comparison of alternatives by resource and potential impact. The environmental consequences for the EI, including the South Lateral Pipeline and COH Forcemain would be the same for each resource under all action alternatives.

Table 2.8-2 provides a summary of the mitigation measures that may be implemented to reduce or eliminate the potential impacts to resources.

Table 2.8-1 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
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.	Insignificant increase in erosion potential during construction. Dredged material would be contained.	Insignificant increase in erosion potential during construction. Dredged material would be contained.
Ground-water	No impact.	Dewatering during construction may result in lowering water levels in domestic wells, and subsidence.	Dewatering during construction may result in lowering water levels in domestic wells, and subsidence.	No impact.	No impact.	No impact.
Surface Water Quality	Increases in chlorophyll levels throughout Boulder Basin. Water quality standards for chlorophyll and TIN would be exceeded at Lake levels of 1,000 ft, and/or 2050 effluent flows. Increase in effluent TP through Hoover Dam of 1 part per million (ppm) with 2030 flows and 1,000-ft Lake level.	Dilution of constituents from groundwater and urban runoff would be reduced.	Dilution of constituents from groundwater and urban runoff would be reduced.	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 3 ppm with 2030 flows and 1,000-ft Lake level.	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 3 ppm with 2030 flows and 1,000-ft Lake level.	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 3 ppm with 2030 flows and 1,000-ft Lake level.

Table 2.8-1 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
Biological Resources	Increased flows would likely result in expansion of riparian plant and wetland communities.	Construction activities would temporarily impact vegetation and wildlife including the desert tortoise. Operation of the EI would result in the transition from wetland communities to drier, more salt tolerant, riparian communities.	Construction activities would temporarily impact vegetation and wildlife including the desert tortoise. Operation of the EI would result in the transition from wetland communities to drier, more salt tolerant, riparian communities.	Construction activities would temporarily 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.	Construction activities would temporarily 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.	Construction activities would temporarily impact biological resources. Effluent-related constituents that may impact aquatic resources would continue to enter the Las Vegas Bay.
Cultural Resources	No impact to identified National Register of Historic Places (NRHP) sites.	No significant impacts.	No significant impacts.	No cultural resources would be impacted by the terrestrial portion of the LCS. Three contributing elements to Site 26CK4046B would be impacted by the BINDP.	Three above-ground elements of Site 26CK7115 are located near the SRMT3-East working shaft. Use of the alternate access road would impact a segment of Site 26CK6247 where the pavement is intact. Five contributing elements to Site 26CK4046B would be impacted by the BISDP.	No impact.

Table 2.8-1 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
Recreation	Increased levels of chlorophyll in the inner Las Vegas Bay may result in temporary algae blooms that deter recreational use.	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.	Temporary and minor impacts at Boulder Beach area during construction. No long-term adverse impacts.	Temporary and minor impacts at Sunset Scenic Overlook and Las Vegas Bay areas during construction.
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.
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.
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.
Earth Resources	No impact.	No significant impact.	No significant impact.	No significant impact.	No significant impact.	No significant impact.
Land Use	No impact.	No significant impact.	No significant impact.	No significant impact.	No significant impact.	No significant impact.

Table 2.8-1 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
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 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 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 at the Sunset Scenic Overlook during construction. Views of construction areas within the LMNRA would be impacted until restoration is complete.
Socio-economics	$361 million (conventional treatment) + $29 million (plant optimization) = $391 million Future cost for mitigation: $979 million for microfiltration or ultrafiltration.	Cost: $87 million.	Cost: $87 million.	Cost: $594 million (includes EI costs)	Cost: $590 million (includes EI costs).	Cost: $540 million (includes EI costs).
Environmental Justice	No impact.	No impact.	No impact.	No impact.	No impact.	No impact.
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.
Paleonto-logical Resources	No impact.	No impact.	No impact.	No impact.	No impact.	No impact.

2.8-2 Summary of Mitigation Measures.

Resource	Effluent Interceptor (both alignments)	Boulder Islands North LCS	Boulder Islands South LCS	Las Vegas Bay LCS
Water Resources				
Surface Water	Best Management Practices (BMPs) will be implemented to reduce potential for spills. Open trench excavation will not cross two major ephemeral washes at any one time.	BMPs will be implemented to reduce potential for spills. Open trench excavation will not cross two major ephemeral washes at any one time. Turbidity curtain will be used during dredging activities.	Same as Boulder Islands North LCS.	Same as Boulder Islands North LCS.
Groundwater	BMPs will be implemented to reduce sediment from entering the system. 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.
Surface Water Quality	Although the SCOP AMP is not a mitigation measure because it is part of the proposed alternative, any adverse water quality impacts would be addressed through the SCOP AMP process as described in Section 2.2.2.6.	Although the SCOP AMP is not a mitigation measure because it is part of the proposed alternative, any adverse water quality impacts would be addressed through the SCOP AMP process as described in Section 2.2.2.6.	Same as Boulder Islands North LCS.	Same as Boulder Islands North LCS.
Biological Resources	Pre-construction surveys for species identified in EIS will be conducted. A Restoration Plan will be developed as outlined in EIS. A USACE Mitigation and Monitoring Plan will be implemented.	Pre-construction surveys for species identified in EIS will be conducted. A Restoration Plan will be developed as outlined in EIS. 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.	Same as Boulder Islands North LCS.	Same as Boulder Islands North LCS.

2.8-2 Summary of Mitigation Measures (continued).

Resource	Effluent Interceptor (both alignments)	Boulder Islands North LCS	Boulder Islands South LCS	Las Vegas Bay LCS
Cultural Resources	None required.	No mitigation is required during construction of terrestrial segments. Mitigation to minimize or eliminate the impact to underwater resources will be determined through coordination among Reclamation, NPS, and SHPO.	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. Mitigation to minimize or eliminate the impact to underwater resources will be determined through coordination among Reclamation, NPS, and SHPO.	None required.
Recreation	Public will be routed around or away from construction areas.	Public will be routed around or away from construction areas. 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. Some construction activities within the LMNRA will be limited to October through March.	Same as Boulder Islands South LCS.
Hazardous Materials	Groundwater suspected of containing perchlorate will be analyzed and disposed of in accordance with NDEP guidelines.	None required.	None required.	None required.
Noise	BMPs will be implemented as part of standard operating procedures.	BMPs will be implemented as part of standard operating procedures.	Same as Boulder Islands North LCS.	Same as Boulder Islands North LCS.

2.8-2 Summary of Mitigation Measures (continued).

Resource	Effluent Interceptor (both alignments)	Boulder Islands North LCS	Boulder Islands South LCS	Las Vegas Bay LCS
Air Quality	Applicable permits will be obtained.	Applicable permits will be obtained.	Same as Boulder Islands North LCS.	Same as Boulder Islands North LCS.
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.
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
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.
Socioeconomics	None required.	None required	None required.	None required.
Environmental Justice	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.
Paleontological Resources	None required.	None required.	None required.	None required.