Salton Sea Funding and Feasibility Action Plan

Benchmark 4: Conceptual Plans and Cost Estimates
Volume 1: Water Import and Export Options

May 2016

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Revision Record

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Date	Version	Changes
February 2016	Working Draft	
May 2016	Official Report	No changes

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Executive Summary

This report presents an overview of conveyance methods for importing and exporting water from the Salton Sea. In addition, this report will cover In-Sea Partitioning, Salinity and Water Quality Improvements, Air Quality and Dust Mitigation, and Habitat Improvements. When considering methods of conveyance, the following components will be discussed: water quantity, water quality, conveyance system and hydraulics, consideration of capital and operational costs, institutional considerations, conceptual plans, cost evaluation, and summary. The report is intended to inform those who are engaged in designing options for the restoration and management of the Sea.

Inflow Conveyance

The Sea has high salinity and no outlet to remove accumulated salt, a high evaporation rate, and in the near future the Sea will undergo a period of inflow reduction. Due to these reasons, it is important to identify water sources that can offset future inflow reductions and provide habitat benefits within and surrounding the Sea. Both small and large improvements will be required to slow or prevent rapid increase in salinity, and support species habitat conservation being planned at Salton Sea. A minimum of 50,000 AFY was identified as the low end of the beneficial supply quantity to the Salton Sea to warrant conceptual level design and cost analysis. Several options that do not achieve this amount are discussed in more general terms. The issue of inflow conveyance is discussed in section 2.0. In section 2.0, ten potential inflow conveyance alternatives are discussed:

- Santa Ana Regional Interceptor (SARI) Pipeline (Section 2.1)
- Metropolitan Water District of Southern California (MWD) Concentrate Pipeline (Section 2.2)
- Yuma Desalting Plant (YDP) Concentrate Pipeline (Section 2.3)
- Main Outlet Drain Extension (MODE) Pipeline (Section 2.4)
- Gulf of California (Section 2.5)
- Pacific Ocean (Section 2.6)
- Excess Colorado River Water (Section 2.7)
- Wastewater Treatment Plant (WWTP) Effluent (Section 2.8)
- Palm Desert Area – WWTP Effluent or Recycled Water Supplies (Section 2.9)

- Lining of Coachella Valley Stormwater Channel (Section 2.10)

Figure 3 presents an overview of the water sources evaluated, and relevant figures for each of the alternatives can be accessed in Section 2.0. Additionally, each of the alternatives is discussed in terms of the following important aspects: water quantity, water quality, conveyance system and hydraulics, consideration of capital and operational costs, institutional costs. This report also includes a screening level analysis performed using the Modified SSAM for each of the ten inflow conveyance alternatives.

The screening analyses suggest that some of the concepts presented here would have only minimal benefits to the full Salton Sea under the projected inflows. However, some of these options could be reviewed again when combined with smaller lake plans discussed in Benchmark 4, Volume 2.

Conveyance of Water from the Sea

Due to the lack of an outlet at the Salton Sea, the salt content transferred to the Sea concentrates over time as evaporation occurs. To reduce or maintain salinity at the Salton Sea requires removal of salt content to a disposal location, or it may require evaporation in the Sea's nearby vicinity. Removal of salt is even more critical if one assumes that inflows to the Salton Sea will be reduced starting in 2018, and conveying water from the Sea has been studied to address the drastic rise of salinity that is expected to occur under No Action. A review of previously considered disposal sites and uses of Salton Sea water was completed and presented in section 3.0 of this report. In Section 3.0, five potential outflow conveyance alternatives are discussed:

- Laguna Salada (Section 3.1)
- La Cienega de Santa Clara (Santa Clara Slough, Wetland) (Section 3.2)
- Gulf of California (Section 3.3)
- Palen Dry Lake (Section 3.4)
- Local Water Use and Evaporative Systems (Section 3.5)

Figure 24 presents an overview of the conveyance methods evaluated, and relevant figures for each of the alternatives can be accessed in Section 3.0. Additionally, each of the alternatives is discussed in terms of the following important aspects: water quantity, water quality, conveyance system and hydraulics, consideration of capital and operational costs, institutional costs. This report also includes a screening level analysis performed using the Modified SSAM for each of the four outflow conveyance alternatives.

Combined Water Source and Outlet Systems

To both offset inflow reductions and better reduce salt and nutrient accumulations in the Sea, combined solutions which provide inflow sources and outflow destinations have been considered at the Salton Sea. These combined solutions of inflow and outflow conveyance are discussed in section 4.0. In section 4.0, three potential inflow/outflow conveyance alternatives are discussed:

- Salton Sea to Gulf of California (Section 4.1)
- Salton Sea to Pacific Ocean (Section 0)
- Local Desalination (Section 4.3)

Relevant figures for each of the alternatives can be accessed in Section 3.0. Additionally, each of the alternatives is discussed in terms of the following important aspects: water quantity, water quality, conveyance system and hydraulics, consideration of capital and operational costs, institutional costs. This report also includes a screening level analysis performed using the Modified SSAM for each of the three combined water source and outlet systems.

Evaluation of Import/ Export Alternatives

The feasibility of the alternatives presented in this report were assessed and a ranking system was developed to compare alternatives in terms of cost and effectiveness. Section 5.0 discusses the ranking system and the results attained from comparing the alternatives with the system. Three matrices were developed and are displayed in section 5.0. Each of the matrices ranks the alternatives on the basis of the following:

- Water Quantity
- Water Quality
- Operational Cost benefit
- Capital Cost Benefit
- Approvals and Environmental
- Community Impacts and Easements

In Section 5.0, Table 9 ranks alternatives for inflow conveyance, Table 10 ranks outlet alternatives, and Table 11 ranks combined inlet and outlet alternatives.

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Acronyms and Abbreviations

Acronyms and abbreviations used in the Work Plan are listed below.

Authority	Salton Sea Authority
AF	Acre-Feet
AFY	Acre-Feet per Year (1,000 AFY = 0.89 MGD)
BDCP	Bay Delta Conservation Plan
BLM	Bureau of Land Management
CEC	California Energy Commission
CVWD	Coachella Valley Water District
DRECP	Desert Renewable Energy Conservation Plan
DWR	California Department of Water Resources
EEC	Environmental Engineering & Contracting, Inc.
fps	Feet per second
GWRS	Groundwater Replenishment System
IID	Imperial Irrigation District
NGVD	National Geodetic Vertical Datum
MGD	Million gallons per day (1 MGD = 1,120 AFY)
mg/L	Milligrams per liter
MOD	Main Outlet Drain
MODE	Main Outlet Drain Extension
MSL	Mean Sea Level
MWD	Metropolitan Water District of Southern California
OCSD	Orange County Sanitation District
OCWD	Orange County Water District
ppm	Parts per Million
ppt	Parts per Thousand
psi	Pounds per square inch
QSA	Quantification Settlement Agreement
RE	Renewable Energy
Reclamation	US Bureau of Reclamation
SARI	Santa Ana Regional Interceptor
SAWPA	Santa Ana Watershed Project Authority
SDCWA	San Diego County Water Authority
SSAM	Salton Sea Accounting Model
TAF	Thousand acre feet
TCT	Technical Coordination Team

TDS	Total dissolved solids
WWTP	Wastewater Treatment Plant
YDP	Yuma Desalting Plant

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1.0 Introduction

Conceptual plans for importing and exporting water to the Salton Sea are presented in this document. The feasibility analysis involves consideration of local geotechnical and soil conditions, availability of materials, and a variety of other engineering factors. Institutional considerations include national and international factors that influence implementation feasibility. Cost estimates are included for many of the import/export concepts.

1.1 Background

The Salton Sea is located in Southern California, north of El Centro and south of Indio, within Riverside and Imperial Counties. The Salton Sea was formed as a result of a breached irrigation control structure along the Colorado River between 1905 and 1907. Agricultural drainage flows from the Imperial, Coachella, and Mexicali Valleys have sustained the Salton Sea since that time. The Salton Sea encompasses an area approximately 15 miles wide and 35 miles long and has a surface elevation of approximately 228 feet below mean sea level (MSL).

Salinity of the Salton Sea is around 44,000 parts per million (ppm), approximately 25 percent greater than the ocean. Over the last few years, salinity levels in the Salton Sea have been on the rise and the water surface level has been declining. Numerous factors have contributed to both, including the following: a decline in the quantity of water inflows to the Salton Sea, more efficient irrigation practices in the areas surrounding the sea reducing inflow as irrigation runoff, drought conditions and evaporation.

The implications and ramifications of increased salinity have been under consideration for over 60 years. Flows to the Salton Sea have decreased, and it is estimated that within the next 15 years, flows will decrease by approximately 40 percent (Cohen 2014). Much of the recent decrease in flow can be attributed to water conservation as a result of greater irrigation efficiency. In 2018, a much more impactful decrease to inflow to the Salton Sea will occur as a result of the Quantification Settlement Agreement (QSA) between Imperial Irrigation District (IID) and the San Diego County Water Authority (SDCWA) that will reduce the amount of water flowing into the Imperial Valley. The agreement was signed in October 2003, and part of the agreement required deliveries of "mitigation water" to the Salton Sea to account for reductions of inflow. The mitigation water deliveries are only required until the end of 2017. Thus, it is estimated that the Salton Sea will enter into a period of rapid decline for the next decade if alternatives to restore flows to the Salton Sea are not implemented.

1.2 Objective

For several decades, alternatives have been identified and studied to determine the most practical solutions for maintaining the water level and salinity of the Salton Sea. Preserving both water quantity and quality is critical to supporting habitat and preventing air quality impacts that would result from exposed shoreline. With the QSA reducing water supply beginning in 2018, it has become even more critical to identify and begin implementation of projects for preservation of the Salton Sea.

This report evaluates potential water sources and water conveyance systems to benefit the Salton Sea. Water conveyance systems considered involve the construction of pumping and pipeline for conveying water to the Salton Sea as well as from the Salton Sea. An emphasis was placed on evaluation of the alternatives considered most practical and beneficial following a thorough review of previous studies and proposed projects. This report will evaluate and eliminate alternatives from further study based on the following criteria:

1. Water Quantity – flow of 10,000 acre-feet per year (AFY) or greater considered for habitat areas, imported flow of 25,000 AFY from outside the basin considered the lowest practical beneficial supply for the entire Salton Sea
2. Water Quality – all water sources less than 35,000 ppm are considered beneficial
3. Conveyance System and Hydraulics – determination flow, headloss and required lift
4. Institutional Considerations – environmental and community impacts, easement acquisition
5. Cost Implications – capital and annual costs

1.3 Performance of Alternatives

A screening level performance analysis was conducted for each of the alternatives using a modified version of the Salton Sea Accounting Model (Modified SSAM). The SSAM model was modified by Tetra Tech using the latest available bathymetry for the Salton Sea lake bottom. It was also adapted to operate in a user friendly manner to quickly evaluate various inflow and outflow options.

For each of the alternatives, the Modified SSAM was run for two future inflow scenarios. The baseline case assumes a future inflow of approximately

865,000 AFY by 2077, long after QSA mitigation flows end in 2017. The uncertainty future inflow scenario of about 689,000 AFY was also evaluated. The Modified SSAM and the future inflow assumptions are discussed in Salton Sea Funding and Feasibility Action Plan, Benchmark 2: Review and Update Existing Condition Data.

Running the model for No Action requires inputting a scenario of no pump in or pump out. The figures in this section will show the predicted impacts of No Action in the Modified SSAM, and these predicted impacts will provide a reference point for other alternatives discussed in subsequent sections. For No Action, the results of the model run for the baseline future inflow case of 865,000 AFY are shown in Figure 1, and the results of the model run for the baseline uncertainty inflow case of 689,000 AFY are shown in Figure 2.

For the baseline inflow case, the results shown in Figure 1 indicate that the lake level would fall about 14 feet below current sea level by the year 2030. Salinity would also continue to rise under No Action.

Key results of the baseline inflow model run are as follows:

- The water surface would stabilize around the year 2030 at an average elevation of around -248' NGVD which would result in an average water depth of around 19 to 20 feet and a maximum depth of about 25 to 26 feet.
- Salinity would continuously rise with this alternative, and the lake would be around 180 to 190 ppt by the year 2100.
- The lake area would stabilize at about 260 to 270 sq mi after the year 2030.
- The volume of water in the lake in the year 2050 is projected to be 3.06 MAF or about 40.2% of the lake volume as it was in 2000.

For the uncertainty inflow case, the results shown in Figure 2 indicate that the lake would fall to a lower elevation and the salinity will increase to a greater degree. Additionally, the lake volume would be reduced to an even smaller size than for the baseline inflow case, with the volume dropping to approximately 28.7% of the year 2000 volume.

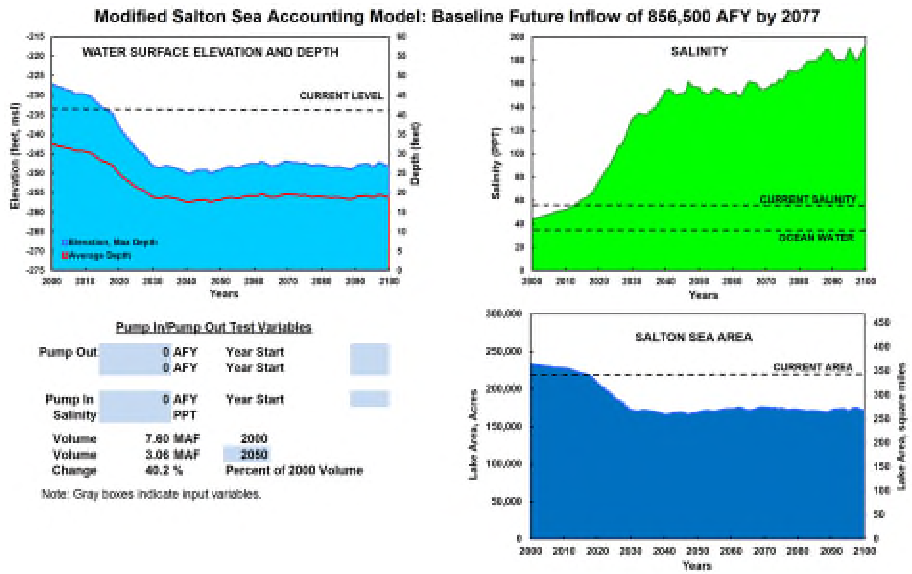

Figure 1 No Action Baseline Future Inflow

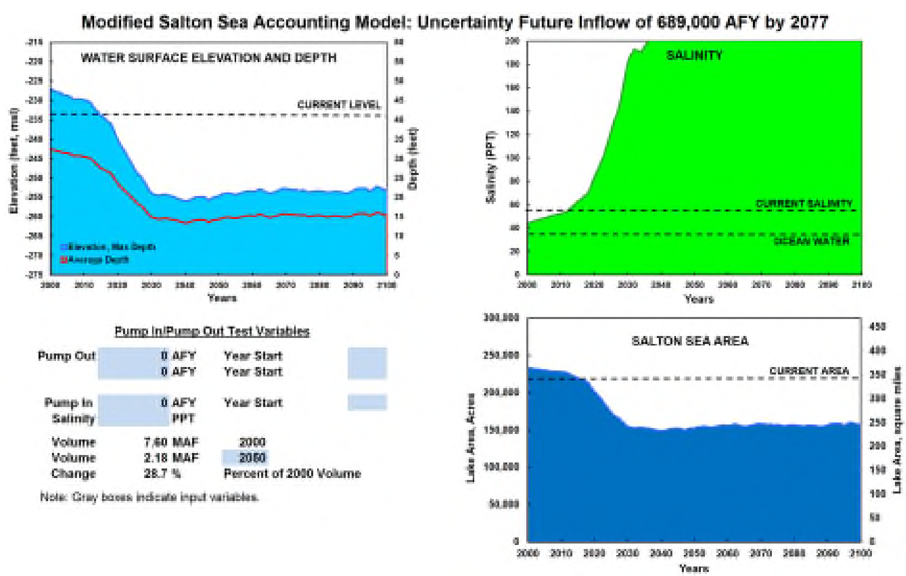

Figure 2 No Action Uncertainty Future Inflow

2.0 Inflow Conveyance

Projected inflow reductions in the coming years will contribute to increasing salinity at the Salton Sea. Therefore, a review of possible sources for inflow conveyance is useful to restoration efforts at the Salton Sea. This review covers ten possible sources of water which could theoretically be used to offset inflow reductions: the SARI Pipeline, the Metropolitan Water District of Southern California Concentrate Pipeline, the Yuma Desalting Plant Concentrate Pipeline, the MODE Pipeline, the Gulf of California, the Pacific Ocean, Excess Colorado River Water, Coastal Wastewater Treatment Plants, Local Wastewater Treatment Plants, and Coachella Valley Stormwater Channel Lining. When applicable, this analysis will consider five factors concerning the ten sources reviewed: quantity of water available at the source, quality of water at the source, the conveyance system and hydraulics used to transport water, a consideration of capital and operational costs, and the institutional costs involved in each option. When possible, a screening level performance analysis using the Modified SSAM was also conducted for each alternative.

Water sources for the Salton Sea are critical to preserving the Salton Sea and its surrounding habitat. The Sea has high salinity and no outlet to remove accumulated salt, a high evaporation rate, and in the near future will undergo a period of inflow reduction. Therefore, it is important to identify water sources that can offset future inflow reductions and benefit habitat within and surrounding the Salton Sea.

Identifying new sources of water for the Salton Sea is challenging, as demands for surrounding communities are on the rise, treatment technology is expanding which sources of water are of beneficial use, and the State of California has experienced several dry winters elevating the criticality of water sources through the state. Historically, additional sources of water identified for the Salton Sea have primarily been large sources of water that were not considered to be of beneficial use for the originating region. Potential sources of additional inflows to the Salton Sea have included brackish water sources, brine disposal pipelines, and treated wastewater. Given current water supply conditions and a greater push for increased local water reliability within the individual regions of Southern California, there are fewer available potential sources of water for the Salton Sea. Over the years, existing inflows to the Salton Sea have decreased, as well, resulting in an increase in salinity within the Salton Sea. This has perpetuated a greater need and urgency for reliable sources of lower salinity water and increased inflows to the Salton Sea.

For this report a comprehensive review of water sources was completed, including reviews of previous studies, reports, and proposals to and by the Authority and Reclamation. The list includes alternatives that range from sources that would provide a large flow rate into the Salton Sea but are located far from the Sea, to sources closer in proximity that could increase the water supply for smaller, more localized improvements. The Salton Sea has approximately 7,500,000 acre-feet (AF) of storage capacity. Annual evaporation is estimated to be about 1,360,000 AFY, and estimated reduction of future inflows is approximately 500,000 AFY. Therefore, without increased supply, it is anticipated that a severe spike in salinity will occur. Consequently, every possible supply source is critical to address the water supply and quality challenges associated with the Salton Sea.

Identifying potential water sources must also consider the means of conveyance to deliver the water to the Salton Sea. Both small and large improvements will be required to slow or prevent rapid increase in salinity, and support species habitat conservation being planned at Salton Sea.

The evaluation focuses on direct water sources in excess of 10,000 AF, including the following:

- Santa Ana Regional Interceptor (SARI) Pipeline
- Metropolitan Water District of Southern California (MWD) Concentrate Pipeline
- Yuma Desalting Plant (YDP) Concentrate Pipeline
- Main Outlet Drain Extension (MODE) Pipeline
- Gulf of California or Pacific Ocean
- In addition, other water sources or means to increase inflow to the Salton Sea were also evaluated, and include the following:
    - Excess Colorado River Water
    - Wastewater Treatment Plant (WWTP) Effluent
    - Palm Desert Area – WWTP Effluent or Recycled Water Supply
    - Lining of Coachella Valley Stormwater Channel

See Figure 3 for an overview of the water sources evaluated.

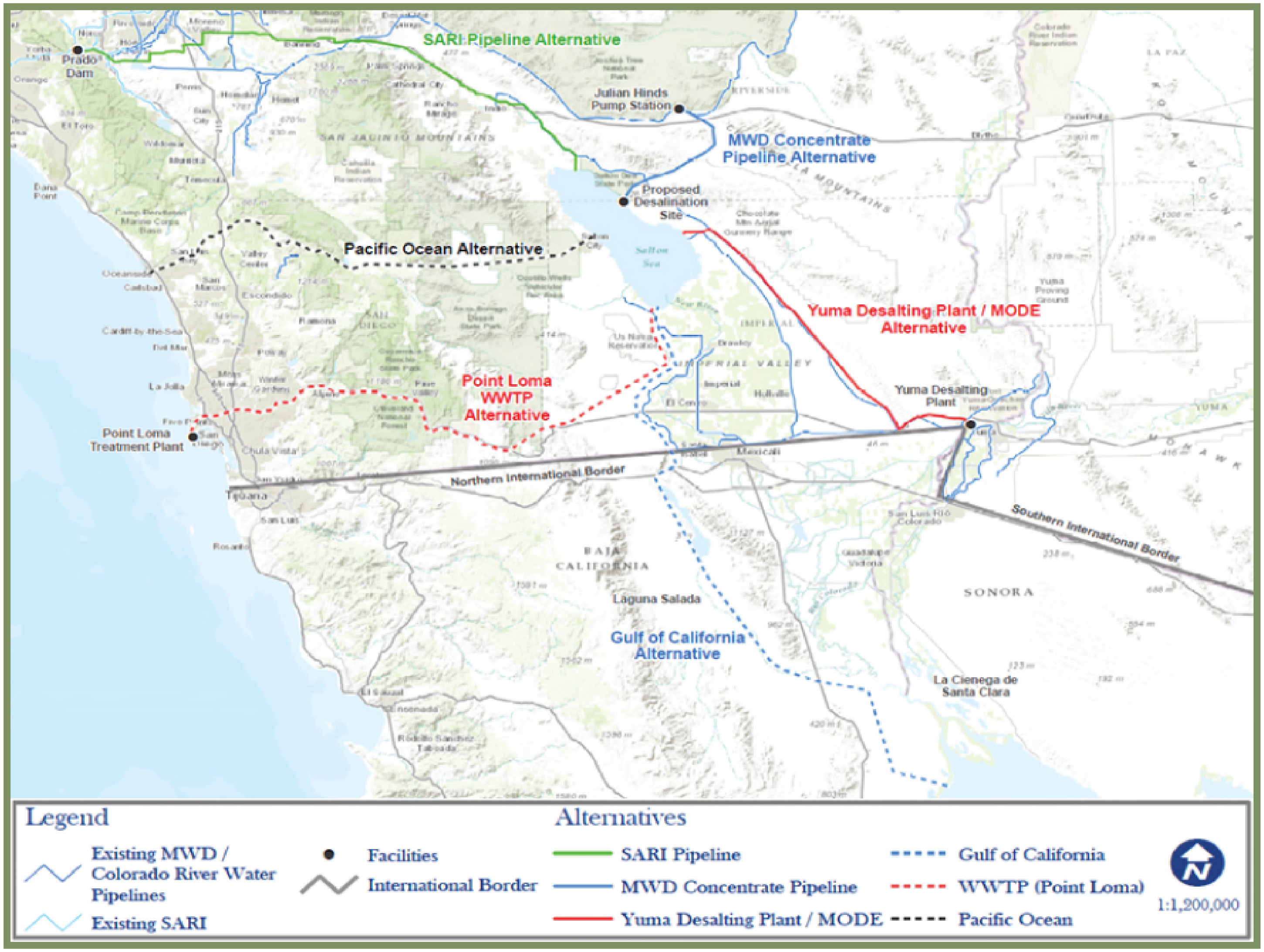

Figure 3 Overview of Alternatives - Inflow to Salton Sea

2.1 SARI Pipeline

The Santa Ana Regional Interceptor (SARI) pipeline was constructed in the 1970s to protect the inland water quality in the upper Santa Ana River Watershed by collecting highly saline discharges from groundwater desalination facilities, power plants, and industrial users. The SARI line within San Bernardino and Riverside Counties is owned and operated by the Santa Ana Watershed Project Authority (SAWPA), and the portion of the line within Orange County is owned and operated by the Orange County Sanitation District (OCSD). Other agencies involved with the upper SARI include Eastern Municipal Water District, San Bernardino Valley Municipal Water District, Western Municipal Water District, and the Inland Empire Utilities Agency.

The SARI system is in good condition, and only one percent of the entire system was over 50 years old in 2002 (Camp, Dresser, and McKee 2002). The SARI line itself has a design capacity of 30 million gallons per day (MGD), and adjusted future flow projections estimate of 28.57 MGD in 2020. In 2013, there was approximately 12 MGD of flow from SAWPA, and the majority of the flow was brine and industrial wastewater (Orange County Water District 2013). Within Orange County, there was approximately 23 MGD of wastewater flow into the SARI line.

It has been proposed that the flows from the upper SARI could potentially be used to augment inflow into the Salton Sea, thereby attempting to reduce the overall salinity in the Salton Sea. Propositions have been made to intercept flows from the upper SARI near Prado Dam along Reach IV-B.

This alternative would include a connection to the SARI Pipeline, treatment to address the varying water quality, and a pipeline to convey water from the connection point near Prado Dam to the Salton Sea. The pipeline is estimated to be 110 to 120 miles long, depending on the final alignment.

2.1.1 Water Quantity

In 2013, the flow in the upper SARI was 12 MGD (13,400 AFY). A flow of 13,400 AFY to the Sea is much lower than the beneficial low flow limit of 50,000 AFY set for developing conceptual engineering plans and cost estimates. Even the maximum design flows of 30 MGD (33,600 AFY) for the SARI do not meet this criteria. While the flow could still be conveyed and used in support of smaller projects around the Salton Sea, the long distance for conveying the flow makes this a high cost and low benefit alternative. Additionally, should OCSD and Orange County Water District (OCWD) decide to utilize the SARI flows for the OCWD Groundwater Replenishment System (GWRS), this option would no longer be viable, as all of the available flow would be required for the GWRS.

2.1.2 Water Quality

As demonstrated in a preliminary audit performed by Environmental Engineering & Contracting, Inc. (EEC), the water quality information for the SARI Pipeline is both inconsistent and deficient. For these reasons OCWD and OCSD have placed a hold on moving forward with the option to utilize SARI flow for the GWRS until more reliable water quality information is available for the upper SARI from SAWPA. Similarly, inconsistencies and irregularity in water quality from the SARI could pose an issue for the Salton Sea, as well, given that the water would need to be treated prior to discharge into the Salton Sea. It is difficult and costly to design a treatment system for high-strength wastewater flows that are variable in water quality. Because the SARI receives wastewater from numerous industrial dischargers, a proactive and effective pretreatment program is necessary to ensure a consistent water quality for proper treatment of the wastewater prior to discharge into the Salton Sea. Without a reliable pretreatment program for the upper SARI, it is difficult to gauge the practicality of utilizing SARI flows for the Salton Sea. The Upper SARI Planning Study states that total dissolved solids concentrations were 3,482 milligrams per liter (mg/L) in 2001.

2.1.3 Conveyance System and Hydraulics

Delivery from the SARI Pipeline to the Salton Sea is one of the longest conveyance systems considered. Approximately 120 miles of 26-inch diameter pipeline would be required. The start point would occur near Prado Dam, at an elevation of 500 feet above MSL. In order to reach the Salton Sea, the pipeline must cross the Box Springs Mountains located between Moreno Valley and Beaumont, where the pipeline would reach an elevation of 2,200 feet. When factoring in headloss in the pipeline based on a flow velocity of 5 feet per second (fps), the total estimated dynamic head (pumping lift and frictional head loss in the pipeline) for this alternative is estimated at 3,300 feet. Due to the long distance of water conveyance and elevation gain, six separate pump stations would be required, with a discharge head of 600 feet, and discharge pipeline rated for an internal pressure of 300 pounds per square inch (psi). In addition, the potential water supply is only 13,000 AFY. Thus, the cost benefit of delivering water from the SARI Pipeline is very low.

Figure 4 depicts a conceptual conveyance system for delivering water from the SARI pipeline.

Inflow Conveyance

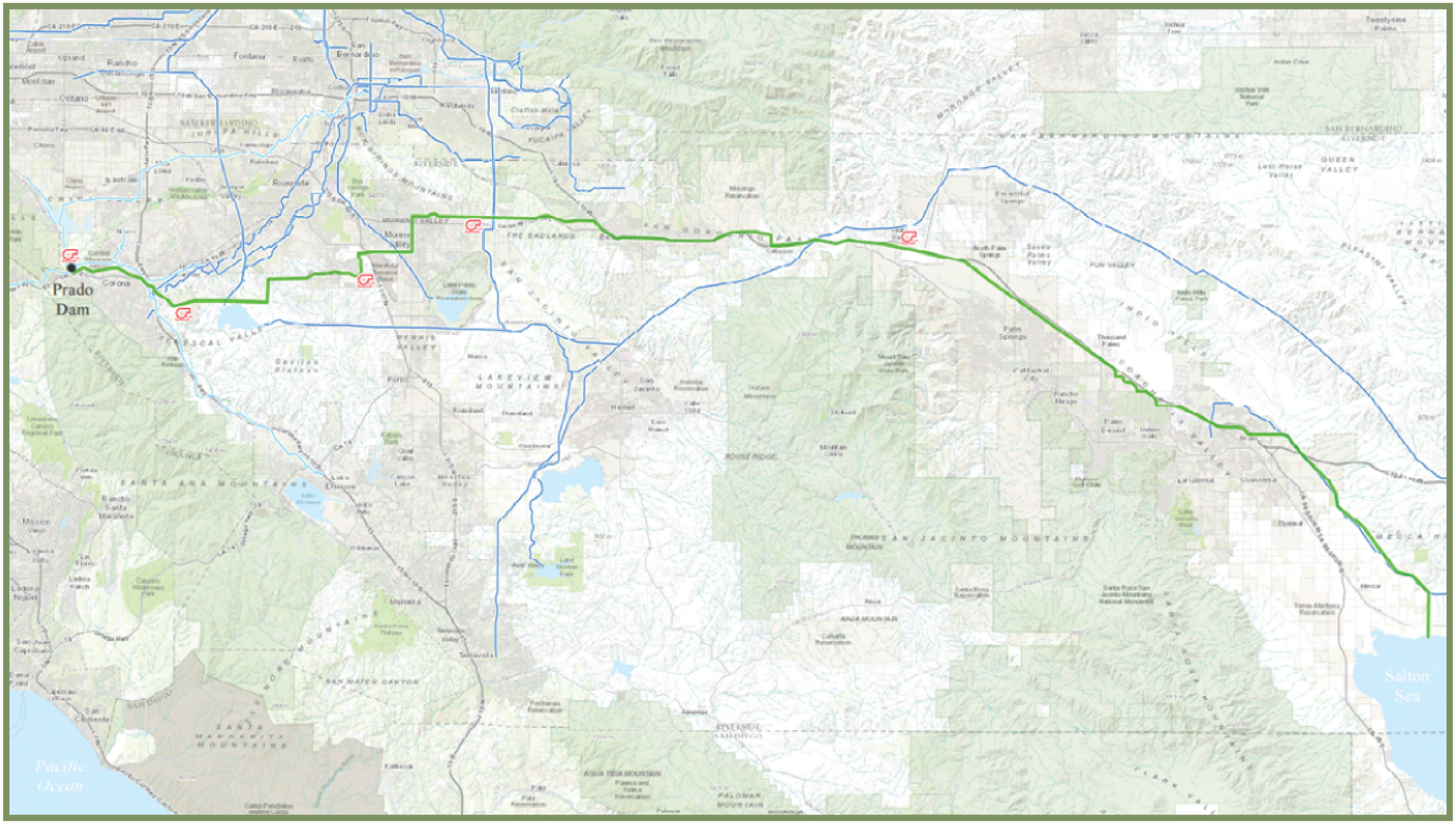

Figure 4 SARI Pipeline

2.1.4 Consideration of Capital and Operational Cost

Hydraulics calculation of the conceptual conveyance system was performed to determine the magnitude of capital and operational costs. Both the capital and operational costs per acre foot for the SARI pipeline alternative are highest amongst the proposed alternatives. The costs for the operation and construction of the conveyance system are significant, as there would be a minimum of six pump stations required to overcome the significant elevation gain and distance of conveyance pipeline. Additionally, the SARI pipeline alternative requires the construction and operation of a wastewater treatment facility focused on high-strength wastewater from industrial and brine discharges, and this adds significantly to both the capital and operational costs.

2.1.5 Institutional Considerations

OCWD and OCSD are also exploring options to augment flows to OCSD Plant No. 1 to provide additional flow to the OCWD GWRS, which is scheduled to complete construction for the expansion of the plant from a design capacity of 70 MGD to 100 MGD within the next year. An audit report conducted by EEC on the SAWPA Pretreatment Program Compliance in November 2012 revealed that there are significant deficiencies in permitting and appropriate permit limits, monitoring, data collection and data reporting for the reaches of the SARI within Riverside and San Bernardino Counties. As a result, it was recommended that until deficiencies in the SAWPA pretreatment program are remedied, flow from the SARI would be unsuitable for ultimately augmenting the water available to the OCWD GWRS. Should OCSD and OCWD choose to proceed with the option to utilize water from the SARI for the GWRS, the flow from the SARI would not be available for augmenting inflows to the Salton Sea.

This alternative for the Salton Sea would also have significant approval land or easement acquisition hurdles. In particular, the distance of conveyance, number of populated communities and environmental impacts between the start and end of the pipeline are anticipated to be far too considerable to outweigh the volume of water available.

2.1.6 Screening Level Performance Analysis

The Modified SSAM was run for the SARI Pipeline inflow alternative, assuming an export capacity of 13,000 AFY. The model was run for two future inflow scenarios. The baseline case assumes a future inflow of approximately 865,000 AFY by 2077, long after QSA mitigation flows end in 2017. The uncertainty case assumes a future inflow of about 689,000 AFY. The Modified SSAM and the future inflow assumptions are discussed in section 1.3 and in

Salton Sea Funding and Feasibility Action Plan, Benchmark 2: Review and Update Existing Condition Data.

The results of the model run for the baseline future inflow case of 865,000 AFY are shown in Figure 5, and the results of the model run for the baseline uncertainty inflow case of 689,000 AFY are shown in Figure 6. These results can be compared to the No Action scenarios illustrated in Figure 1 and Figure 2. For this screening level evaluation it was assumed that operation of the SARI Pipeline to the Salton Sea would begin in the year 2025. It was estimated that, from a decision point in 2017, it would take about eight years to complete the environmental documentation, the design and permitting, right-of-way clearance and land acquisition, and thus result in a 2025 start up.

For the baseline inflow case, the results shown in Figure 5 indicate that the SARI Pipeline would raise the lake level by about 1/2 foot compared to the No Action alternative. Although the SARI Pipeline would add salt to the lake, the rate of rise in salinity would be slowed compared to No Action due to the additional water supplied.

Key results of the baseline inflow model run are as follows:

- The water surface would stabilize around the year 2030 at an average elevation of around -247.8' NGVD which would result in an average water depth of around 20 feet and a maximum depth of about 27 feet.
- Salinity would continuously rise with this alternative, but rising salinity would be slowed when compared to a No Action alternative.
- The lake area would stabilize at about 270 sq mi after the year 2030.
- The volume of water in the lake in the year 2050 is projected to be 3.14 MAF or about 41.4% of the lake volume as it was in 2000.

For the uncertainty inflow case, the results shown in Figure 12 indicate that the SARI Pipeline would still raise the lake level by about 1/2 foot compared to the No Action alternative. Although the SARI Pipeline would still add salt to the lake, the rate of rise in salinity would be slowed compared to No Action due to the additional water supplied. The trends are similar to the previous scenario, but the rising salinity is more drastic due to the reduction of inflows inherent to this scenario. Additionally, the lake volume would be reduced to an even smaller size than for the baseline inflow case, with the volume dropping to approximately 29.5% of the year 2000 volume.

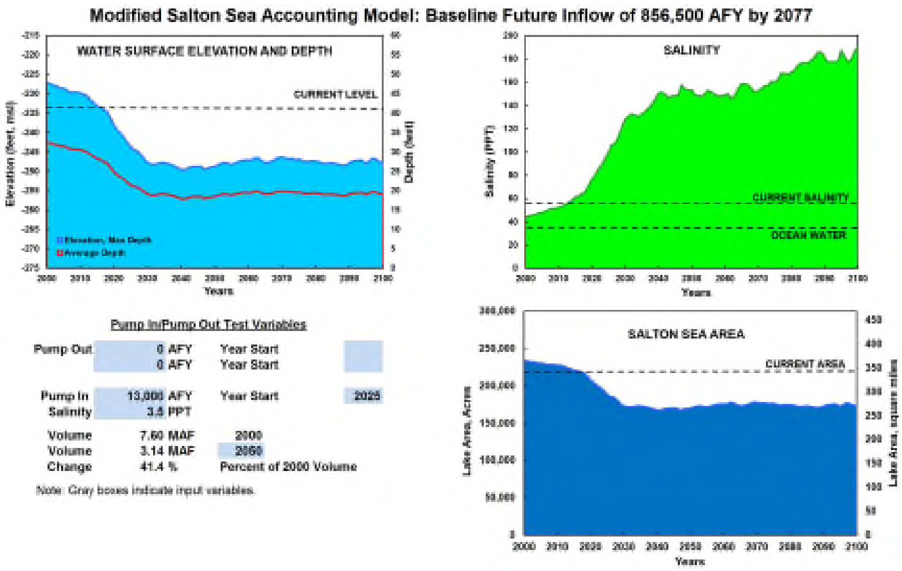

Figure 5 SARI Baseline Future Inflow

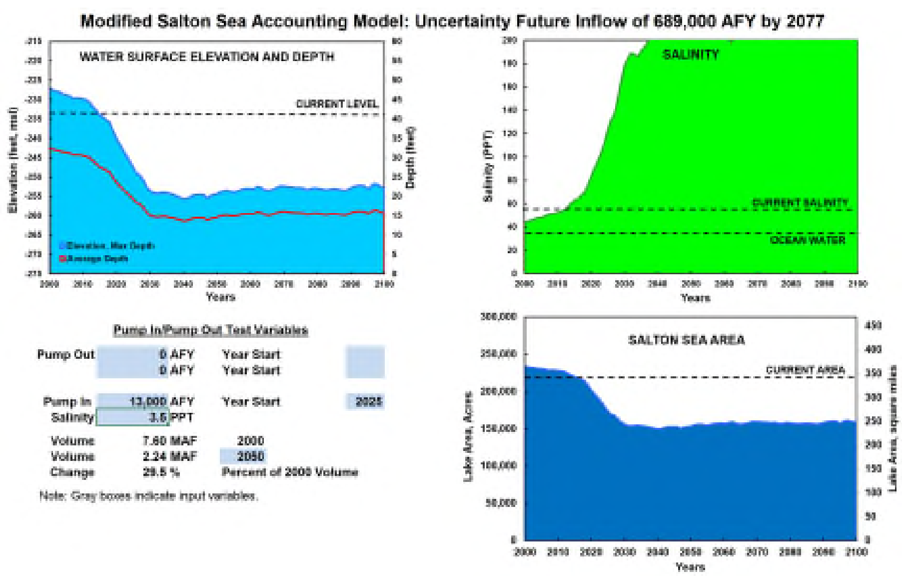

Figure 6 SARI Uncertainty Future Inflow

2.1.7 Summary

Based on the available information regarding the SARI Pipeline, there are several issues that impede upon the viability of the SARI as a potential water source for the Salton Sea. Major concerns include water quality, the quantity of water available, and the distance of pipeline necessary to convey flows from the SARI pipeline to the Salton Sea.

2.2 Metropolitan Water District of Southern California Concentrate Pipeline

MWD relies heavily on imported water from the Colorado River. MWD has an entitlement of 550 thousand acre feet (TAF) of Colorado River water, fifth priority for an additional 662 TAF per year, and an additional 180 TAF per year when surplus flows are available. Salinity has always been a water quality issue associated with the Colorado River Water. In the MWD 2010 Regional Urban Water Management Plan, it was estimated that approximately $353 million in quantified damages to the lower Colorado River Basin can be attributed to high concentrations of salts in the Colorado River.

Since 2010, implementation of several salinity control projects have led to a reduction in salinity concentrations by over 100 mg/L on average and savings of over $264 million annually in avoided damages (in 2005 dollars) (Metropolitan Water District of Southern California 2010). As expected, salinity issues tend to escalate during periods of drought and lower flows, such as the 1987 to 1992 drought with average levels of 600 to 650 mg/L, and salinity levels decrease during periods of high flows, such as the time period from 1983 to 1986 where average salinity levels were 525 mg/L. In general, salinity concentrations have averaged 630 mg/L since 1976. MWD adopted a Salinity Management Policy on April 13, 1999, which set a goal of delivering water with less than 500 mg/L of total dissolved solids (TDS).

Recently, a concept for a mutually beneficial project for MWD and the Salton Sea has been identified. It would consist of constructing a treatment plant adjacent to the MWD conveyance system, to receive a bypass flow of 25 percent, treat to reduce salinity and then blend back into the Colorado River water, to achieve salinity less than 500 mg/L. Through the process of treating Colorado River water, a concentrate of higher salinity would be generated that could be delivered to the Salton Sea.

With this alternative a treatment plant would be constructed that would generate a higher salinity flow that must be disposed of or re-purposed. The flow would have a salinity of approximately 4,000 to 6,000 mg/L. The Julian Hinds Pump Station has been identified as the best location for treatment of a bypass flow off the MWD conveyance system. It is located closest to the Salton Sea at approximately 25 miles.

2.2.1 Water Quantity

Based on the assumption that 15 percent of the treated flow would be rejected as the brine concentrate and that a salt rejection of 95 percent can be achieved, the estimated quantity of water available for discharge into the Salton Sea would be 43,000 AFY.

2.2.2 Water Quality

Available reports indicate that the average salinity of the water from the Colorado River is about 630 mg/L. Treatment of 25 percent of the flow by reverse osmosis would result in a water quality with approximately 490 mg/L of TDS.

As a result, an option exists to treat a portion of the Colorado River water flow to reduce salinity for MWD, while generating a source of lower salinity water for beneficial uses at the Salton Sea. To provide a water supply with salinity levels below 500 mg/L, to meet MWD's goal, approximately 25 percent of the total flow (approximately 1,600 cubic feet per MWD literature) at the Julian Hinds Pump Station must be treated and blended with the remaining flow. This would provide water with salinity levels of approximately 490 mg/L. These calculations were made based on the average water quality of 630 mg/L of TDS, 85 percent recovery from the reverse osmosis process, and 95 percent salt rejection. This process would enable MWD to meet its salinity level objective and at the same time create a brine solution beneficial to the Salton Sea in both volume and quantity.

With the assumptions stated previously, the estimated brine concentrate could be approximately 4,000 to 6,000 mg/L, which is significantly lower than the current salinity in the Salton Sea.

2.2.3 Conveyance System and Hydraulics

A delivery system for brackish water from treatment of Colorado River Water at Julian Hinds pump station would require 25 miles of 47-inch diameter pipeline, based on a flow velocity of 5 fps. It is estimated that a single pump station capable of pumping 27,000 gallons per minute (gpm) at 600 feet (260 psi discharge pressure) discharge head would be required. It would be constructed near the Julian Hinds pump station to boost the water over the high point located between the Orocopia and Chocolate Mountains.

In addition, an option exists to this alternative, as the flow could be conveyed to Salt Creek, which ultimately flows to the Salton Sea. The creek has experienced a decline in flow in recent years, and it is estimated that less than 700 AFY flows in the creek to the Salton Sea, which is a significant reduction from the historic annual flow of approximately 4,000 AFY. Delivering water to the Salton Sea through Salt Creek could potentially have two primary benefits: gravity flow by open channel which would reduce the length of pressurized pipeline construction and future maintenance, and additional water supply to the area known as Salt Creek Beach along the northern shore of the Salton Sea. This area is known to have one of the larger populations of Desert Pupfish existing at the Salton Sea. So there may also be a direct habitat benefit with this alternative of improving water quality for the Desert Pupfish population along the eastern shoreline of the Salton Sea.

Figure 7 depicts a conceptual conveyance system for delivering water from the Julian Hinds Pump Station to the Salton Sea.

2.2.4 Consideration of Capital and Operational Cost

The capital and operational costs per acre foot associated with implementing a desalination plant adjacent to the Julian Hinds Pump Station and brine conveyance system to the Salton Sea is not as significant as the SARI pipeline alternative, but it is still significant when compared against larger flow rate options such as seawater from the Gulf of California.

A preliminary evaluation of cost for this alternative was completed, factoring in the cost of treating the water from the Colorado River. It must be noted, however, that some of the treatment costs would most likely be borne by MWD, as the Salton Sea would receive the concentrate (high salinity flow) from the desalination process, not the permeate (treated Colorado River water), and MWD would benefit from the operational flexibility provided by the decrease in salinity in the Colorado River water. This is contingent on agreement and approval by MWD as such an endeavor is not currently a priority project for MWD.

Additionally, the quality of the water in terms of salinity is far superior to the seawater from the Gulf of California, and the overall capital and operational costs are lower due to the fact that a much lower quantity is required for a similar benefit in water quality improvements to the Salton Sea. Therefore, the overall annual operational cost for this option is lower in magnitude in comparison to both the SARI and Gulf of California options.

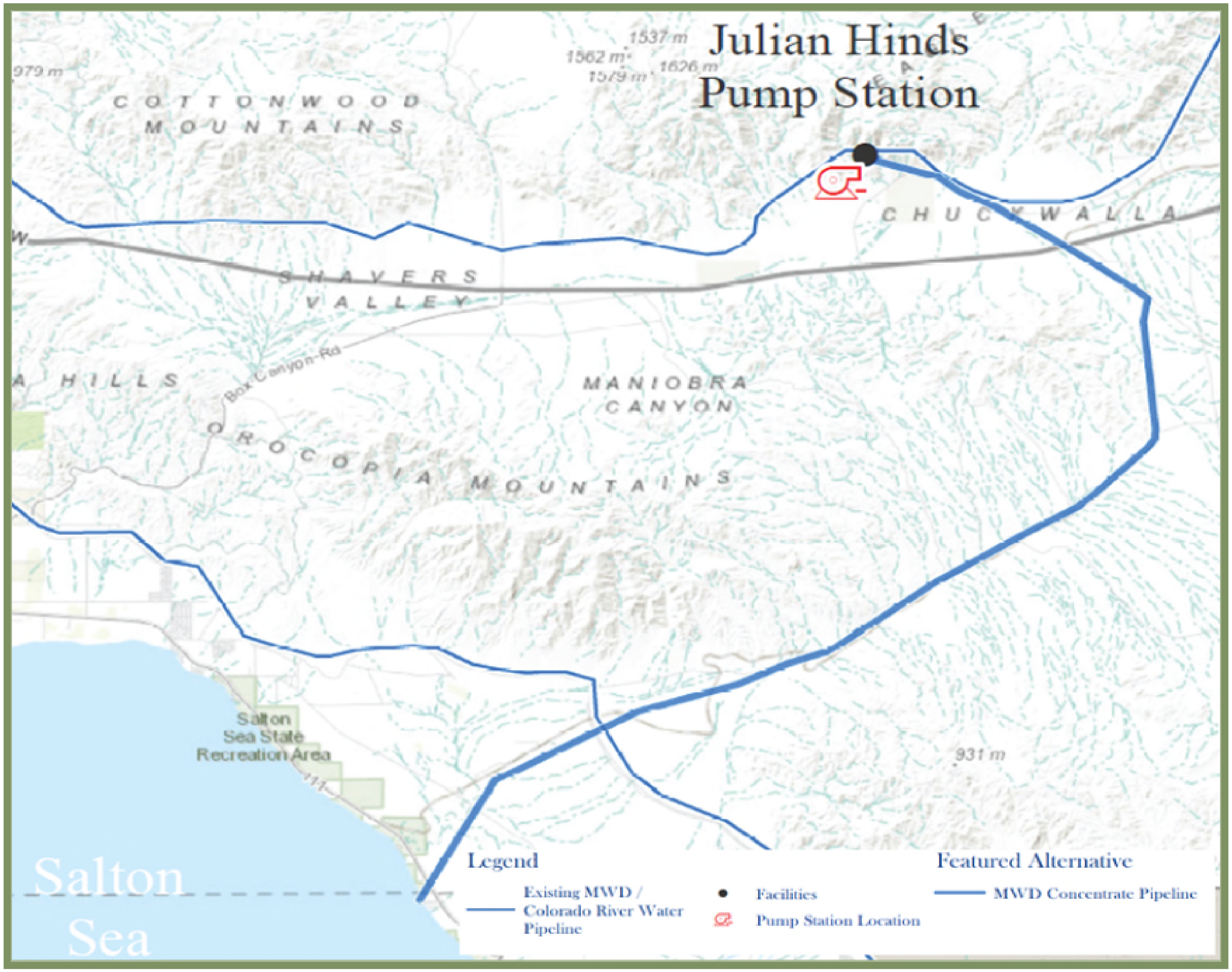

Figure 7 Metropolitan Water District of Southern California Concentrate Pipeline

2.2.5 Institutional Considerations

In order for this option to become feasible, participation and collaboration with MWD would be required. MWD needs to meet their water quality goal of 500 mg/L or less of total dissolved solids. They currently blend State Water Project supplies with Colorado River Water to lower salinity in water delivered throughout Southern California. Improving the water quality of the water from the Colorado River would allow MWD greater operational flexibility by eliminating the blending with State Water Project supplies that is currently required to address salinity issues. This would also help alleviate much of the quantified damages associated with the salinity of the Colorado River water.

The construction and implementation of a treatment facility for the Colorado River water would greatly benefit MWD by addressing the salinity issue, which has historically been a significant issue. There is, however, no indication at the present that MWD is considering proceeding with this option, and additional discussions with MWD should be held to determine whether this option is going to become a possibility. Should MWD choose to proceed with this project, it would require significant collaboration, coordination, and time to facilitate details such as partnership logistics, cost-sharing, and schedule.

2.2.6 Conceptual Plans

Conceptual plans prepared for the MWD Concentrate Pipeline alternative can be found in Appendix 11.1. These plans were used to form the basic concept for the pipeline route and its key components. Conceptual level cost estimates were then developed from the layouts presented in these plans. Appendix 11.1 contains the following conceptual drawings:

- Hydraulic profile;
- A pump station mechanical plan and section; and
- Outlet structure.

2.2.7 Cost Evaluation

An evaluation of project costs was conducted including the following components: mobilization and demobilization, intake systems and facilities, intake pump station, intake pumps, intake pump station mechanical piping, intake pump station auxiliary items, conveyance pipe, pressure reducing station, buildings and/or vaults, outlet system facilities, onshore additional structures, and electrical/instrumentation. The pipe flow capacity for this alternative was estimate at Q = 43,000 AFY (60.16 cfs). The cost provided in

Table 1 provides a preliminary conceptual estimate based on the best currently available data and is subject to change.

Table 1 Cost Estimate for MWD Concentrate Pipeline

Description	Quantity	Unit	Unit Price	Total
1 Mobilization/Demobilization	1	LS	$5,109,000	$5,109,000
2 Intake System/Facility	1	LS	$304,000	$304,000
3 Intake Pump Station	1	LS	$4,624,000	$4,624,000
4 Intake Pumps	1	LS	$3,969,000	$3,969,000
5 Intake Pump Station Mechanical Piping	1	LS	$226,000	$226,000
6 Intake Pump Station Auxiliary Items	1	LS	$994,000	$994,000
7 Conveyance Pipe	1	LS	$87,358,000	$87,358,000
8 Pressure Reducing Station, Building or Vault (4 Total)	1	LS	$400,000	$400,000
9 Outlet System/Facility, onshore	1	LS	$138,000	$138,000
10 Additional Structures	1	LS	$1,547,000	$1,547,000
11 Electrical / Instrumentation	1	LS	$2,629,000	$2,629,000
			Design, Project and Construction Management (25% Items 2 to 11)	$25,547,000
			Subtotal	$132,845,000
			Contingency (30%)	$39,854,000
			Total	$172,699,000

2.2.8 Screening Level Performance Analysis

The Modified SSAM was run for the MWD Concentrate Pipeline inflow alternative, assuming an import capacity of 43,000 AFY. The model was run for two future inflow scenarios. The baseline case assumes a future inflow of approximately 865,000 AFY by 2077, long after QSA mitigation flows end in 2017. The uncertainty case assumes a future inflow of about 689,000 AFY. The Modified SSAM and the future inflow assumptions are discussed in section 1.3 and in Salton Sea Funding and Feasibility Action Plan, Benchmark 2: Review and Update Existing Condition Data.

The results of the model run for the baseline future inflow case of 865,000 AFY are shown in Figure 8, and the results of the model run for the baseline uncertainty inflow case of 689,000 AFY are shown in Figure 9. These results can be compared to the No Action scenarios illustrated in Figure 1 and Figure 2. For this screening level evaluation it was assumed that operation of the MWD Concentrate Pipeline to the Salton Sea would begin in the year 2025. It was estimated that, from a decision point in 2017, it would take about eight years to complete the environmental documentation, the design and permitting, right-of-way clearance and land acquisition, and thus result in a 2025 start up.

For the baseline inflow case, the results shown in Figure 8 indicate that the MWD concentrate would raise the lake level by about 1.5 feet compared to the no action case. Although the MWD concentrate would add salt to the lake, the rate of rise in salinity would be slowed compared to No Action due to the additional water supplied.

Key results of the baseline inflow model run are as follows:

- The water surface would stabilize around the year 2030 at an elevation of -246.6’ NGVD which would result in an average water depth of about 20 to 21 feet and a maximum depth of around 28 to 30 feet.
- Salinity would continuously rise with this alternative, but rising salinity would be slowed when compared to a No Action scenario.
- The lake area would stabilize at about 275 to 280 sq mi after the year 2030.
- The volume of water in the lake in the year 2050 is projected to be 3.34 MAF or about 44% of the lake volume as it was in 2000.

For the uncertainty inflow case, the results shown in Figure 9 indicate that the MWD concentrate would still raise the lake level by about 1.5 feet compared to the No Action alternative. Although the MWD concentrate would still add salt to the lake, the rate of rise in salinity would be slowed compared to No Action due to the additional water supplied. The trends are similar to the previous scenario, but the salinity peak is more drastic due to the reduction of inflows inherent to this scenario. Additionally, the lake volume would be reduced to an even smaller size than for the baseline inflow case, with the volume dropping to approximately 31.2% of the year 2000 volume.

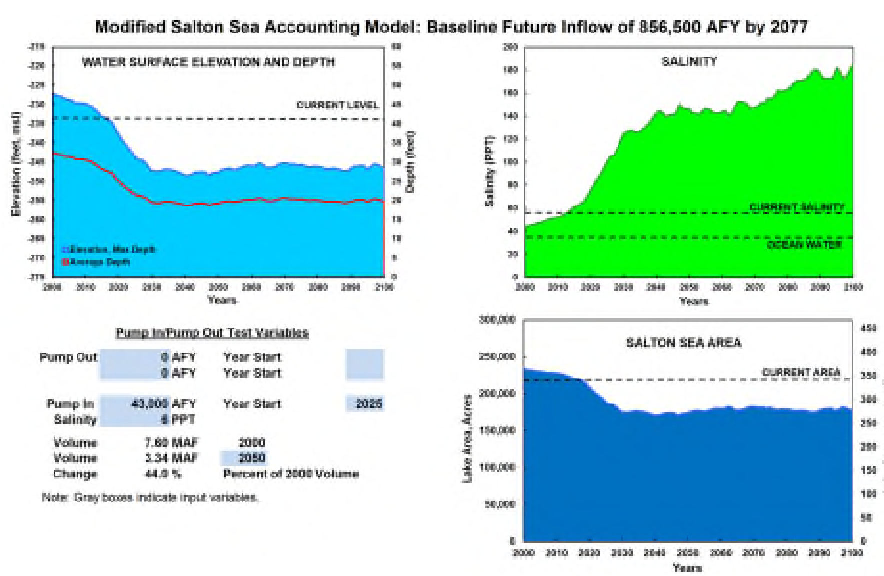

Figure 8 MWD Baseline Future Inflow

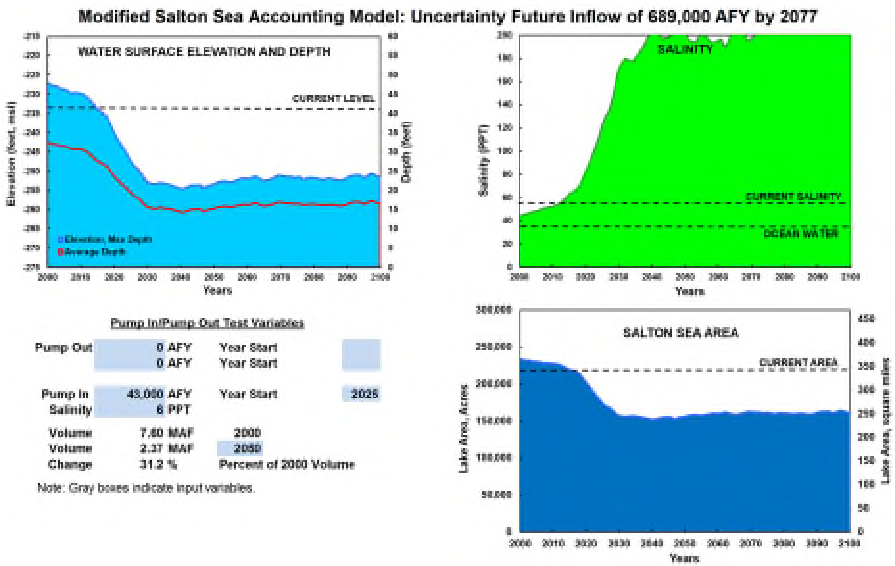

Figure 9 MWD Uncertainty Future Inflow

2.2.9 Summary

This alternative would treat Colorado River water near the Julian Hinds Pump Station, which would benefit a large area of Southern California and provide MWD with greater operational flexibility. Not only would treatment of the Colorado River Water alleviate many of the issues associated with the highly saline water, the benefit for the Salton Sea would be the creation of a water source estimated at 43,000AFY with salinity of 4,000 to 6,000 mg/L. This alternative is viable, but entirely dependent on coordination and agreements with MWD.

2.3 Yuma Desalting Plant Concentrate Pipeline

The YDP is located five miles west of Yuma, Arizona, and was constructed in response to salinity issues related to Colorado River waters delivered to Mexico. In 1974, research was completed under the Colorado River Basin Salinity Control Act to identify technological means to reduce the salinity of water transferred to Mexico. In total, three projects were constructed, with one of the projects being the YDP, which began construction in 1980 and was completed in 1992. The objective of the plant is to address the salinity of the irrigation drainage water from the farmlands and groundwater pumping of the Wellton-Mohawk Irrigation and Drainage District. The water is received from the Main Outlet Drain pipeline and the MODE, which delivers water to the YDP. Between 2004 and 2008, the average annual runoff flow through the MODE was approximately 107,000 acre feet. Unless treated, all of this water has too high of salinity to be blended with the flows of the Colorado River for credit of water transfer between the United States and Mexico.

This alternative would consist of operation of the Yuma Desalting Plant to deliver treated water for credit at the United States and Mexico border, with delivery of the high salinity concentrate flow to the Salton Sea. At full capacity, the YDP was designed to receive water from the MODE pipeline and produce approximately 60,000 AF of treated water, to be blended with 10,000 AF of untreated supply and generate a total flow 70,000 AF. The plant was last operated at 30 percent capacity for a pilot run in 2010. Based upon that pilot run and the initial design of the plant, it is estimated that a concentrate flow of 32,000 AFY having a salinity level of approximately 7,000 ppm would result from full operation of the plant.

Water rights at the International Border between the United States and Mexico were defined in the Treaty of 1944. Mexico's right was determined to be 1,500,000 AFY, without provisions regarding water quality. On August 30, 1973, Minute 242 was signed, which established requirements for water quality, such that water crossing the International Border must not have salinity higher than 145 ppm above the salinity levels measured at the Imperial Dam. Today approximately 1,360,000 AFY of the total water transfer to Mexico occurs upstream of the Morales Dam in Mexico.

Normally, the untreated irrigation drainage that flows through Yuma Arizona does not count in the 1,360,000 AFY transfer of water to Mexico because of elevated salinity levels. Instead, it is diverted to La Cienega de Santa Clara, and the United States does not receive any delivery credit. Treatment of the water would allow for the United States to receive credit for the water delivery to Mexico and reduce the amount of water that would have to be drawn from Lake Mead to fulfill the water transfer obligations to Mexico.

2.3.1 Plant Operation

The plant operated at one-third capacity until 1993 when the MODE was damaged by a flood. The facility remained out of operation until 2007 due to a variety of factors including budget constraints, wet years on the lower Colorado River, and more until the present. At that time, Reclamation elected to conduct a demonstration run of the desalting plant at 10 percent capacity for a period of three months. A following decision was made to perform longer-term operation of the facility at one-third capacity for a period of about a year in 2010.

Preparation of the YDP for the pilot run took about a year, as the plant was not currently in operation and had never been in continuous operation for any extended period of time. The pilot run itself began on May 3, 2010, and operations ceased 328 days later on March 26, 2011. The system operated continuously during this time, and operation of the desalting plant allowed for conservation of 30,496 AF of water by reducing the amount of water to be drained from Lake Mead in order to fulfill water delivery obligations to Mexico. This included 22,666 AF of product water from the YDP and 7,830 AF of untreated drainage water that was blended with the product water. The concentrate resulting from the desalting operation was transported by the MODE to the Bypass Drain. Operational data indicates an average recovery of about 70 percent and a product flow with a salinity concentration of about 241 ppm. Additionally, the pilot run reduced flow in the Bypass Drain by about 31,079 AF and increased the salinity of the flow by 516 ppm. Overall operational costs including preparation for the pilot run totaled just over $23 million dollars.

2.3.2 Water Quantity

In accordance with these agreements, the average annual salinity of approximately 1.36 million AF of water delivered to Mexico should average 115 ± 30 ppm annually higher than the annual average salinity of the Colorado River water measured at Imperial Dam, located roughly 27 miles upstream of the Morelos Dam.

Currently, the 1.36 million AF of water requirement delineated in Minute No. 242 is fulfilled with water sources that do not include the drainage from the Wellton-Mohawk Division farmlands. Minute No. 242 also provides for about 140,000 AF of water to be delivered annually to Mexico at the Southerly International Boundary at San Luis Rio Colorado, Mexico, with a salinity level substantially the same as that of waters customarily delivered there. Lastly, Minute No. 242 provided for the construction of the concrete-lined Bypass Drain from Morelos Dam to La Cienega de Santa Clara in Mexico.

Utilizing the Bypass Drain for all of the drainage from the Wellton-Mohawk Division farmlands began in 1977 and was intended to be temporary. The agricultural drainage was intended for treatment by the YDP once construction began; however, the plant was never placed into long-term operation, the drainage continued to inundate La Cienega de Santa Clara via the Bypass Drain, and over the course of time has re-established the wetland habitat in La Cienega de Santa Clara, which is now home to hundreds of species, including several threatened and endangered species.

Due to the re-establishment of the wetland habitat in La Cienega de Santa Clara, there may be a substantial impact to the habitat should the drainage flow from the Wellton-Mohawk Division farmlands be decreased or eliminated. The feasibility impact of reducing or eliminating the drainage flow to La Cienega de Santa Clara must be fully evaluated.

Minute No. 316 outlined details for utilization of the Wellton-Mohawk Bypass Drain and conveyance of water to La Cienega de Santa Clara during the YDP

Pilot Run in 2010. According to Minute No. 316, La Cienega de Santa Clara is part of the Upper Gulf of California and Colorado River Delta Biosphere Reserve, the highest category of protection that Mexico assigns to a wetland, in addition to being declared a protected wetland under the RAMSAR Wetlands Convention. Both Mexico and the United States expressed interest in preserving the environmental value of La Cienega de Santa Clara during the YDP Pilot Run, and therefore, stipulations were made in Minute No. 316 to provide 30,000 AF of additional water to La Cienega de Santa Clara to account for the losses from operating the YDP during the pilot run. Based on the average recoveries from the pilot run, approximately 32,000 AF would be available for the Salton Sea. It can be anticipated that any long-term operation of the facility would require identification of a long-term alternative source of water to replenish the reduction in flow to La Cienega de Santa Clara.

2.3.3 Water Quality

The salinity of the treated product water from the YDP is well below the current salinity level of the Salton Sea. The untreated flow has a salinity of approximately 2,600 ppm on average, the concentrate from the YDP to the MODE is estimated to have a salinity of 7,300 ppm, and the pretreated/backwash water returned to the MODE is estimated to have a salinity of 2,300 ppm. Therefore, all flow streams associated with the operation of the YDP would reduce the overall salinity of the Salton Sea. Further water quality evaluations are required to determine whether additional treatment is required prior to discharge of the water from either option into the Salton Sea.

2.3.4 Conveyance System and Hydraulics

Delivery of treated water from the YDP to the Salton Sea would require construction of approximately 65 miles of 40-inch diameter pipeline, and two pump stations. The first pump station would be located at the YDP, and the second pump station would be nearly half the distance to the Salton Sea. Total estimated hydraulic lift to convey to the Salton Sea is 700 feet. Therefore, each pump station would be designed to pump 20,000 gpm at 350 feet of lift.

Figure 10 depicts a conceptual conveyance system for delivering water from the YDP to the Salton Sea.

2.3.5 Consideration of Capital and Operational Cost

Both capital and operational costs are very similar in magnitude to the estimated costs for the alternative to import the concentrate flow from treatment of Colorado River water. Likewise, this option is less costly per acre foot in comparison to the SARI pipeline alternative and much more costly in comparison to importing untreated seawater from the Gulf of California. The cost estimate for this alternative considers costs for start-up and operation of the YDP. Similar to the previous option, some of the capital and operational costs associated with this alternative would most likely be borne by Reclamation, as it would only be the reject flow, or concentrate, from the desalination process that would be imported into the Salton Sea. This is, however, contingent on agreement from Reclamation, as the plant is currently not in operation.

Similar to the previous option, however, the salinity in the concentrate from the YDP is much less than the salinity of the seawater from the Gulf of California. Therefore, the overall capital and operational costs are lower than the option to pump in water from the Gulf of California because a smaller quantity of water is required to achieve a similar benefit in water quality improvements to the Salton Sea. As a result, the overall annual operational cost for this option is the lowest in magnitude in comparison to both the SARI and Gulf of California options.

2.3.6 Institutional Considerations

The available quantities of water that can be diverted from the YDP or MODE are highly dependent on treaty provisions regarding flow requirements to Mexico. Governing agreements include a treaty made with Mexico on February 3, 1944, and Minute No. 242, which was adopted on August 30, 1973. Extensive negotiations between the United States and Mexico took place leading up to Minute No. 242.

Potentially, the largest institutional and approval hurdles to treating water at the YDP and conveying the water to the Salton Sea include the start-up and operational costs of the YDP and the environmental impact of the resulting reduction in untreated water transferred to Mexico and into the Bypass Drain which flows to La Cienega de Santa Clara (Santa Clara Slough). Minute No. 316 included provisions for additional importation of 30,000 AF of water to La Cienega de Santa Clara to alleviate some of the environmental impacts and the decrease in flow associated with the operation of the YDP. It can be anticipated that any long-term operation of the YDP would require identification and implementation of an alternative source of inflow to La Cienega de Santa Clara.

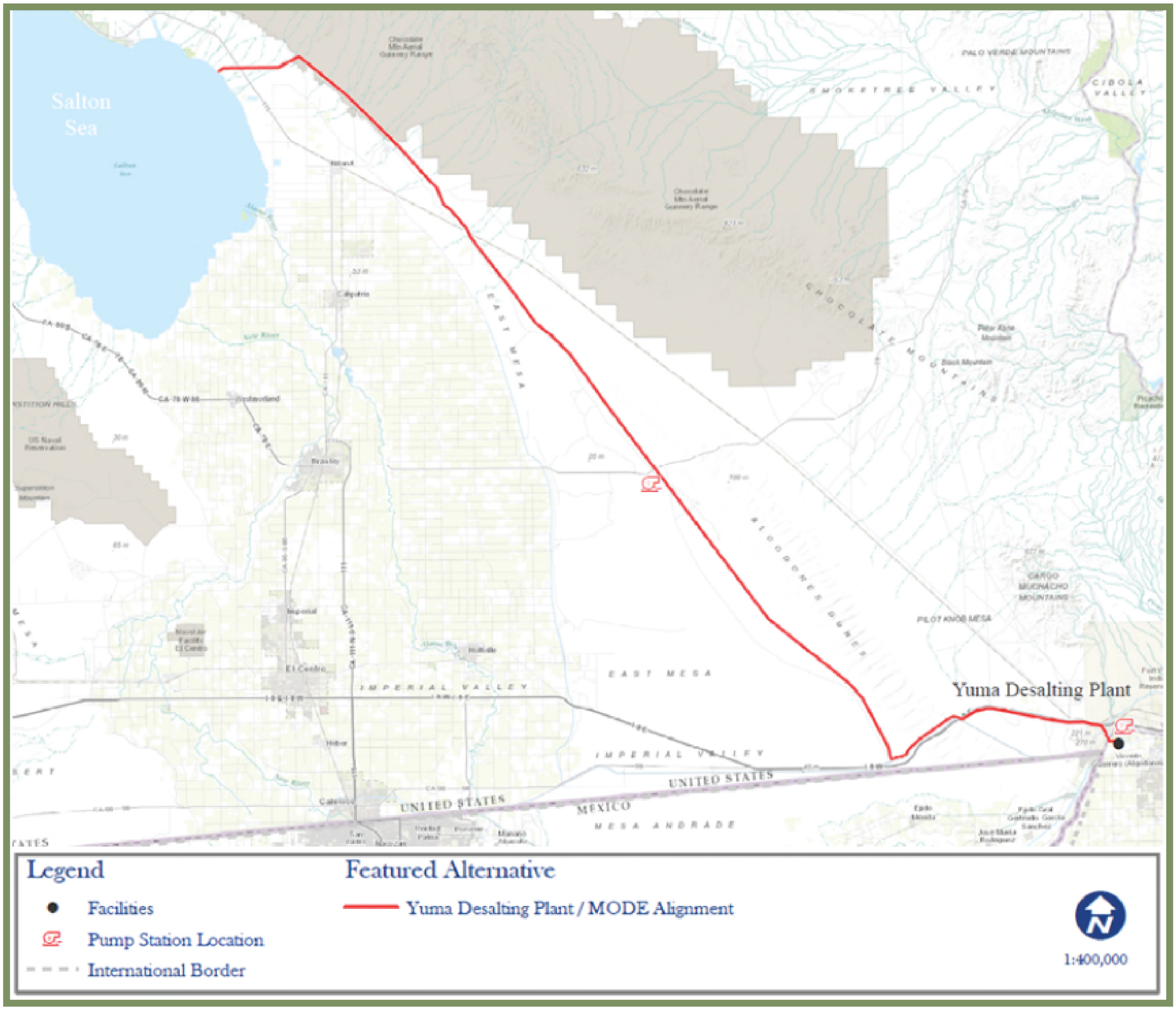

Figure 10 Yuma Desalting Plant Concentrate Pipeline

2.3.7 Conceptual Plans

Conceptual plans prepared for the YDP Pipeline alternative can be found in Appendix 11.2. These plans were used to form the basic concept for the pipeline route and its key components. Conceptual level cost estimates were then developed from the layouts presented in these plans. Appendix 11.2 contains the following conceptual drawings:

- Hydraulic profile;
- A pump station mechanical plan and section; and
- Outlet structure.

2.3.8 Cost Evaluation

An evaluation of project costs was conducted including the following components: mobilization and demobilization, intake systems and facilities, intake pump station, intake pumps, intake pump station mechanical piping, intake pump station auxiliary items, conveyance pipe, pressure reducing station, buildings and/or vaults, outlet system facilities, onshore additional structures, and electrical/instrumentation. The pipe flow capacity for this alternative was estimate at Q = 43,000 AFY (60.16 cfs). The cost provided in Table 2 provides a preliminary conceptual estimate based on the best currently available data and is subject to change.

Table 2 Cost Estimate for YDP

Description	Quantity	Unit	Unit Price	Total
1 Mobilization/Demobilization	1	LS	$9,376,000	$9,376,000
2 Intake System/Facility	1	LS	$159,000	$159,000
3 Intake Pump Station	1	LS	$4,033,000	$4,033,000
4 Intake Pumps	1	LS	$3,287,000	$3,287,000
5 Intake Pump Station Mechanical Piping	1	LS	$168,000	$168,000
6 Intake Pump Station Auxilary Items	1	LS	$751,000	$751,000
7 Conveyance Pipe	1	LS	$165,415,000	$165,415,000
8 Booster Pump Station	1	LS	$3,833,000	$3,833,000
9 Booster Pumps	1	LS	$2,358,000	$2,358,000
10 Booster Pump Station Mechanical Piping	1	LS	$168,000	$168,000
11 Booster Pump Station Auxilary Items	1	LS	$869,000	$869,000
12 Pressure Reducing Station, Building or Vault	1	LS	$100,000	$100,000
13 Outlet System/Facility, onshore	1	LS	$87,000	$87,000
14 Additional Structures	1	LS	$2,359,000	$2,359,000
15 Electrical / Instrumentation	1	LS	$3,932,000	$3,932,000
Design, Project and Construction Management (25% Items 2 to 15)				$46,880,000
			Subtotal	$243,775,000
			Contingency (30%)	$73,133,000
			Total	$316,908,000

2.3.9 Screening Level Performance Analysis

The Modified SSAM was run for an inflow pipeline from the YDP, assuming an import capacity of 32,000 AFY. The model was run for two future inflow scenarios. The baseline case assumes a future inflow of approximately 865,000 AFY by 2077, long after QSA mitigation flows end in 2017. The uncertainty case assumes a future inflow of about 689,000 AFY. The Modified SSAM and the future inflow assumptions are discussed in section 1.3 and in Salton Sea Funding and Feasibility Action Plan, Benchmark 2: Review and Update Existing Condition Data.

The results of the model run for the baseline future inflow case of 865,000 AFY are shown in Figure 11, and the results of the model run for the uncertainty future inflow case of 689,000 AFY are shown in Figure 12. These results can be compared to the No Action scenarios illustrated in Figure 1 and Figure 2. For this screening level evaluation it was assumed that operation of the pipeline from the YDP would begin in the year 2025. It was estimated that, from a decision point in 2017, it would take about eight years to complete the environmental documentation, the design and permitting, right-of-way clearance and land acquisition, and thus result in a 2025 start up.

For the baseline inflow case, the results shown in Figure 11 indicate that the YDP concentrate would raise the lake level by about 1 foot compared to the no action case. Although the YDP concentrate would add salt to the lake, the rate of rise in salinity would be slowed compared to No Action due to the additional water supplied.

Key results of the baseline inflow model run are as follows:

- The water surface would remain relatively stable at around the year 2030 with a predicted mean elevation of about -247 NGVD for at least 50 years. This elevation would result in an average water depth of about 20 to 21 feet and a maximum depth of around 27 to 29 feet.
- Salinity would continuously rise with this alternative, but rising salinity would be slowed when compared to a No Action scenario.
- The lake area would stabilize at around 270 sq mi after the -year 2030.
- The volume of water in the lake in the year 2050 is projected to be 3.27 MAF or about 43% of the lake volume as it was in 2000.

For the uncertainty inflow case, the results shown in Figure 12 indicate that the YDP concentrate would still raise the lake level by about 1 foot compared to the no action case. Although the YDP concentrate would still add salt to the lake, the rate of rise in salinity would be slowed compared to No Action due to the additional water supplied. The trends are similar to the previous scenario, but the rising salinity is more drastic due to the reduction of inflows inherent to this scenario. Additionally, the lake volume would be reduced to an even smaller size than for the baseline inflow case, with the volume dropping to approximately 30.6% of the year 2000 volume.

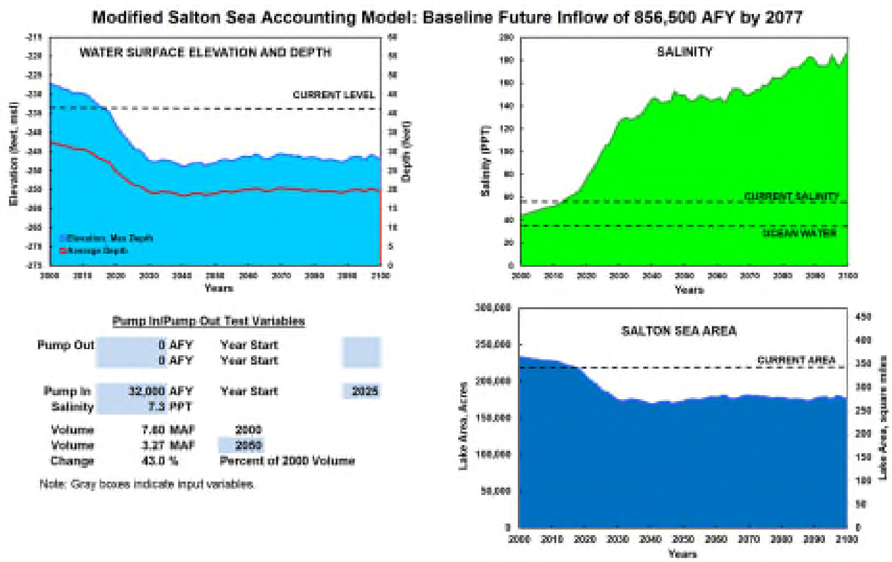

Figure 11 YDP Baseline Future Inflow

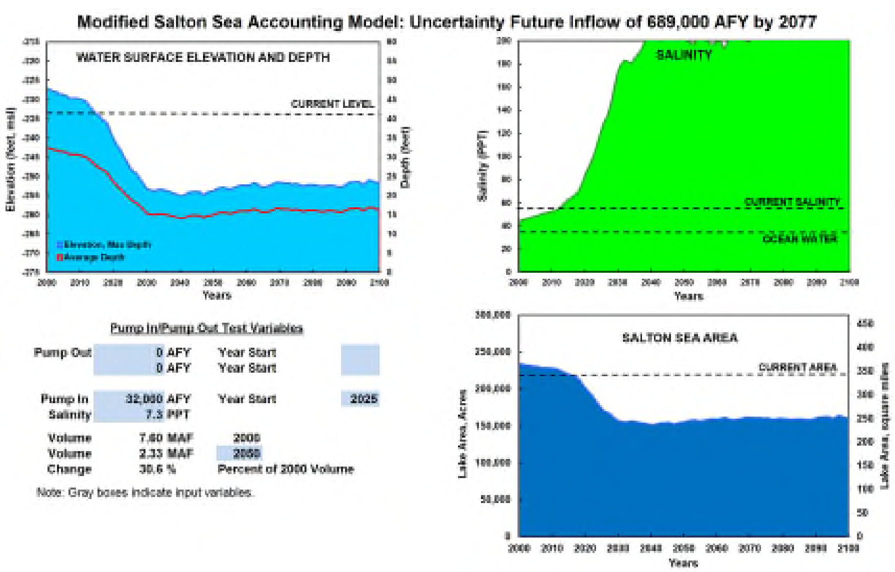

Figure 12 YDP Uncertainty Future Inflow

2.3.10 Summary

A preliminary evaluation of the YDP history, operations and design capacity indicates there are offsetting benefits, necessary approvals, and implementation costs associated with operating the YDP. Through the operation of the YDP, it would be possible to reduce the water drawn from Lake Mead to meet the flow transfer requirement with Mexico. The impact would be that flow otherwise sent to Mexico through the Bypass Drain to La Cienega de Santa Clara would be reduced. The quantity of the reduction in flow would have to be replaced with an alternative water source in order to preserve the habitat and ecosystem at the protected wetland. With a maximum flow rate of 30,000 AFY, the alternative is viable with careful consideration of the benefits against the institutional approvals.

2.4 MODE Pipeline

Flow through the MOD and MODE pipelines originates as irrigation drainage and pumped groundwater from the Wellton-Mohawk Irrigation Drainage District service area east of Yuma, Arizona. This flow is typically conveyed through the MODE pipeline and into the Bypass Drain, which eventually leads to La Cienega de Santa Clara in Mexico.

This alternative considers redirecting this irrigation drainage water to the Salton Sea. This alternative has been considered due to the large available flow rate and low hydraulic lift requirements. However, as further addressed to follow, the largest challenge in taking the flow is that it would resulting in halting flow to the Bypass Drain which flows to La Cienega de Santa Clara.

2.4.1 Water Quantity

The MODE pipeline has an average flow rate of 107,000 AFY that could be transferred to the Salton Sea. As further discussed in the institutional considerations section below, conveyance of the water to the Salton Sea would result in a reduction of flow to La Cienega de Santa Clara in Mexico, which could be a concern based on the precedence set by Minute No. 316.

2.4.2 Water Quality

The untreated flow has an average salinity of approximately 2,600 ppm. Further water quality and environmental impact evaluations are required to determine whether additional treatment is required prior to discharge of the water from either option into the Salton Sea.

2.4.3 Conveyance System and Hydraulics

To maximize the delivery of untreated water to the Salton Sea would include full transfer of the 107,000 AFY from the MODE Pipeline. In order to deliver water from the MODE Pipeline near the YDP to the Salton Sea would take 65 miles of 73-inch diameter pipeline. The topography from Yuma, Arizona to the Salton Sea is relatively flat, with a general slope toward the Salton Sea just inside of California. As a result, the total estimated hydraulic lift to pump to the Salton Sea is approximately 400 feet. Pump facilities would be built near the YDP and located halfway to the Salton Sea. The resulting hydraulic lift per pump facility would be 200 feet, at a flow rate of 66,000 gpm.

Figure 10 depicts a conceptual conveyance system for delivering water from the MODE near the YDP to the Salton Sea.

2.4.4 Consideration of Capital and Operational Cost

The alternative to deliver untreated irrigation drainage water from the Wellton-Mohawk Irrigation Drainage District is the least expensive option per acre foot in terms of direct conveyance to the Salton Sea. This is largely a result of the low elevation change from Yuma to the Salton Sea, and that the alternative does not include any treatment costs. The preliminary cost analysis does not take into consideration the costs associated with providing an alternative water supply to La Cienega de Santa Clara, which is where the drainage water currently flows to. The following institutional considerations demonstrate that an alternative water supply to La Cienega de Santa Clara is more than likely to be required, and this would add significant costs to the overall cost of this alternative.

2.4.5 Institutional Considerations

If the entire quantity of the agricultural drainage from the Wellton-Mohawk Irrigation Drainage District were to be diverted to the Salton Sea, an alternative water source of comparable water quality and quantity would have to be identified as a supply for La Cienega de Santa Clara. La Cienega de Santa Clara is part of the Upper Gulf of California and Colorado River Delta Biosphere Reserve, the highest category of protection that Mexico assigns to a wetland, in addition to being declared a protected wetland under the RAMSAR Wetlands Convention according to Minute No. 316. The logistics and complications associated with a one-time supply of 30,000 AF of supplemental water to La Cienega de Santa Clara were significant and costly for the YDP Pilot Run, and this option is unlikely and infeasible, as the costs and institutional concerns far outweigh any potential benefit to the Salton Sea. Not to mention, such an option would more likely than not exacerbate environmental issues associated with La Cienega de Santa Clara, which is another highly protected habitat and ecosystem.

2.4.6 Screening Level Performance Analysis

The Modified SSAM was run for an inflow pipeline from the MODE, assuming an import capacity of 107,000 AFY. The model was run for two future inflow scenarios. The baseline case assumes a future inflow of approximately 865,000 AFY by 2077, long after QSA mitigation flows end in 2017. The uncertainty case assumes a future inflow of about 689,000 AFY. The Modified SSAM and the future inflow assumptions are discussed in section 1.3 and in Salton Sea Funding and Feasibility Action Plan, Benchmark 2: Review and Update Existing Condition Data.

The results of the model run for the baseline future inflow case of 865,000 AFY are shown in Figure 13, and the results of the model run for the uncertainty future inflow case of 689,000 AFY are shown in Figure 14. These results can be compared to the No Action scenarios illustrated in Figure 1 and Figure 2. For this screening level evaluation it was assumed that operation of the MODE Pipeline to the Salton Sea would begin in the year 2025. It was estimated that, from a decision point in 2017, it would take about eight years to complete the environmental documentation, the design and permitting, right-of-way clearance and land acquisition, and thus result in a 2025 start up.

For the baseline inflow case, the results shown in Figure 13 indicate that the MODE Pipeline would raise the lake level by about 3 to 4 feet compared to the No Action alternative. Although the MODE Pipeline would add salt to the lake, the rate of rise in salinity would be slowed compared to No Action due to the additional water supplied.

Key results of the baseline inflow model run are as follows:

- The water surface would remain relatively stable at around the year 2030 with a predicted mean elevation of about -244’ NGVD for at least 50 years. This elevation would result in an average water depth of about 21 to 22 feet and a maximum depth of around 29 to 31 feet.
- Salinity would continuously rise with this alternative, but rising salinity would be slowed when compared to a No Action alternative.
- The lake area would stabilize at around 290 to 300 sq mi after the year 2030.
- The volume of water in the lake in the year 2050 is projected to be 3.76 MAF or about 49.4% of the lake volume as it was in 2000.

For the uncertainty inflow case, the results shown in Figure 14 indicate that the MODE Pipeline would still raise the lake level by about 3 to 4 feet compared to the No Action alternative. Although the MODE Pipeline would still add salt to the lake, the rate of rise in salinity would be slowed compared to No Action due to the additional water supplied. The trends are similar to the previous scenario, but the rising salinity is more drastic due to the reduction of inflows inherent to this scenario. Additionally, the lake volume would be reduced to an even smaller size than for the baseline inflow case, with the volume dropping to approximately 35.3% of the year 2000 volume.

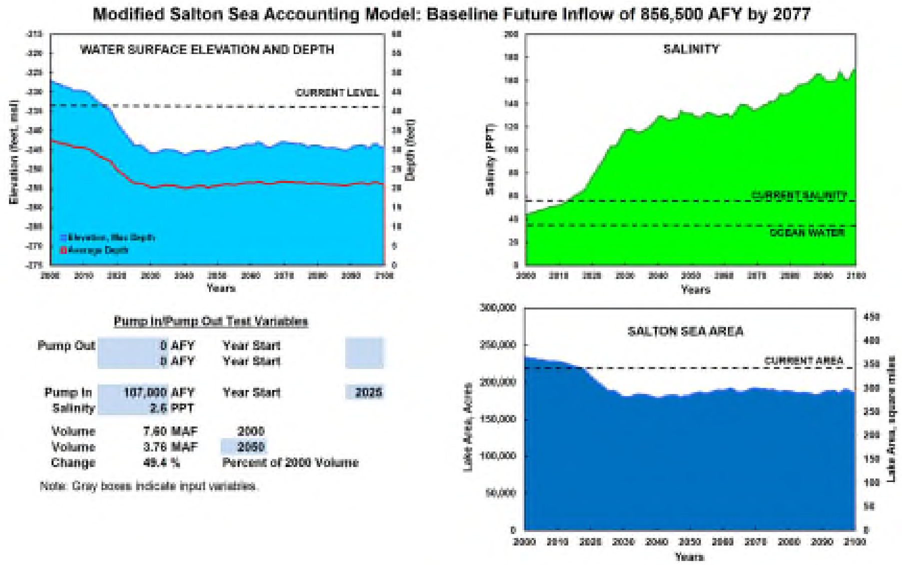

Figure 13 MODE Baseline Future Inflow

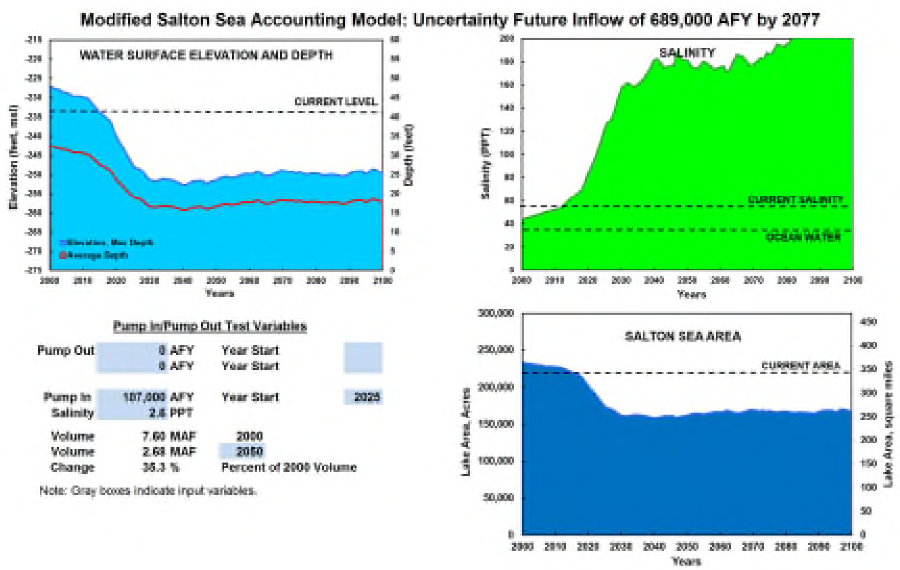

Figure 14 MODE Uncertainty Future Inflow

2.4.7 Summary

The transfer of irrigation drainage water from the Wellton-Mohawk Irrigation Drainage District to the Salton Sea is feasible. The available water supply exceeds 100,000 AFY, and thereby is one of the larger water sources identified. The quality of the water would directly benefit the Salton Sea, and initially it appears that treatment would not be required prior to delivery to the Salton Sea.

The environmental implications and the logistical challenges associated with this alternative, however, far outweigh the benefits of the potential increase in water supply to the Salton Sea. This alternative essentially transfers issues and concerns at the Salton Sea to La Cienega de Santa Clara. Addressing the need for increased inflows would divert necessary flows to La Cienega de Santa Clara and result in a subsequent need for identification of an alternative water source for La Cienega de Santa Clara, as it is a highly protected wetland habitat. Given the complexity of the environmental concerns associated with this option, this alternative does not provide an optimal solution for the issues related to the Salton Sea.

2.5 Gulf of California

Delivering water from the Gulf of California has been considered one of the most advantageous alternatives to supply water to the Salton Sea. The strongest supporting reasons for the alternative are the ample supply and opportunities for a pipeline alignment with relatively low hydraulic lift and the perception that there would be low impacts to Baja Mexico and Imperial County California. The distance between the Salton Sea and Gulf of California is approximately 120 miles. A review of topography indicates 300 feet above MSL would be the highest elevation for a pipeline alignment through Laguna Salada and west of the Cities of Mexicali and El Centro. By comparison, all pipeline alignments from the Pacific Ocean would reach a minimum elevation of 3,000 feet above MSL.

Figure 15 depicts a conceptual conveyance system for delivering water from the Gulf of California to the Salton Sea.

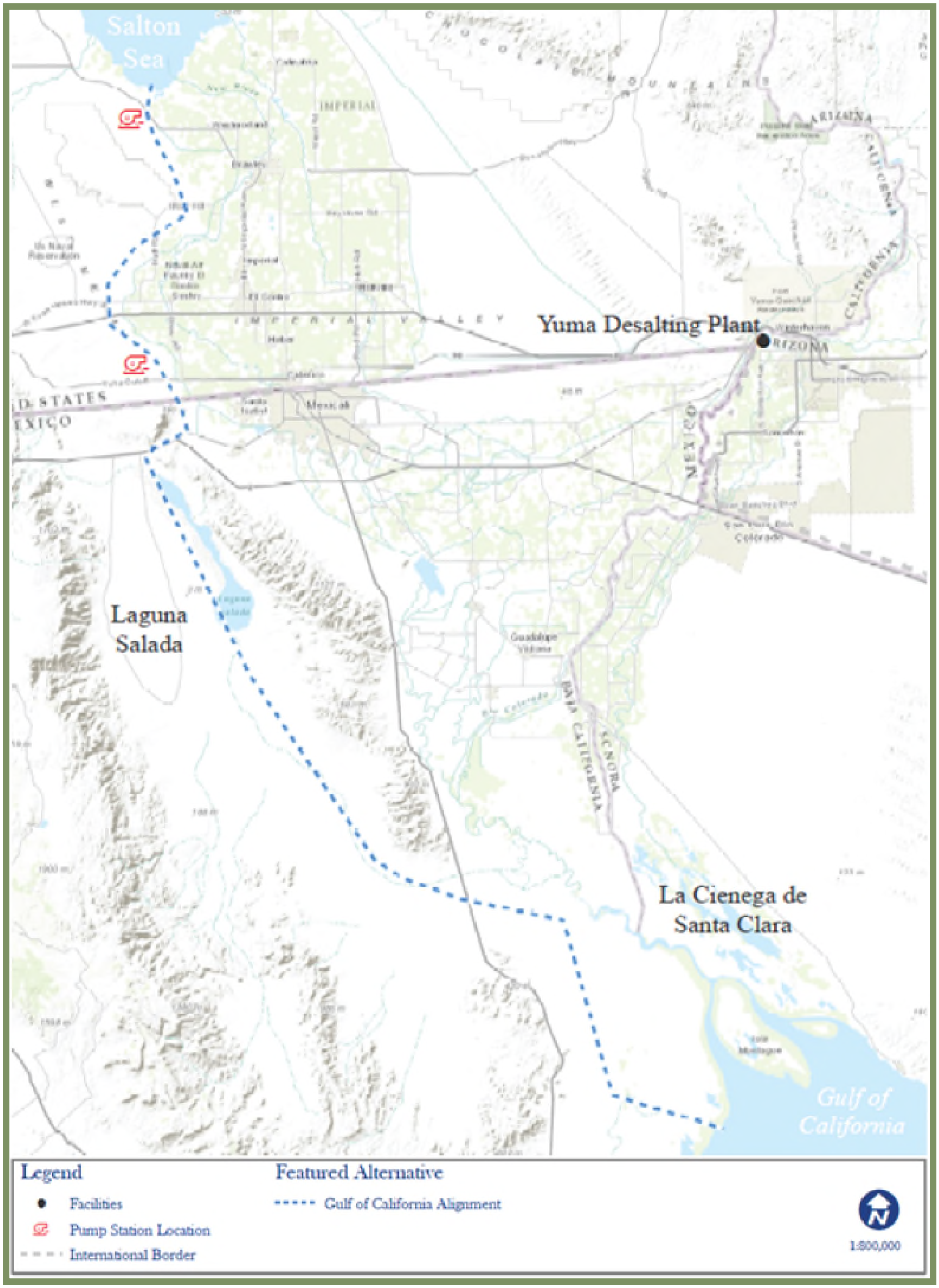

Figure 15 Gulf of California Pipeline for Inflow

2.5.1 Water Quantity

Water delivery from the Gulf of California could provide ample water supply. The limiting factor of supply flow rate from the Gulf of California is anticipated to be capital and annual operation costs. In addition, due to the high salinity of the source, a large volume of water from the Gulf of California would be required to prevent a rapid rise in salinity at the Salton Sea. For the purpose of this report, the beneficial supply flow rate considered is 150,000 AFY.

2.5.2 Water Quality

The salinity at the Gulf of California is 35,000 to 38,000 ppm. While a large flow rate may be achievable with this alternative, it will also come with large salt transfer to the Salton Sea. Therefore, the water quality of the Gulf of California itself is not a driving factor for this alternative. The primary benefit of this alternative is the quantity of water available.

2.5.3 Conveyance System and Hydraulics

The conveyance of 150,000 AFY of water from the Gulf of California to the Salton Sea would require 120 miles of 86-inch diameter pipeline. The pipeline alignment from the Salton Sea to the Gulf of California will have approximately 300 feet of elevation gain, minimizing the pumping required.

The highest elevated point along all pipeline alignments from the Gulf of California to the Salton Sea occurs near the Mexicali-Tecate Highway 2 just south of the international border. Design considerations must also be made to attribute for the greater salinity in seawater compared to freshwater for all aspects of the conveyance system that may contact with seawater.

2.5.4 Consideration of Capital and Operational Cost

The option to import water from the Gulf of California is just slightly more expensive per acre foot than importing untreated water from the Wellton-Mohawk Irrigation Drainage District. The overall costs, however, are considerably greater for this option in comparison to the other import alternatives presented. This is primarily due to the fact that the seawater is much higher in salinity than the alternative sources of water, and therefore, a much greater quantity is required to address the objective to decrease the overall salinity in the Salton Sea.

2.5.5 Institutional Considerations

The primary considerations for the Gulf of California water supply are easement and land acquisition along the pipeline alignment through Mexico and approval by Mexico. By comparison against other alternatives, a primary advantage of this alternative is that the alignment will often coincide with open space and uninhabited areas through the Laguna Salada in Mexico and west of the agricultural areas surrounding El Centro and Brawley in California.

2.5.6 Screening Level Performance Analysis

The Modified SSAM was run for an inflow pipeline from the Gulf of California, assuming an import capacity of 150,000 AFY. The model was run for two future inflow scenarios. The baseline case assumes a future inflow of approximately 865,000 AFY by 2077, long after QSA mitigation flows end in 2017. The uncertainty case assumes a future inflow of about 689,000 AFY. The Modified SSAM and the future inflow assumptions are discussed in section 1.3 and in Salton Sea Funding and Feasibility Action Plan, Benchmark 2: Review and Update Existing Condition Data.

The results of the model run for the baseline future inflow case of 865,000 AFY are shown in Figure 16, and the results of the model run for the uncertainty future inflow case of 689,000 AFY are shown in Figure 17. These results can be compared to the No Action scenarios illustrated in Figure 1 and Figure 2. For this screening level evaluation it was assumed that operation of a pipeline from the Gulf of California to the Salton Sea would begin in the year 2025. It was estimated that, from a decision point in 2017, it would take about eight years to complete the environmental documentation, the design and permitting, right-of-way clearance and land acquisition, and thus result in a 2025 start up.

For the baseline inflow case, the results shown in Figure 16 indicate that a pipeline from the Gulf of California transporting 150,000 AFY to the Sea would raise the lake level by about 8 to 10 feet compared to No Action. The salinity would still rise, and a supply of saline rich Gulf water would partially mitigate but not resolve the problem of increasing salt accumulations.

Key results of the baseline inflow model run are as follows:

- The average depth of water throughout the Sea is predicted to be about -245’ NGVD in 2030 and -238’ NGVD in 2100. This indicates that the average depth of water throughout the Sea will eventually stabilize just below the current level. In 2100 the average depth will be about 25 feet, and the maximum depth will be around 36 or 37 feet.
- Salinity would continuously rise with this alternative, but rising salinity would be slowed when compared to a No Action alternative.
- The lake area would be about 330 to 350 sq mi in the year 2100.
- The volume of water in the lake in the year 2050 is projected to be 4.22 MAF or about 55.5% of the lake volume as it was in 2000.

For the uncertainty inflow case, the results shown in Figure 17 indicate that an inflow of 150,000 AFY from the Gulf of California would still raise the lake level by about 8 to 10 feet compared to the No Action alternative. As with the previous baseline scenario, additional water supplied from the Gulf of California would still mitigate the rate of rise in salinity compared to No Action. The trends are similar to the previous scenario, but the rising salinity is more drastic due to the reduction of inflows inherent to this scenario. Additionally, the lake volume would be reduced to an even smaller size than for the baseline inflow case, with the volume dropping to approximately 42.3% of the year 2000 volume.

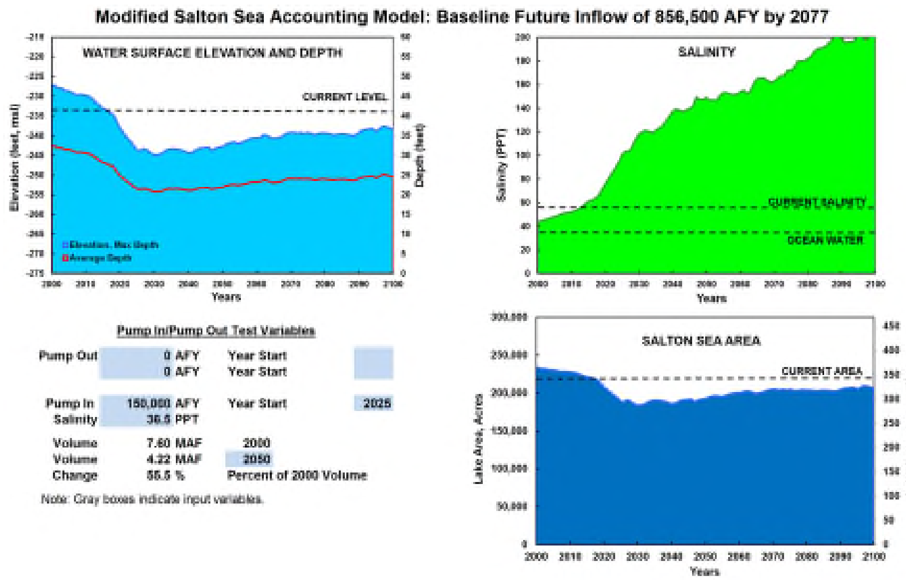

Figure 16 Gulf of California Baseline Future Inflow

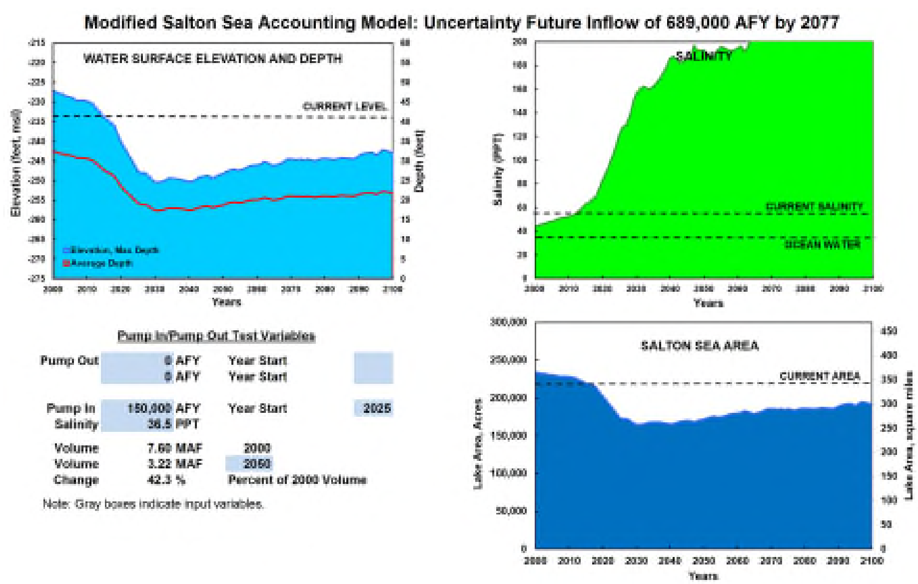

Figure 17 Gulf of California Uncertainty Future Inflow

2.5.7 Summary

Water supply from the Gulf of California is a viable option with advantages of potentially providing the largest flow rate to the Salton Sea, low pumping lift, and pipeline alignments through Mexico that would impact fewer developed areas than a route to the Pacific Ocean. The disadvantages of this alternative remain the long distance of conveyance and approvals required from Mexico. Due to the high salinity of the water source, this alternative should be considered most beneficial in maintaining or limiting the reduction of stored water in the Salton Sea. However, it would take an extremely large conveyance system to supply water from the Gulf of California to the Salton Sea and achieve stabilization or reduction in salinity.

2.6 Pacific Ocean

Water supply from the Pacific Ocean has been previously considered for two primary reasons: the large water supply capacity and ability to construct the conveyance system exclusively within the United States. Outside of these reasons, many disadvantageous factors exist, including the following: impacts to existing communities, a mountain range between the coast and the Salton Sea that increases hydraulic lift, and a pipeline delivery system of 100 to 110 miles in length.

2.6.1 Water Quantity

Similar to the Gulf of California alternative, water delivery from the Pacific Ocean could provide more than sufficient water supply for sustaining the Salton Sea. Capital and annual operation costs are anticipated to be the limiting factors to the flow rate of conveyance from the Gulf of California. Due to the high salinity of the source, a large volume of water from the Pacific Ocean would be required to offset the rise in salinity at the Salton Sea. Previous studies on delivery from the Pacific Ocean and Gulf of California have considered flows of 200,000 to 2,500,000 AFY in attempts to promote large-scale changes to the Salton Sea in a shorter period of time. Such proposed solutions are infeasible, given the magnitude of these proposed solutions and associated increased cost and infrastructure requirements. For the evaluation, a beneficial supply of 150,000 AFY was utilized, which is roughly equivalent to supplying 20 percent of the total volume of the Salton Sea as inflow over the next 10 years.

2.6.2 Water Quality

The salinity of water in the Pacific Ocean is approximately 35,000 ppm. Similar to the alternative to receive water from the Gulf of Mexico, water from the Pacific Ocean would continue the delivery of large quantities of salt. Thus, a large amount of water would be necessary to offset loss of inflow water and have an impact on overall salinity of the Salton Sea.

2.6.3 Conveyance System and Hydraulics

The conveyance of 150,000 AFY of water from the Pacific Ocean to the Salton Sea would require up to 110 miles of 86-inch diameter pipeline based on a flow velocity of 5 fps. The highest elevated point along the pipeline alignment from the Pacific Ocean to the Salton Sea would occur in the Laguna Mountains. Based upon a preliminary pipeline alignment it is anticipated that the pipeline would reach an elevation of 4,000 feet above sea level, east of San Diego. Including friction loss in the pipeline, and assuming pump stations capable of discharge head of 500 feet, it would take seven pump stations to deliver water from the Pacific Ocean.

This alternative involves the conveyance of seawater, which requires additional design considerations that must be made for all aspects of the conveyance system that may come in contact with the seawater.

Figure 18 depicts a conceptual conveyance system for delivering water from the Pacific Ocean to the Salton Sea.

2.6.4 Consideration of Capital and Operational Cost

The estimated capital costs associated with this alternative are very similar in magnitude to the costs associated with constructing a conveyance system from the Gulf of California to the Salton Sea. The operational costs, on the other hand, are estimated to be more than four times greater than the operational costs to convey water from the Gulf of California. Both of these options exceed the cost estimates for all of the other alternatives in terms of annual operational costs, and conveying water from the Pacific Ocean is exorbitantly costly due to the combination of distance and lift required.

2.6.5 Institutional Considerations

There are numerous institutional and approval considerations associated with receiving water from the Pacific Ocean. The most significant anticipated considerations are easement and land acquisition to construct the pipeline across San Diego and Imperial County land and approval for construction of the inlet at the ocean. Far greater impacts to existing residential communities would have to occur in order to deliver water from the Pacific Ocean, as opposed to the Gulf of California.

2.6.6 Screening Level Performance Analysis

The Modified SSAM was run for an inflow pipeline from the Pacific Ocean, assuming an import capacity of 150,000 AFY. The model was run for two future inflow scenarios. The baseline case assumes a future inflow of approximately 865,000 AFY by 2077, long after QSA mitigation flows end in 2017. The uncertainty case assumes a future inflow of about 689,000 AFY. The Modified SSAM and the future inflow assumptions are discussed in section 1.3 and in Salton Sea Funding and Feasibility Action Plan, Benchmark 2: Review and Update Existing Condition Data.

The results of the model run for the baseline future inflow case of 865,000 AFY are shown in Figure 19, and the results of the model run for the uncertainty future inflow case of 689,000 AFY are shown in Figure 20. These results can be compared to the No Action scenarios illustrated in Figure 1 and Figure 2. For this screening level evaluation it was assumed that operation of a pipeline from the Pacific Ocean to the Salton Sea would begin in the year 2025. It was estimated that, from a decision point in 2017, it would take about eight years to complete the environmental documentation, the design and permitting, right-of-way clearance and land acquisition, and thus result in a 2025 start up.

For the baseline inflow case, the results shown in Figure 19 indicate that a pipeline from the Pacific Ocean transporting 150,000 AFY to the Sea would raise the lake level by about 8 to 10 feet compared to No Action. The salinity would still rise, and a supply of saline rich ocean water would partially mitigate but not resolve the problem of increasing salt accumulations.

Key results of the baseline inflow model run are as follows:

- The average depth of water throughout the Sea is predicted to be about -244.9' NGVD in 2030 and -238.6' NGVD in 2100. This indicates that the average depth of water throughout the Sea will eventually stabilize just below the current level. In 2100 the average depth will be about 25 feet, and the maximum depth will be around 36 or 37 feet.
- Salinity would continuously rise with this alternative, but rising salinity would be slowed when compared to a No Action alternative.
- The lake area would be about 330 to 350 sq mi in the year 2100.
- The volume of water in the lake in the year 2050 is projected to be 4.21 MAF or about 55.4% of the lake volume as it was in 2000.

Inflow Conveyance

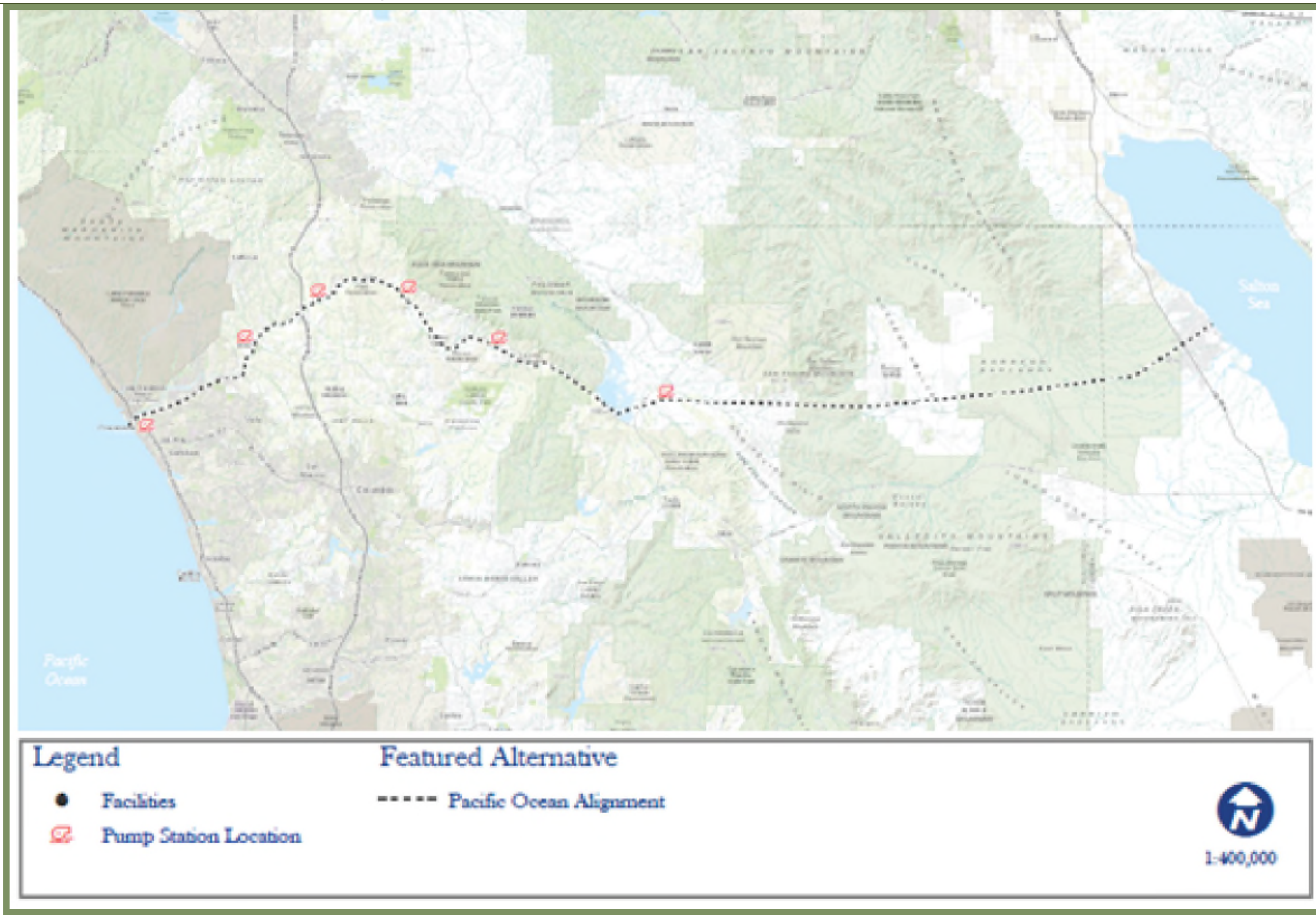

Figure 18 Pacific Ocean Pipeline for Inflow

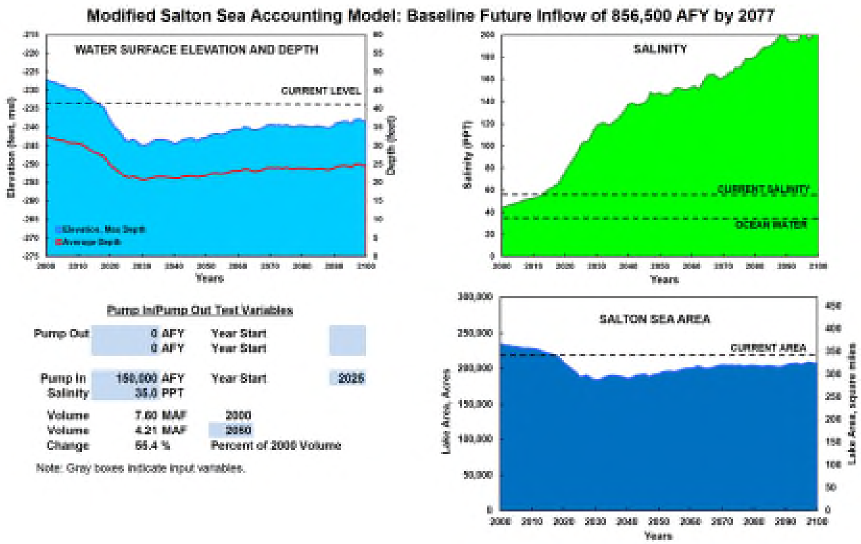

Figure 19 Pacific Ocean Baseline Future Inflow

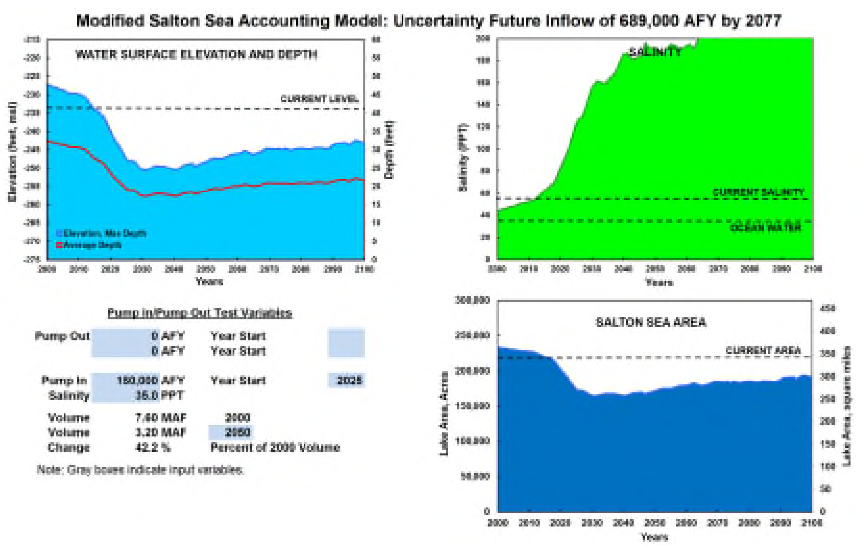

Figure 20 Pacific Ocean Uncertainty Inflow

2.6.7 Summary

Water supply from the Pacific Ocean has historically been viewed as an attractive and viable option based primarily on the quantity of water available. However, the institutional issues with this alternative far outweigh the benefits of the available water quality. The high salinity of the seawater source requires a larger flow rate to be transferred to the Salton Sea, and the large hydraulic lift requires a conveyance system of immense magnitude. Coupled with these challenges are others associated with the approvals, easements, and land acquisition requirements for crossing through densely populated areas near the Pacific Ocean. In the end, it is considered that the approvals and cost of the system would be too high, as importing seawater is only beneficial in very large volumes to offset salinity increase. Given that the challenges and concerns far outweigh the benefits of importing sea water from the Pacific Ocean to the Salton Sea, other more feasible alternatives should be considered.

2.7 Excess Colorado River Water

Historically, Colorado River flows vary with higher flows coinciding with wet years. As a result, a concept previously considered has been to collect flood flows in excess of normal conditions which overtop the banks of the Colorado River. To accomplish this, facilities for water capture, storage and conveyance would be required. As discussed in the following sections, there are both water quantity and institutional issues that prevent this alternative from being viable.

2.7.1 Water Quantity

The quantity of water available under this alternative is unpredictable and cannot be predetermined. In addition, the flows that historically have occurred have been reduced due to weather conditions and additional diversion and storage facilities along the Colorado River.

2.7.2 Water Quality

With this alternative water would be received from the Colorado River which has a typical average salinity of about 630 mg/L. The salinity historically decreases during high water flows, and from 1983 to 1986, the salinity level was as low as 525 mg/L. During periods of drought, such as 1987 to 1992, higher salinity levels between 600 to 650 mg/L were observed.

2.7.3 Conveyance System and Hydraulics

With this alternative, the water would be transferred a distance of 50 miles to the Salton Sea from a location just west of the Colorado River.

2.7.4 Institutional Considerations

A restriction of use of Colorado River Water as water supply to the Salton Sea has been established. The Salton Sea Reclamation Act of 1998 prohibits the inclusion of any option that relies on the importation of any new or additional water from the Colorado River. The Act also preserves all current rights and obligations concerning Colorado River use.

2.7.5 Screening Level Performance Analysis

The quantities for this alternative are uncertain, and it is not feasible to do a screening level evaluation at this point.

2.7.6 Summary

This alternative is not viable. No excess Colorado River Water has been available for many years, and regulations prohibiting the use of Colorado

River Water from use to supplement the Salton Sea have been established by means of the Salton Sea Reclamation Act of 1998.

2.8 Coastal Wastewater Treatment Plants

Wastewater treatment plants have previously been identified as potential water supply sources for the Salton Sea. A review of large wastewater treatment plants was done to locate plants capable of delivering high volumes of water to benefit the Salton Sea. Two primary wastewater treatment plants considered include the Point Loma Wastewater Treatment Plant located along the coast in San Diego, and the Hyperion Wastewater Treatment Plant located along the coast within the City of El Segundo and Los Angeles County.

This alternative considers conveying large volumes of wastewater effluent from the Point Loma and Hyperion Wastewater Treatment Plants. The water quantity, conveyance hydraulics and institutional considerations are evaluated.

2.8.1 Water Quantity

Large quantities of treated effluent are produced by wastewater treatment plants in Southern California. The production fluctuates annually, but large baseline treatment flows remain due to the large populations that exist in the Los Angeles and San Diego areas. This steady production in combination with high flow rates has led to consideration of treated effluent as a potential water source for the Salton Sea.

The Hyperion Treatment Plant is one of the largest wastewater treatment plants in the United States. As of 2010, it was treating just above 300 MGD and producing 275 MGD of secondary effluent. Approximately 35 MGD is recycled at the West Basin Recycling Facility and used for industrial and cooling water. In addition, nearly 5 to 6 percent of the effluent is used as dilution water or cooling water for the treatment processes at Hyperion. The remainder of the flow is delivered to an ocean outfall.

The Point Loma Wastewater Treatment Plant treats approximately 175 MGD of wastewater and directs nearly all of the effluent to its ocean outfall. The large flow rates are directly attributed to the high population densities in the greater Los Angeles and San Diego areas. The wastewater treatment plants closer to the Salton Sea produce significantly lower quantities of effluent due to lower population densities in the surrounding areas.

2.8.2 Water Quality

Water quality of effluent from wastewater treatment plants varies based on the source water quality, urban water management practices, and the associated treatment processes at the individual plants. Wastewater treatment plants are subject to waste discharge requirements, and generally, treated effluent from these plants is much lower in salinity than the brackish water and ocean water alternatives under consideration.

2.8.3 Conveyance System and Hydraulics

Conveyance of any significant quantity of water from either Point Loma or Hyperion would require over 100 miles of large diameter pipeline. A pipeline alignment transferring treated effluent from Point Loma would have the highest elevated point in the Laguna Mountains located east of San Diego. A pipeline alignment from Hyperion to the Salton Sea would likely traverse from Moreno Valley to Beaumont with a high point elevation of approximately 2,200 feet. Pumping systems of this magnitude would require numerous pump stations to account for the pumping lift and frictional head loss.

Figure 21 depicts a conceptual conveyance system for delivering water from the Point Loma WWTP to the Salton Sea.

2.8.4 Consideration of Capital and Operational Cost

The estimated capital and operational costs are very inhibitive to this option. The capital costs are several orders of magnitude greater than the other proposed alternatives, and the estimated operational costs are similar in magnitude to the Pacific Ocean option.

2.8.5 Institutional Considerations

Importing treated effluent from large wastewater treatment plants such as Hyperion and Point Loma is infeasible due to the pumping requirements associated with such geographically distant sources of water. Additionally, the local agencies have first rights to these water sources, which are increasingly being utilized to a greater extent at the local level in response to local water reliability and reuse efforts.

2.8.6 Screening Level Performance Analysis

The quantities for this alternative are uncertain, and it is not feasible to do a screening level evaluation at this point.

2.8.7 Summary

Treated effluent from wastewater treatment plants is a very viable option for augmenting inflows into the Salton Sea. Effluent from distant wastewater treatment plants, such as Hyperion and Point Loma, is not an optimal alternative; however, given the long distance and pumping requirements associated with these options. Additionally, obtaining approvals for the alignments, which include crossing through several highly populated and established regions, would be an arduous process.

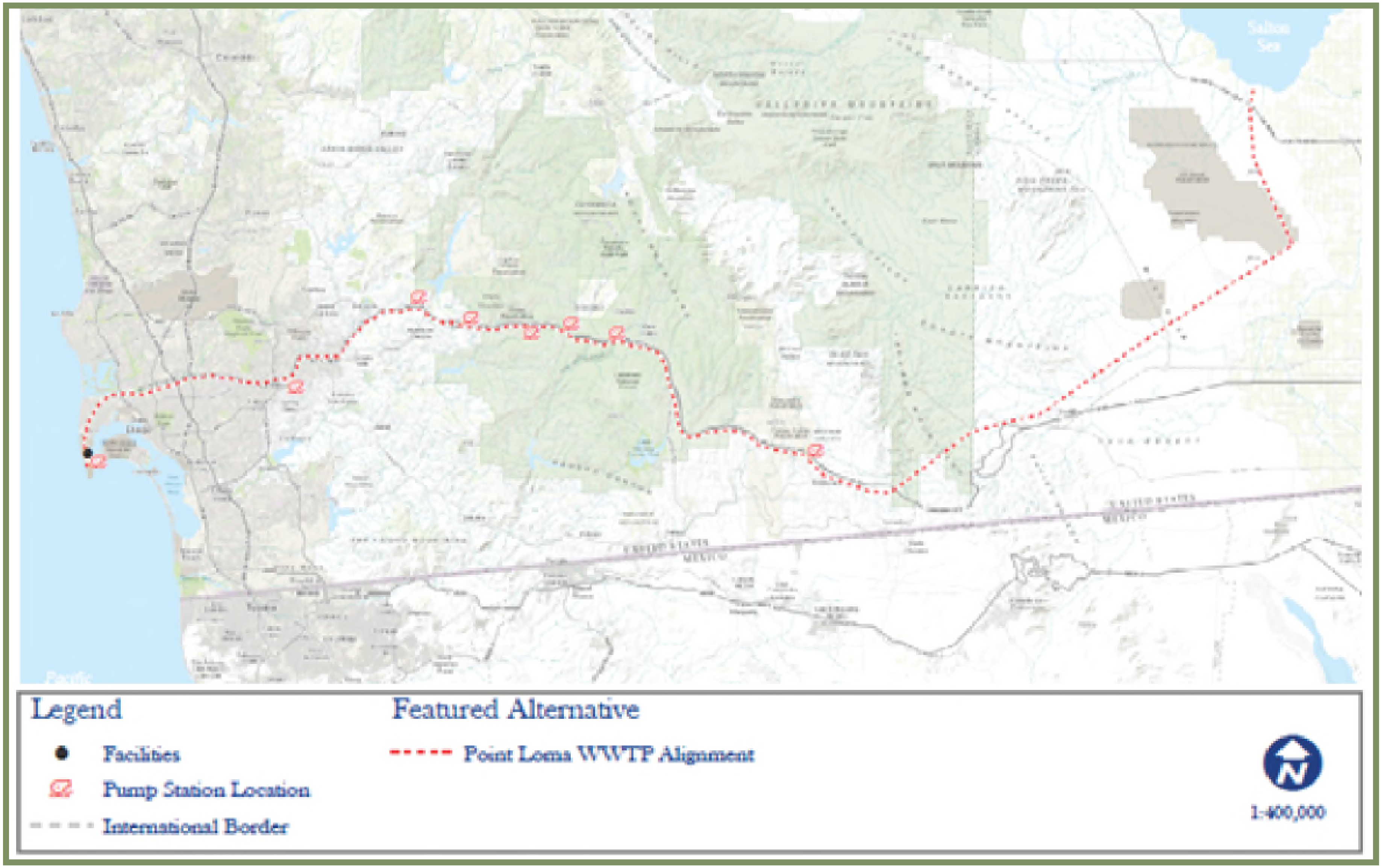

Figure 21 Point Loma WWTP Inflow Source

2.9 Local Wastewater Treatment Plants

The largest quantities of treated effluent in Southern California exist nearest the Pacific Ocean, based on topography and the need for an ocean outfall. However, as addressed in the previous section, such facilities are nearly 100 miles from the Salton Sea. Closer effluent sources exist with lower flow rates, and include a combination of plants that discharge to the Coachella Valley Stormwater Channel and plants that produce Title 22 recycled water that is used for irrigation (primarily golf course irrigation) purposes throughout Palm Desert and its surrounding area. The plants that discharge to Coachella Valley Stormwater Channel are the most practical sources of increased flow to the Salton Sea. Currently, effluent from three local wastewater treatment plants discharged to the Coachella Valley Stormwater Channel (historically referred to as the Whitewater Channel), which drain to the Salton Sea.

This alternative considers construction of facilities to more efficiently convey treated wastewater to the Salton Sea. The Coachella Valley Stormwater Channel is an unlined earthen channel that is located to the north of the Salton Sea. The majority of the flow in the Coachella Valley Stormwater Channel consists of effluent from the City of Coachella, Coachella Valley Water District (CVWD), and Valley Sanitary District. The delivery of water more directly from the plants could be achieved by constructing a pipeline parallel to the channel or by lining a portion of the channel to convey low flows, and reduce losses to infiltration.

2.9.1 Water Quantity

Valley Sanitary District discharges treated effluent from its wastewater treatment plant into the Coachella Valley Stormwater Channel. The channel runs approximately 17 miles between the treatment plant located in the City of Indio and the Salton Sea. The current average flow at the plant is 6.5 MGD with a capacity of 7.5 MGD. Estimated future flow is 16 MGD. In 2000, a wetlands system was constructed adjacent to the channel, and it provides Valley Sanitary District with 1 MGD of wastewater treatment capacity. The constructed wetlands also serve as a habitat for the Coachella Valley Wild Bird Center.

The City of Coachella operates a wastewater treatment plant at the intersection of 54th Street and Polk Street, which also discharges in the Coachella Valley Stormwater Channel. This plant currently has a treatment capacity of 4.5 MGD, and the current average flow is 2.8 MGD.

CVWD operates six facilities in total, and presently, one facility, WRP-4, currently discharges into the Coachella Valley Stormwater Channel. This facility has a capacity of 9.9 MGD with an average flow of 4.75 MGD. CVWD operates a recycled water program using effluent from its other treatment facilities.

Therefore, the total flow from the three plants to the Coachella Valley Stormwater Channel on average is 14 million gallons per day (or 15,700 AFY). While this quantity is not greater than 50,000 AFY, which was identified as the low end of the beneficial supply quantity to the Salton Sea to warrant further detailed analysis at this time, the flow could be advantageous as part of a combination of projects to reach an increased inflow of 50,000 AFY, or it could serve to support wetlands or habitat projects at or along the perimeter of the Salton Sea. In addition, it is estimated that future flows for the three plants will increase, with an ultimate flow rate projection of up to 81 MGD.

2.9.2 Water Quality

The salt loads contributed to the Salton Sea from the wastewater treatment plants are primarily dependent on the source water salinity and urban water management practices. Surface water discharge through the Coachella Valley Stormwater Channel is subject to a limit of 2,500 mg/L of total dissolved solids, and the annual average is 2,000 mg/L. This is based on the limits set forth in the Water Quality Control Plan for the Colorado River Basin – Region 7. These values are significantly lower than the existing salinity in the Salton Sea.

2.9.3 Conveyance System and Hydraulics

The Salton Sea currently receives a combination of stormwater runoff and wastewater treatment plant effluent through the Coachella Valley Stormwater Channel. The City of Coachella, Valley Sanitary District, and CVWD WRP-4 facilities currently discharge into the Coachella Valley Stormwater Channel. The Valley Sanitary District plant is located the furthest from the Salton Sea, at approximately 18 miles. Conveyance of water directly from the plants to the Salton Sea would require installation of liner for the channel or construction of a pipeline to collect and deliver flows. Therefore, 18 miles of pipeline ranging from 16-inch to 29-inch in diameter would be required for the pipeline option.

2.9.4 Consideration of Capital and Operational Cost

The capital and operational costs for this option are the lowest per acre foot, and the overall operational costs are similar in magnitude to the overall operational costs for the MWD and YDP concentrate pipeline options.

2.9.5 Institutional Considerations

Presently, the effluent from local wastewater treatment plants is either being recycled locally or discharged into the Coachella Valley Stormwater Channel, and ultimately, the Salton Sea. Due to the current drought situation and the push for increased local water reliability, water recycling efforts have been on the rise. Both Valley Sanitary District and the City of Coachella are exploring options for implementing recycled water programs, which would divert some of the flow into the Coachella Valley Stormwater Channel; however, these programs would not be in place for quite some time and flow projections show a significant increase in the future.

This option would increase the flow rate of conveyance to the Salton Sea, or convey flows through a pipeline that would bypass the existing channel. Therefore, the environmental impacts of increasing flow velocity, or reducing low flow in the channel would have to be studied further.

2.9.6 Conceptual Plans

Conceptual plans prepared for the pipeline to Local WWTPs alternative can be found in Appendix 11.3. These plans were used to form the basic concept for the pipeline route and its key components. Conceptual level cost estimates were then developed from the layouts presented in these plans. Appendix 11.3 contains the following conceptual drawings:

- Hydraulic profile;
- A pump station mechanical plan and section; and
- Outlet structure.

2.9.7 Cost Evaluation

An evaluation of project costs was conducted including the following components: mobilization and demobilization, intake systems and facilities, intake pump station, intake pumps, intake pump station mechanical piping, intake pump station auxiliary items, conveyance pipe, pressure reducing station, buildings and/or vaults, outlet system facilities, onshore additional structures, and electrical/instrumentation. The pipe flow capacity for this alternative was estimate at Q = 43,000 AFY (60.16 cfs). The cost provided in Table 3 provides a preliminary conceptual estimate based on the best currently available data and is subject to change.

Table 3 Cost Estimate for Local WWTPs

Description	Quantity	Unit	Unit Price	Total
1 Mobilization/Demobilization	1	LS	$953,000	$953,000
2 Intake System/Facility	1	LS	$157,000	$157,000
3 Intake Pump Station	1	LS	$3,029,000	$3,029,000
4 Intake Pumps	1	LS	$1,214,000	$1,214,000
5 Intake Pump Station Mechanical Piping	1	LS	$108,000	$108,000
6 Intake Pump Station Auxilary Items	1	LS	$354,000	$354,000
7 Conveyance Pipe	1	LS	$12,174,000	$12,174,000
8 Outlet System/Facility, onshore	1	LS	$83,000	$83,000
9 Additional Structures	1	LS	$729,000	$729,000
10 Electrical / Instrumentation	1	LS	$1,216,000	$1,216,000
Design, Project and Construction Management (25% Items 2 to 10)				$4,766,000
			Subtotal	$24,783,000
			Contingency (30%)	$7,435,000
			Total	$32,218,000

2.9.8 Screening Level Performance Analysis

The Modified SSAM was run for potential inflow received from local WWTPs, assuming an import capacity of 15,700 AFY. The model was run for two future inflow scenarios. The baseline case assumes a future inflow of approximately 865,000 AFY by 2077, long after QSA mitigation flows end in 2017. The uncertainty case assumes a future inflow of about 689,000 AFY. The Modified SSAM and the future inflow assumptions are discussed in section 1.3 and in Salton Sea Funding and Feasibility Action Plan, Benchmark 2: Review and Update Existing Condition Data.

The results of the model run for the baseline future inflow case of 865,000 AFY are shown in Figure 22, and the results of the model run for the uncertainty future inflow case of 689,000 AFY are shown in Figure 23. These results can be compared to the No Action scenarios illustrated in Figure 1 and Figure 2. For this screening level evaluation it was assumed that the conveyance of local WWTP water to the Salton Sea would begin in the year 2025. It was estimated that, from a decision point in 2017, it would take about eight years to complete the environmental documentation, the design and permitting, right-of-way clearance and land acquisition, and thus result in a 2025 start up.

For the baseline inflow case, the results shown in Figure 22 indicate that local WWTP inflow would raise the lake level by about 1/2 foot compared to the No Action alternative. Although the treated effluent received in this alternative would not supply the 50,000 AFY, which was set as a minimum for more detailed analysis, the rate of rise in salinity would be slowed compared to No Action due to the additional water that would be supplied.

Key results of the baseline inflow model run are as follows:

- The water surface would remain relatively stable at around the year 2030 with a predicted mean elevation of about -247’ to -248’ NGVD for at least 50 years. This elevation would result in an average water depth of about 20 feet and a maximum depth of around 26 to 28 feet.
- Salinity would continuously rise with this alternative, but rising salinity would be slowed when compared to a No Action alternative.
- The lake area would stabilize at around 265 to 280 sq mi after the year 2030.
- The volume of water in the lake in the year 2050 is projected to be 3.16 MAF or about 41.6% of the lake volume as it was in 2000.

For the uncertainty inflow case, the results shown in Figure 23 indicate that the treated effluent from local WWTPs would still raise the lake level by about

1/2 foot compared to the No Action alternative, and the rate of rise in salinity would be slowed somewhat compared to No Action due to the additional water supplied. The trends are similar to the previous scenario, but the rising salinity is more drastic due to the reduction of inflows inherent to this scenario. Additionally, the lake volume would be reduced to an even smaller size than for the baseline inflow case, with the volume dropping to approximately 29.6% of the year 2000 volume.

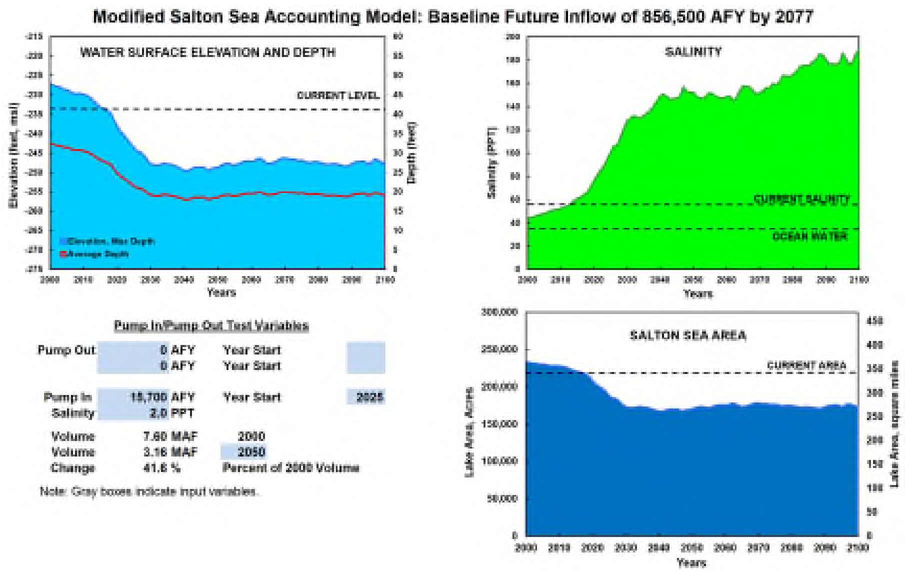

Figure 22 Local WWTP Baseline Future Inflow

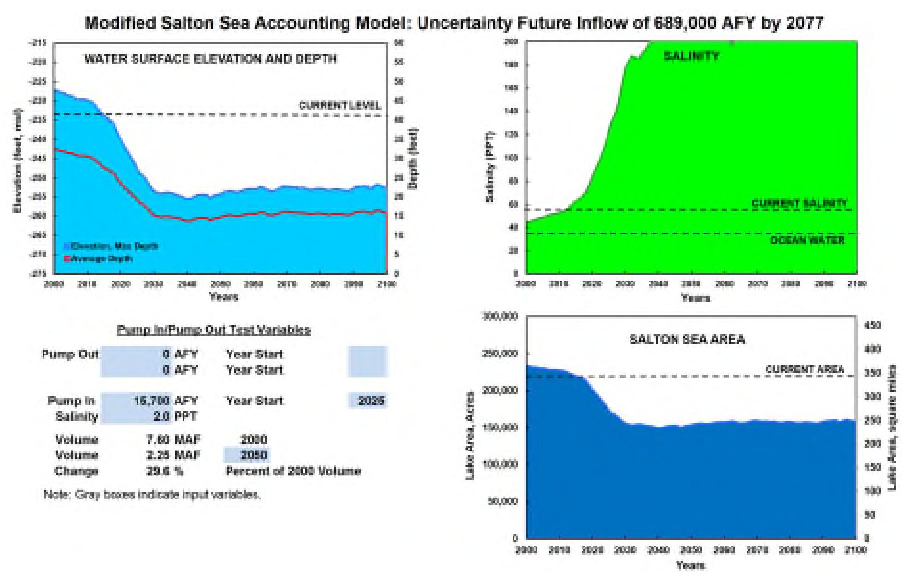

Figure 23 Local WWTP Uncertainty Future Inflow

2.9.9 Summary

Treated effluent from local wastewater treatment plants serves as an existing inflow source to the Salton Sea. The City of Coachella, CVWD, and Valley Sanitary District currently discharge about 14 MGD into the Coachella Valley Stormwater Channel. The current flow capacity of the three plants that discharge into the channel is almost 22 MGD, and estimated future flow is projected to be as high as 81 MGD. Therefore, the alternative is viable and would provide infrastructure planned to convey high flows as the local wastewater treatment plants expand in capacity.

2.10 Coachella Valley Stormwater Channel Lining

As mentioned in the previous section, the Coachella Valley Stormwater Channel is an unlined earthen channel that extends the Whitewater River and feeds into the Salton Sea. Over 40 percent of the inflows to the Salton Sea from the Coachella Valley are discharged through the Coachella Valley Stormwater Channel, and the flows generally consist of agricultural drainage, stormwater runoff, municipal and fish farm discharges.

Lining the earthen channel would reduce water loss via infiltration and provide a long term benefit to the channel and habitat nearby while increasing the quantity of inflows directly to the Salton Sea. Options include lining the bottom of the channel to increase direct inflows to the Salton Sea during low flow conditions to a complete lining of the bottom and sidewalls of the channel.

2.10.1 Water Quantity

The Coachella Valley Stormwater Channel was designed for conveying flows up to 80,000 cubic feet per second. Historically, approximately 40 percent of the total annual volume of discharge from the Coachella Valley into the Salton Sea flows through the Coachella Valley Stormwater Channel. In recent years, the channel has conveyed an estimated annual surface flow of 90,000 AFY. Historical flows were estimated to be 113,827 AFY with an annual minimum of 53,368 AFY in 1957 and an annual maximum of 174,684 AFY in 1976.

2.10.2 Water Quality

Salt loads to the Salton Sea from agricultural and municipal return flows are highly dependent on the agricultural and urban water management practices, in addition to the source water salinity. Historically, the average annual net salt load from the Coachella Valley to the Salton Sea was estimated at 262,434 tons per year, and recently, estimates are less than half of this value. As mentioned previously, the Coachella Valley Stormwater Channel has a surface water discharge limit of 2,500 mg/L of total dissolved solids with an annual average limit of 2,000 mg/L.

In 2010, a Basin Plan Amendment to the Water Quality Control Plan for the Colorado River Basin Region was made to revise indicator bacteria criteria to address concerns related to periodic instances of increased bacteria levels. The amendment states that persistent violations of the total maximum daily loads would require implementation of additional actions to control anthropogenic sources of bacteria.

Inflows to the Salton Sea are much lower in salinity than the Salton Sea, and water quality is currently not of a concern, as there is no additional treatment required prior to discharge into the Salton Sea at present.

2.10.3 Conveyance System and Hydraulics

The Coachella Valley Stormwater Channel currently drains into the Salton Sea. The channel is the principal drainage channel for the lower Coachella Valley, and primarily provides for safe passage of storm flows and drainage of agricultural and municipal return flows. This option would not require construction of a new conveyance system.

2.10.4 Consideration of Capital and Operational Cost

The main costs associated with this option are the capital costs for installing the liner, and there are no notable operational costs associated.

2.10.5 Institutional Considerations

Lining the Coachella Valley Stormwater Channel would improve conveyance of flows that discharge into the Salton Sea. Modifications to the Coachella Valley Stormwater Channel would improve its capacity to address flooding during storm events, thereby benefiting nearby residents and properties while conveying more water to the Salton Sea. There may be an initial adverse effects on existing wetlands and habitats associated with channel lining.

2.10.6 Screening Level Performance Analysis

The quantities for this alternative are uncertain, and it is not feasible to do a screening level evaluation at this point.

2.10.7 Summary

In order for this alternative to be most beneficial to the Salton Sea, the lining of the channel must reach the locations of regular discharge. Otherwise, the lining would be of benefit for nearby residents and properties during storm events, but not result in increased year-around flows to the Salton Sea. This option may be a cost-effective interim solution for increasing the flows to the Salton Sea. Lining the Coachella Valley Stormwater Channel would allow more flows to enter the Salton Sea directly as opposed to seeping through the dirt channel into the brackish groundwater basin. As flow quantities increase, based on available flow projection information, the lining would ensure greater flow transfer efficiency from the channel to the Salton Sea.

3.0 Conveyance of Water from the Sea

The lack of an outlet at Salton Sea contributes to increasing salinity. Therefore, a review of possible destinations for the conveyance of water from the Salton Sea is useful to restoration efforts. This review covers five possible approaches to removing saline water from the Salton Sea: using the Laguna Salada basin as an outlet, using the La Cienega De Santa Clara basin as an outlet, using the Gulf of California as an outlet, using the Palen Dry Lake as an outlet, and using man-made methods of removing water for evaporation. When applicable, this analysis considered four factors concerning the five methods reviewed: water quantity removed, the conveyance system and hydraulics necessary for removal, consideration of capital and operational cost, and institutional considerations. An applicable screening level performance analysis using the Modified SSAM was also conducted for each alternative. Note that dividing the Sea into two or more basins provides another means for exporting saline water from one basin to another. Divided Sea concepts are discussed later in this report.

One of the largest challenges facing the Salton Sea is the lack of an outlet, as the salt content transferred to the sea concentrates over time due to evaporation. This salt content has historically been transferred with irrigation drainage and other flows. To reduce or maintain salinity at the Salton Sea requires removal of salt content to a disposal location, or evaporation in the nearby area to the sea. This is even more critical assuming that inflows to the Salton Sea will be reduced starting in 2018.

At 7.5 million AF it has been determined that an extremely large area would be required to evaporate sufficient amounts of water to reduce salinity. It would be more advantageous to separate the salt from the water using a treatment process, in order to prevent water loss. However, treatment which will be covered in Section 4.0 is also an expensive solution.

A review of previously considered disposal sites and uses of Salton Sea water was completed. This included alternatives reflected in reports and received as proposals by the Authority and Reclamation. The water discharge locations evaluated include the following:

- Laguna Salada
- La Cienega de Santa Clara (Santa Clara Slough, Wetland)

- Gulf of California
- Local Water Use and Evaporative Systems

Figure 24 shows the water conveyance alternatives from the Salton Sea.

3.1 Laguna Salada

The Laguna Salada basin lies to the west of the Sierra de los Cucapah and Sierra de Mayor Mountains. Formed by the Laguna Salada fault on the east side and the Sierra Juarez fault on the west side, the Laguna Salada is approximately 10 meters (32.8 feet) below MSL. Part of the Colorado River Delta, the Laguna Salada area receives water from the discharge drains at the Hardy River, Plan de Ayala, and the south Collector.

At its nearest point the Laguna Salada is approximately 40 miles from the Salton Sea. It is a large, remote area away from any major cities or developments. Water from the Salton Sea would have to be pumped up to an elevation of approximately 300 feet above MSL near the vicinity of Signal Mountain in order to be delivered by gravity to the northern part of Laguna Salada. The Laguna Salada Basin area already has existing roads, flood control channels, and commercial power in place, which could be used to convey water from the Salton Sea. There are several other flow path options that can be explored, as well. Possible routes would be westward of El Centro and Mexicali, traveling south from the Salton Sea to the Laguna Salada.

3.1.1 Water Quantity

The Laguna Salada is approximately 13 miles wide at its widest point and about 30 miles long. Discharge drains from the Hardy River, the drain Plan de Ayala, and the south Collector drain currently flow into the Laguna Salada Basin. Export flows from the Salton Sea would serve to augment any current flows, and the quantity of water would depend largely on the quantity of water imported into the Salton Sea to preserve the water level and the environmental impact of the flow from the Salton Sea on the existing Laguna Salada ecosystem. Additional considerations include pumping capabilities and costs, elevation gains, and distance. Studies and evaluations must be made to determine a feasible range in quantity of water to be exported from the Salton Sea.

3.1.2 Conveyance System and Hydraulics

To deliver 150,000 AFY to the Laguna Salada would require construction of approximately 60 miles of 86-inch diameter pipeline and two pump stations would be required to convey water from the Salton Sea and over the high point located near Signal Mountain. The discharge head of the pump stations would be 400 feet. Accounting for surge, the pipeline system would need to be designed for an internal pressure of 250 psi.

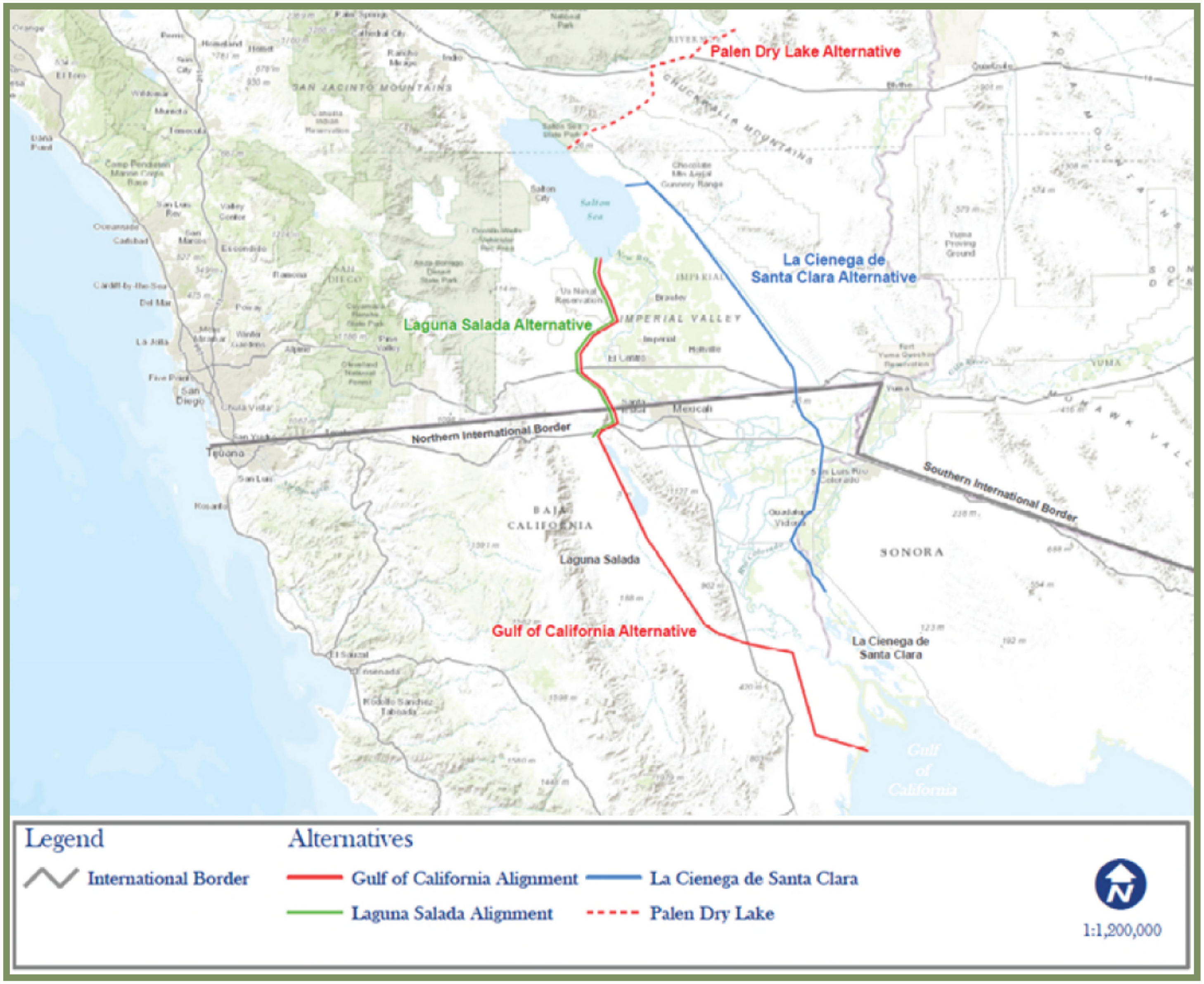

Figure 24 Overview of Alternatives - Outflow from Salton Sea

Figure 25 depicts a conceptual conveyance system for delivering water to Laguna Salada

3.1.3 Consideration of Capital and Operational Cost

The capital costs associated with the alternative to export water from the Salton Sea to Laguna Salada are relatively low in comparison to some of the other proposed alternatives. These estimated capital costs do not include any costs for treatment or blending, which may be required. The operating costs associated with pumping water from the Salton Sea to Laguna Salada are also low in comparison to many of the other proposed alternatives.

3.1.4 Institutional Considerations

The Laguna Salada varies in depth from 20 centimeters to 4 meters, and the inundated area depends on available flows. Historical flow rates to the Laguna Salada have ranged from 6 cubic meters per second to 60 cubic meters per second. Any increase in flow to the Laguna Salada would increase the inundated area, and careful considerations regarding salinity and water quality of the inflow must be made to minimize any environmental impacts. Because this option requires transfer of water between the United States and Mexico, both countries would need to come into agreement over this option and the potential impacts of exporting flow from the Salton Sea to the Laguna Salada.

Environmental considerations may be significant, as the Laguna Salada is home to threatened and endangered species such as the Desert Pupfish, and current habitat restoration options call for increases in freshwater flow, not water that is high in salinity, such as that of the Salton Sea. Treatment or blending requirements would most likely be deemed necessary prior to discharge of water from the Salton Sea into the Laguna Salada, and this would drive up the costs of this alternative substantially. Additionally, typical flows into the Laguna Salada evaporate and never reach the Gulf of California, and importation of significant flow quantities from the Salton Sea may drastically alter the Laguna Salada ecosystem should the flows be significant enough to promote the transfer of flows from the Laguna Salada to the Gulf of California.

3.1.5 Conceptual Plans

Conceptual plans prepared for the Laguna Salada Pipeline alternative can be found in Appendix 11.4. These plans were used to form the basic concept for the pipeline route and its key components. Conceptual level cost estimates were then developed from the layouts presented in these plans. Appendix 11.4 contains the following conceptual drawings:

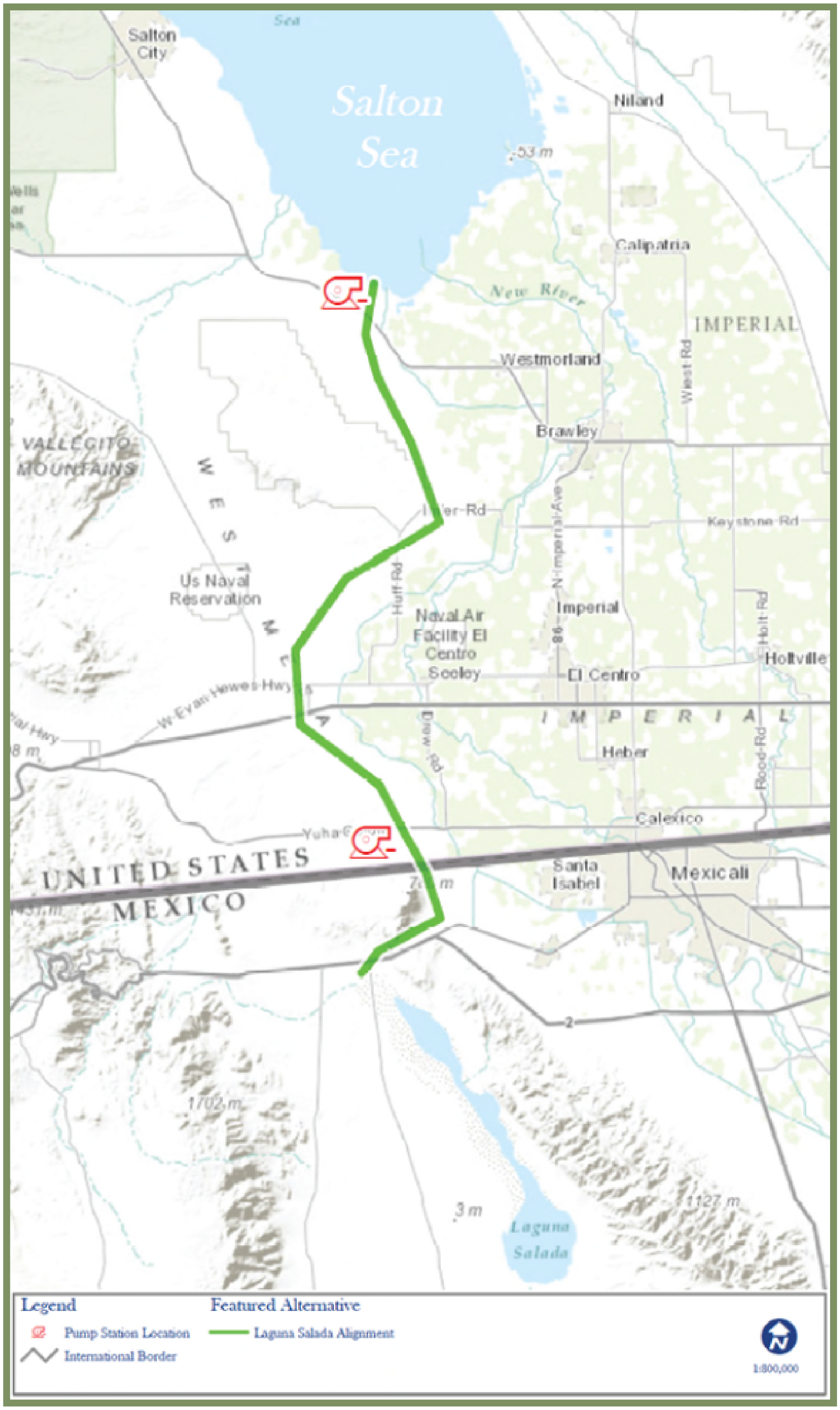

Figure 25 Salton Sea to Laguna Salada

- Hydraulic profile;
- A pump station mechanical plan and section; and
- Intake structure.

3.1.6 Cost Evaluation

An evaluation of project costs was conducted including the following components: mobilization and demobilization, intake systems and facilities, intake pump station, intake pumps, intake pump station mechanical piping, intake pump station auxiliary items, conveyance pipe, pressure reducing station, buildings and/or vaults, outlet system facilities, onshore additional structures, and electrical/instrumentation. The pipe flow capacity for this alternative was estimate at Q = 43,000 AFY (60.16 cfs). The cost provided in Table 4 is a preliminary conceptual estimate based on the best currently available data and is subject to change.

Table 4 Cost Estimate for using the Laguna Salada as an outlet

Description		Quantity	Unit	Unit Price	Total
1	Mobilization/Demobilization	1	LS	$15,582,000	$15,582,000
2	Intake Structure and Pipeline	1	LS	$9,931,000	$9,931,000
3	Intake Pump Station	1	LS	$4,825,000	$4,825,000
4	Intake Pumps	1	LS	$12,237,000	$12,237,000
5	Intake Pump Station Mechanical Piping	1	LS	$314,000	$314,000
6	Intake Pump Station Auxiliary Items	1	LS	$1,857,000	$1,857,000
7	Conveyance Pipe	1	LS	$245,959,000	$245,959,000
8	Booster Pump Station	1	LS	$4,700,000	$4,700,000
9	Booster Pumps	1	LS	$10,674,000	$10,674,000
10	Booster Pump Station Mechanical Piping	1	LS	$314,000	$314,000
11	Booster Pump Station Auxilary Items	1	LS	$1,857,000	$1,857,000
12	Pressure Reducing Station, Building or Vault	1	LS	$100,000	$100,000
13	Outlet System/Facility	1	LS	$149,000	$149,000
14	Additional Structures	1	LS	$7,029,000	$7,029,000
15	Electrical / Instrumentation	1	LS	$11,702,000	$11,702,000
	Design, Project and Construction Management (25% Items 2 to 15)				$77,912,000
				Subtotal	$405,142,000
				Contingency (30%)	$121,543,000
				Total	$526,685,000

3.1.7 Screening Level Performance Analysis

The Modified SSAM was run for an outflow pipeline to the Laguna Salada, assuming an export capacity of 150,000 AFY. The model was run for two future inflow scenarios. The baseline case assumes a future inflow of approximately 865,000 AFY by 2077, long after QSA mitigation flows end in 2017. The uncertainty case assumes a future inflow of about 689,000 AFY. The Modified SSAM and the future inflow assumptions are discussed in section 1.3 and in Salton Sea Funding and Feasibility Action Plan, Benchmark 2: Review and Update Existing Condition Data.

The results of the model run for the baseline future inflow case of 865,000 AFY are shown in Figure 26, and the results of the model run for the uncertainty future inflow case of 689,000 AFY are shown in Figure 27. These results can be compared to the No Action scenarios illustrated in Figure 1 and Figure 2. For this screening level evaluation it was assumed that operation of a pipeline to the Laguna Salada from the Salton Sea would begin in the year 2025. It was estimated that, from a decision point in 2017, it would take about eight years to complete the environmental documentation, the design and permitting, right-of-way clearance and land acquisition, and thus result in a 2025 start up.

For the baseline inflow case, the results shown in Figure 26 indicate that the salinity would eventually return to ocean-like salinity of about 35 ppt, but that would not occur until about the year 2070. After an initial pump out period, the export flow volume could be reduced as shown in this analysis. For the scenario shown here, the pump out is reduced from 150,000 AFY to 100,000 AFY in the year 2045.

Key results of the baseline inflow model run are as follows:

- The water surface would begin to stabilize around the year 2050 at an elevation of about -260' NGVD which would result in an average water depth of about 10 feet and a maximum depth of about 15 feet.
- Salinity would peak at about 130 ppt around year 2030 and take about 30 to 40 years to return to ocean like salinity of about 35 ppt
- The lake area would stabilize at about 200 to 210 sq mi after the -year 2040.
- The volume of water in the lake in the year 2050 is projected to be 1.54 MAF or about 20.3% of the lake volume as it was in 2000.

For the uncertainty inflow case, the results shown in Figure 27 indicate that the salinity would also eventually return to ocean-like salinity of about 35 ppt. The trends are similar to the previous scenario, but the duration of the salinity peak is cut somewhat, and the time to return to ocean-like salinity is shortened. For the scenario shown here, the pump out has been allowed to continue at the upper level of 150,000 AFY until the year 2045 at which point it is reduced to 75,000 AFY. The lake volume would be reduced to an even smaller size than for the baseline inflow case, with the volume dropping to 9.2% of the year 2000 volume.

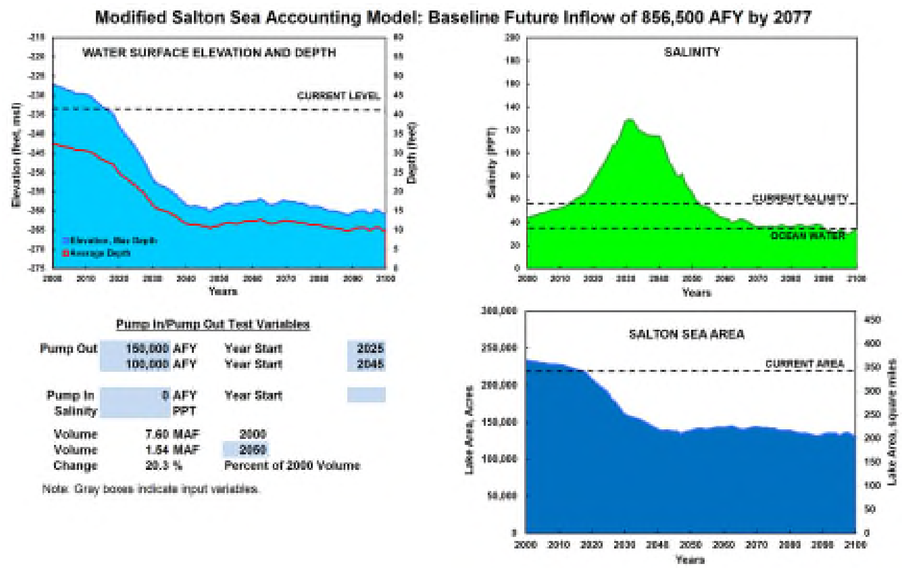

Figure 26 Laguna Salada Baseline Future Inflow

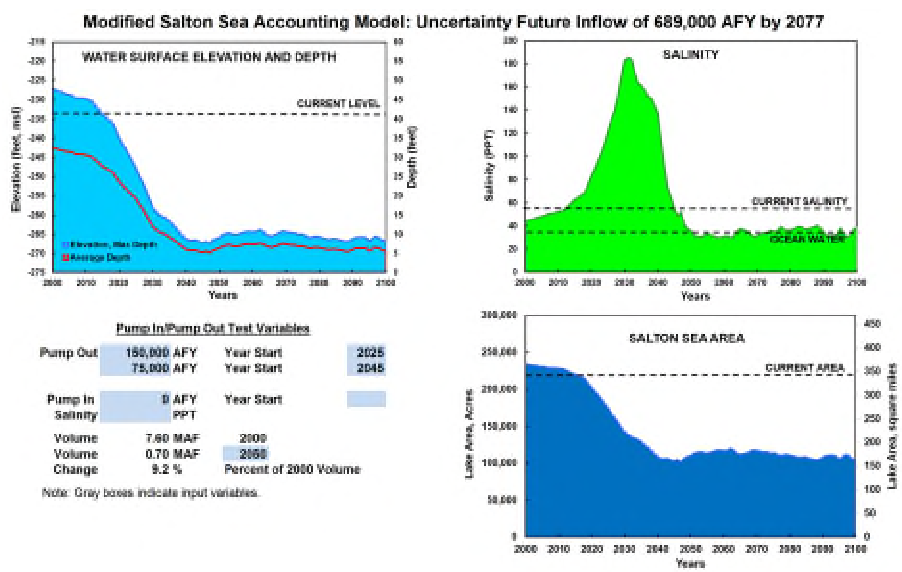

Figure 27 Laguna Salada Uncertainty Future Inflow

3.1.8 Summary

Transfer of water from the Salton Sea to the Laguna Salada would require a significantly shorter pipeline distance than transfer of water to the Gulf of California or La Cienega de Santa Clara. The Laguna Salada, however, is typically accustomed to replenishment from drainage flows that are much lower in salinity in comparison to water from the Salton Sea. Therefore, any inflows to the Laguna Salada from the Salton Sea would have to be blended or treated, thereby dramatically reducing the feasibility and cost effectiveness of this option. Additionally, this option would require approvals from both countries involved.

3.2 La Cienega De Santa Clara

La Cienega de Santa Clara is the largest wetland on the Mexican portion of the Colorado River Delta and is approximately 90 miles from the Salton Sea. The boundaries and extent of La Cienega de Santa Clara are constantly in flux, due to factors such as seasonal changes and variations and the general ambiguity of the area commonly referred to as La Cienega de Santa Clara. Generally speaking, La Cienega is an asymmetric basin bounded by desert vegetation to the east and bare mudflats that are occasionally inundated by oceanic tides to the west. The northern portion of La Cienega is bounded by the Bypass Drain, which is predominantly comprised of agricultural drainage. The majority of the inflow for La Cienega de Santa Clara is obtained via the Bypass Drain.

La Cienega de Santa Clara serves as a habitat for over 260 species of birds and dozens of fish species, including two endangered species; the Yuma Clapper Rail and Desert Pupfish. Similar to the Salton Sea, La Cienega de Santa Clara was created in 1976 by human engineering, and the inflows have been supplied by drainage from California farmlands. Construction of the Hoover Dam dramatically reduced flows to the Colorado River Delta area, and full-time operation of the YDP would further reduce flows to La Cienega de Santa Clara. Preliminary evaluations during the pilot operation of the YDP demonstrated that La Cienega de Santa Clara appears to be an ecosystem that is resilient to short-term disturbances and minor changes in water quality and quantity. From a purely quantitative perspective, discharge of additional flows from the Salton Sea could help to offset the decrease in flows to La Cienega, should Reclamation choose to begin full-time operation of the YDP.

Potential flow paths to La Cienega de Santa Clara include approaches from both the southwest and southeast portions of the Salton Sea. Between the Salton Sea and La Cienega de Santa Clara lie an expanse of small towns and cities, including El Centro, Mexicali, and Guadalupe Victoria. Additional evaluations must be made to determine which potential routes are most optimal, and environmental considerations regarding the impact of any outflows from the Salton Sea must be made in order to ensure the protection of the ecosystems and endangered species.

3.2.1 Water Quantity

Recent flows from the Bypass Drain average approximately 107,000 AFY, and the flows from the Bypass Drain account for over 90 percent of the total inflow to La Cienega de Santa Clara. Less than 10 percent of the flows to La Cienega de Santa Clara are from the Santa Clara-Riito Drain, which is generally comprised of agricultural wastewater from farms in the San Luis Valley of Mexico. Salinity for water from the Bypass Drain typically ranges between

2,400 to 3,700 ppm and 3,100 to 4,800 ppm for the water from the Santa Clara-Riito Drain. Untreated export flows from the Salton Sea would be at least an order of magnitude greater in salinity, and the quantity of exportable water would depend primarily on the overall environmental impact to La Cienega de Santa Clara. Other considerations include maintaining the water level in the Salton Sea based on available inflows compared to the quantity of water to be exported, pumping capabilities and costs, elevation gains, and distance. Additional studies and evaluations must be made to determine a feasible range in quantity of water to be exported from the Salton Sea.

3.2.2 Conveyance System and Hydraulics

To deliver 150,000 AFY of water from the Salton Sea to La Cienega de Santa Clara would require 90 miles of 86-inch diameter pipeline, and two pump stations. The first pump station would be located near the Salton Sea to boost water into the pipeline. A second pump station would be constructed to deliver water to the end point of the pipeline. Each pump station would be designed for 400 feet of discharge head, and the internal pipeline pressure would need to be 250 psi.

Figure 28 depicts a conceptual conveyance system for delivering water to La Cienega de Santa Clara.

3.2.3 Consideration of Capital and Operational Cost

The capital and operational costs for transferring water from the Salton Sea to La Cienega de Santa Clara are similar in magnitude to the costs for transferring water to the Laguna Salada. Again, these cost estimates do not include any costs for treatment or blending to decrease the salinity of the water exported from the Salton Sea. Such considerations would be necessary as La Cienega de Santa Clara is a highly protected wetland and the introduction of water from the Salton Sea would expose the habitat to a salinity that is much greater than the current salinity of the existing inflows.

3.2.4 Institutional Considerations

La Cienega de Santa Clara is home to over 260 species of animals and two endangered species. Typical inflows to La Cienega de Santa Clara are less than 150,000 AFY. Any quantity of flow greater than what is currently flowing into La Cienega or any flow with salinity levels that are a magnitude of order greater than current flows would have a significant environmental impact. Additionally, similar to the Laguna Salada option, the transfer of water from the Salton Sea to La Cienega de Santa Clara would require approvals and agreements from both countries involved. Treatment or blending requirements may be considered; however, combined with the cost to export water from the Salton Sea to La Cienega de Santa Clara, such options would likely be proven not to be cost-effective.

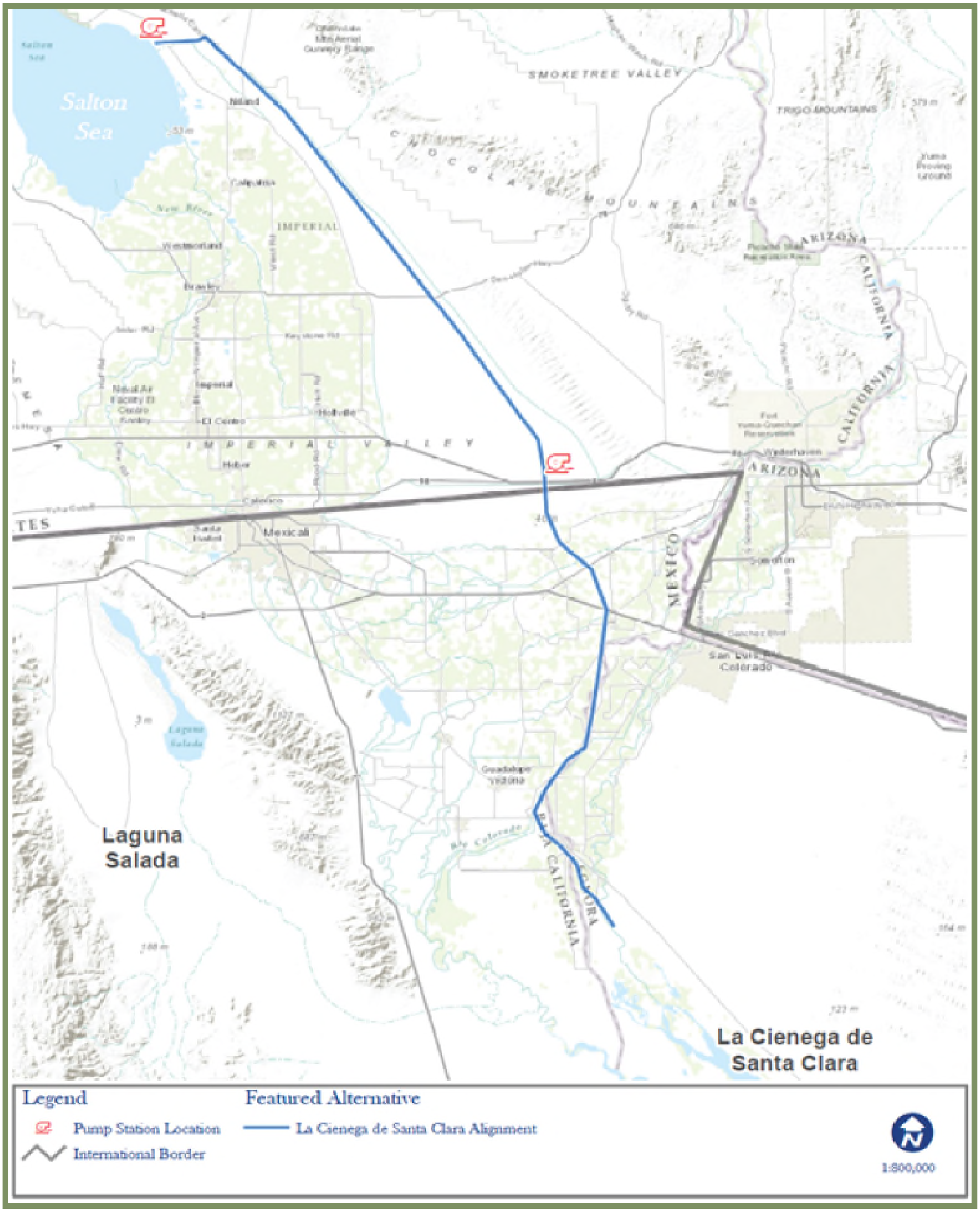

Figure 28 Salton Sea to La Cienega De Santa Clara

3.2.5 Screening Level Performance Analysis

Estimates for both the La Cienega de Santa Clara pump out alternative and the Laguna Salada pump out alternative assumed an export amount of 150,000 AFY. The Modified SSAM was run for the outflow pipeline to the Laguna Salada in section 3.1.7 using the amount of 150,00 AFY. The results of the model run for the baseline future inflow case of 865,000 AFY are shown in Figure 26, and the results of the model run for the uncertainty future inflow case of 689,000 AFY are shown in Figure 27. Section 3.1.7 also includes a summary of the results attained from running the model.

3.2.6 Summary

La Cienega de Santa Clara feeds into the Gulf of California, and the transfer of water from the Salton Sea to La Cienega would require a shorter pipeline distance. It must be taken into consideration, however, that La Cienega de Santa Clara ecosystem includes hundreds of animal species and any increase in flows or significant changes to water quality, such as a dramatic increase in salinity, could easily upset the existing ecosystem. In the event that Mexico and the United States reach an agreement to permit exportation of water from the Salton Sea to La Cienega de Santa Clara, it is highly likely that any transfer of water to La Cienega the Santa Clara from the Salton Sea would require some level of treatment or blending to reduce the salinity of the incoming flows, and this would drastically minimize the feasibility and cost effectiveness of this option. This option would also require significant collaboration and approval from both the United States and Mexico.

3.3 Gulf of California

The Gulf of California is approximately 120 miles from the Salton Sea and 30 miles away from La Cienega de Santa Clara. There is an existing and operational canal system which covers 80 percent of the distance from the Gulf of California to the US-Mexico border. Additionally, 95 percent of the distance from the Gulf to the border is below sea level, with an average elevation of -25 MSL. The general terrain in the area is loose, rocky to sandy soil. The Gulf of California has been losing coastal land at a very high rate over the last 50 years, and the environmental impact of discharging flows from the Salton Sea must be evaluated thoroughly. Similar to La Cienega de Santa Clara option, the flow paths to the Gulf of California can originate from either the southwest or southeast portions of the Salton Sea.

3.3.1 Water Quantity

The quantity of water that could be exported from the Salton Sea to the Gulf of California would depend on several factors. These factors include maintaining the desired water level in the Salton Sea, environmental impacts of discharging the higher salinity water from the Salton Sea into the Gulf of

California, and the associated costs and capabilities of the pumping systems and pipelines from the Salton Sea to the Gulf of California.

3.3.2 Conveyance System and Hydraulics

Delivery of 150,000 AFY of water from the Salton Sea to the Gulf of California would require 120 miles of pipeline that is 86-inch diameter with two pump stations. There is an elevation gain of approximately 530 feet from the Salton Sea to the Gulf of California with the high point located south of the international border near the Mexicali-Tecate Highway 2. To deliver water to the Gulf of California would also require a minimum of two pump stations. The first pump station would be located near the Salton Sea to convey water into the pipeline. A second pump station would be necessary along the pipeline alignment to deliver water to the final discharge point. Each pump station would be designed with a discharge head of 500 feet, and pipeline design would be based on internal pressure of 300 psi, accounting for surge.

3.3.3 Consideration of Capital and Operational Cost

Given the greater distance and elevation gain for the option to export water from the Salton Sea to the Gulf of California in comparison to the other alternatives to transport water either to Laguna Salada or La Cienega de Santa Clara, this alternative has the highest cost out of the four outflow alternatives in terms of both capital and operational costs.

3.3.4 Institutional Considerations

The average salinity in the ocean is generally 35,000 ppm, whereas salinity values in the Salton Sea have reportedly ranged from 44,000 ppm to 52,000 ppm. Evaluation of discharge methods into the Gulf of California and significant consideration of environmental impacts to the coastal habitats would be necessary for determining whether this option is feasible. The cost-effectiveness of transporting a significant volume of water for 120 miles over significant elevation gains must also be evaluated. Again, this option requires a transfer of water across international borders, and the feasibility and validity of this option relies heavily on collaboration and permits and approvals being resolved between the government of the United States and Mexico governments.

3.3.5 Conceptual plans

Conceptual plans prepared for the Gulf of California Pipeline alternative can be found in Appendix 11.5. These plans were used to form the basic concept for the pipeline route and its key components. Conceptual level cost estimates were then developed from the layouts presented in these plans. Appendix 11.5 contains the following conceptual drawings:

- Hydraulic profile;

- A pump station mechanical plan and section;
- An intake structure; and
- A discharge header

3.3.6 Cost Evaluation

An evaluation of project costs was conducted including the following components: mobilization and demobilization, intake systems and facilities, intake pump station, intake pumps, intake pump station mechanical piping, intake pump station auxiliary items, conveyance pipe, pressure reducing station, buildings and/or vaults, outlet system facilities, onshore additional structures, and electrical/instrumentation. The pipe flow capacity for this alternative was estimate at Q = 43,000 AFY (60.16 cfs). The cost provided in Table 5 provides a preliminary conceptual estimate based on the best currently available data and is subject to change.

Table 5 Cost Estimate for using the Gulf of California as an outlet

Description	Quantity	Unit	Unit Price	Total
1 Mobilization/Demobilization	1	LS	$35,002,000	$35,002,000
2 Intake Structure	1	LS	$9,931,000	$9,931,000
3 Intake Pump Station	1	LS	$5,225,000	$5,225,000
4 Intake Pumps	1	LS	$14,239,000	$14,239,000
5 Intake Pump Station Mechanical Piping	1	LS	$295,000	$295,000
6 Intake Pump Station Auxilary Items	1	LS	$1,857,000	$1,857,000
7 Conveyance Pipe	1	LS	$623,086,000	$623,086,000
8 Booster Pump Station	1	LS	$5,225,000	$5,225,000
9 Booster Pumps	1	LS	$10,913,000	$10,913,000
10 Booster Pump Station Mechanical Piping	1	LS	$314,000	$314,000
11 Booster Pump Station Auxilary Items	1	LS	$1,857,000	$1,857,000
12 Outlet System/Facility, offshore	1	LS	$7,196,000	$7,196,000
13 Additional Structures	1	LS	$7,431,000	$7,431,000
14 Electrical / Instrumentation	1	LS	$12,464,000	$12,464,000
			Design, Project and Construction Management (25% Items 2 to 14)	$175,008,000
			Subtotal	**$910,043,000**
			Contingency (30%)	**$273,013,000**
			Total	**$1,183,056,000**

3.3.7 Screening Level Performance Analysis

Estimates for both the Gulf of California pump out alternative and the Laguna Salada pump out alternative assumed an export amount of 150,000 AFY. The Modified SSAM was run for the outflow pipeline to the Laguna Salada in section 3.1.7 using the amount of 150,00 AFY. The results of the model run for the baseline future inflow case of 865,000 AFY are shown in Figure 26, and the results of the model run for the uncertainty future inflow case of 689,000 AFY are shown in Figure 27. Section 3.1.7 also includes a summary of the results attained from running the model.

3.3.8 Summary

Exportation of water from the Salton Sea to the Gulf of California would require significant infrastructure and operational costs for pumping such a high salinity water for a distance over 120 miles. Additional considerations for the environmental impact of importing higher salinity water to the already impacted coastline habitats must be made, and should blending or treatment be required, the added costs in addition to the baseline conveyance costs may significantly impact the feasibility and cost-effectiveness of this option.

3.4 Palen Dry Lake

The Palen Dry Lake is located northeast of the Salton Sea in the central portion of Chuckwalla Valley. The lake bed has been previously considered as a discharge location for water from the Salton Sea. The lake is adjacent to the Palen Mountains. Palen Dry Lake is a "wet playa" with significant shallow groundwater discharge at the ground surface by evaporation.

3.4.1 Water Quantity

Palen Dry Lake generally remains dry aside from large rainfall events, where the water may be retained in shallow ponds for days or weeks. The impact of exporting water from the Salton Sea on the water level in Palen Dry Lake would depend significantly on the quantity of water. The option to export 150,000 AFY of water from the Salton Sea was evaluated for this study, and such a large quantity of water would likely result in the establishment of a permanent water level above the ground surface. Exportation of water from the Salton Sea to the Palen Dry Lake could negatively impact groundwater quality in the Chuckwalla Valley Groundwater Basin. Water from the basin is currently used for agricultural irrigation and domestic use.

3.4.2 Conveyance System and Hydraulics

The route to Palen Dry Lake from the Salton Sea includes recent lake deposits, alluvium, and sand dunes, in addition to Pleistocene non-marine sediments. The alignment also crosses the San Andreas Fault Zone. Palen Dry Lake is located approximately 47 miles from the Salton Sea. In addition, the nearby mountains would require pumping water to an elevation of approximately 1,700 feet to reach the dry lake bed. A conveyance system capable of pumping 150,000 AFY would require a minimum of four pump stations with a discharge head of 600 feet for each pump station.

Figure 29 depicts a conceptual conveyance system for delivering water to Palen Dry Lake.

3.4.3 Consideration of Capital and Operational Cost

The capital and operational cost to pump water to Palen Dry Lake are lower by comparison to other alternatives primarily based on the shorter pipeline construction associated with the alternative. However, the operational cost for this alternative will be more significant due to the higher pumping head to deliver water from the Salton Sea to an outfall at Palen Dry Lake with a high point in between of approximately 1,700 feet in elevation.

Figure 29 Salton Sea to Palen Dry Lake

3.4.4 Institutional Considerations

Palen Dry Lake protects both natural and cultural resources and is designated as an Area of Critical Environmental Concern (ACEC). Most recently, BrightSource Energy and Abengoa Solar withdrew their Palen Solar Electric Generating System project after attempting to address a variety of issues ranging from high potential bird mortality from solar flux to cultural concerns by local tribes. Several detailed ACEC management plans and environmental assessments of the Palen Dry Lake area were conducted, and most notably, the area was designated as an ACEC to protect a series of archaeological sites related to the lacustrine environment of Pleistocene Palen Lake. Some of the earliest human remains in California were discovered near the dry lake shores, and great measures are made to protect this area. The Palen Dry Lake is also home to species such as the sand-dependent Mojave fringe-toed lizard, and it neighbors the Edmund C. Jaeger Nature Sanctuary, which preserves the desert lily, many other native desert plants, and a critical undeveloped “land bridge” wildlife corridor.

3.4.5 Screening Level Performance Analysis

Estimates for both the Palen Dry Lake pump out alternative and the Laguna Salada pump out alternative assumed an export amount of 150,000 AFY. The Modified SSAM was run for the outflow pipeline to the Laguna Salada in section 3.1.7 using the amount of 150,00 AFY. The results of the model run for the baseline future inflow case of 865,000 AFY are shown in Figure 26, and the results of the model run for the uncertainty future inflow case of 689,000 AFY are shown in Figure 27. Section 3.1.7 also includes a summary of the results attained from running the model.

3.4.6 Summary

Transfer of water from the Salton Sea to the Palen Dry Lake requires extensive pumping and would dramatically alter the existing environmental conditions, and due to the protected nature of the area, it is unlikely that this option is feasible at all.

3.5 Evaporation

Since it was formed the Salton Sea has lacked an outlet. Irrigation drainage supporting the Salton Sea has delivered high salt content, and naturally occurring evaporation has led to increasing salinity. Beginning in 2018 it is anticipated that reductions in irrigation drainage to the Salton Sea will initiate more severe increases in salinity. There are just two options to prevent a rapid increase in salinity: remove salt content from the sea or increase inflow with water of lower salinity.

Increased evaporation of Salton Sea water by man-made means has been considered strictly to reduce salinity. The alternative must be considered independent of the goal to maintain the volume of the Salton Sea. These means to increase evaporation include construction of solar evaporation ponds along the shore of the Salton Sea, spraying the water along the shore of the Salton Sea to prevent the development of dust, or advanced evaporation methods that spray the water into the air to increase the rate of evaporation. All three of these methods utilize water to remove salt content.

3.5.1 Water Quantity

A significant challenge with this alternative is that due to the Salton Sea having a water volume of nearly 7,500,000 AF and salinity of approximately 44,000 ppm, extremely large facilities and spreading grounds would be required. With the solar evaporation ponds the necessary land will dictate the quantity of water. The Salton Sea has a total volume of nearly 7,500,000 AF. The evaporation rate in the area of the Salton Sea is typically 6 feet per year. Thus, it will take a very large area of solar evaporation ponds to achieve beneficial salt removal. For example, evaporation of two percent of the total volume of the Salton Sea would require a system capacity of 150,000 AFY, which would span 25,000 acres with a depth of six feet.

Advanced evaporation systems will enable a smaller footprint but have associated cost, and regular maintenance requirements. Small scale advanced evaporation facilities have been operated along the Salton Sea. The facilities have exhibited higher evaporation rates, but also proven to require a lot of maintenance and repair. Handling high salinity water is best accomplished in large conduits at high flow rates. However, with advanced evaporation systems the flows and pipeline sizes are smaller, causing higher likelihood of clogged pipelines and forced pump shutoff.

3.5.2 Conveyance System and Hydraulics

To deliver 50,000 AFY from the Salton Sea to solar evaporation ponds, shoreline sprayers or advanced evaporation systems is assumed to require 10 miles of pipeline ranging from 8- to 50-inches in diameter pipeline. Whenever possible, the water from the Salton Sea should be transferred by open channel, instead of pipeline, to prevent clogging and provide easiest access for maintenance.

3.5.3 Institutional Considerations

Institutional considerations vary amongst the evaporation methods of water distribution along the shore of the Salton Sea, to creating solar evaporation ponds. The footprint and location of the proposed evaporation facilities would dictate the level of approvals, impacts to nearby communities and environmental studies in order to implement. In addition, the concept for evaporation ponds would appear to strictly enable salt removal. With the salinity at the ponds to be elevated above the level in the Salton Sea as evaporation occurs, there does not appear to be options available to combine evaporation ponds with other projects, or to benefit the habitat in the region.

3.5.4 Conceptual Plans

Conceptual plans prepared for the Evaporation alternative can be found in Appendix 11.6. These plans were used to form the basic concept for the pipeline route and its key components. Conceptual level cost estimates were then developed from the layouts presented in these plans. Appendix 11.6 contains the following conceptual drawings:

- A pump station mechanical plan and section; and
- An intake structure.

3.5.5 Cost Evaluations

An evaluation of project costs was conducted including the following components: mobilization and demobilization, intake systems and facilities, intake pump station, intake pumps, intake pump station mechanical piping, intake pump station auxiliary items, conveyance pipe, pressure reducing station, buildings and/or vaults, outlet system facilities, onshore additional structures, and electrical/instrumentation. The pipe flow capacity for this alternative was estimate at Q = 43,000 AFY (60.16 cfs). The cost provided in Table 6 provides a preliminary conceptual estimate based on the best currently available data and is subject to change.

Table 6 Cost Estimate for using Evaporation

Description		Quantity	Unit	Unit Price	Total
1	Mobilization/Demobilization	1	LS	$1,337,000	$1,337,000
2	Intake Structure	1	LS	$10,318,000	$10,318,000
3	Intake Pump Station	1	LS	$4,524,000	$4,524,000
4	Intake Pumps	1	LS	$2,524,000	$2,524,000
5	Intake Pump Station Mechanical Piping	1	LS	$215,000	$215,000
6	Intake Pump Station Auxilary Items	1	LS	$923,000	$923,000
7	Conveyance Pipe	1	LS	$698,000	$698,000
8	Outlet System/Facility	1	LS	$138,000	$138,000
9	Additional Structures	1	LS	$2,776,000	$2,776,000
10	Electrical / Instrumentation	1	LS	$4,626,000	$4,626,000
				Design, Project and Construction Management (25% Items 2 to 10)	$6,686,000
				Subtotal	$34,765,000
				Contingency (30%)	$10,430,000
				Total	$45,195,000

3.5.6 Screening Level Performance Analysis

The Modified SSAM was run for an outflow pipeline to evaporation facilities, assuming an export capacity of 50,000 AFY. The model was run for two future inflow scenarios. The baseline case assumes a future inflow of approximately 865,000 AFY by 2077, long after QSA mitigation flows end in 2017. The uncertainty case assumes a future inflow of about 689,000 AFY. The Modified SSAM and the future inflow assumptions are discussed in section 1.3 and in

Salton Sea Funding and Feasibility Action Plan, Benchmark 2: Review and Update Existing Condition Data.

The results of the model run for the baseline future inflow case of 865,000 AFY are shown in Figure 30, and the results of the model run for the uncertainty future inflow case of 689,000 AFY are shown in Figure 31. These results can be compared to the No Action scenarios illustrated in Figure 1 and Figure 2. For this screening level evaluation it was assumed that operation of a pipeline to evaporation facilities from the Salton Sea would begin in the year 2025. It was estimated that, from a decision point in 2017, it would take about eight years to complete the environmental documentation, the design and permitting, right-of-way clearance and land acquisition, and thus result in a 2025 start up.

For the baseline inflow case, the results shown in Figure 30 indicate that the salinity would begin to decline around the year 2050.

Key results of the baseline inflow model run are as follows:

- The water surface would gradually decline and reach an elevation of -257.1' NGVD in the year 2100. This would result in an average water depth of about 13 feet and a maximum depth of about 17 feet.
- Salinity would peak at about 140 ppt around year 2040 and begin declining around the year 2050. In the year 2100 salinity will be around 100 ppt.
- The lake area would be relatively stable at about 230 sq mi after the year 2030.
- The volume of water in the lake in the year 2050 is projected to be 2.42 MAF or about 31.8% of the lake volume as it was in 2000.

For the uncertainty inflow case, the results shown in Figure 31 indicate that the salinity would still begin to decline around the year 2050, but salinity would rise and fall more dramatically. Additionally, the lake volume would be reduced to an even smaller size than for the baseline inflow case, with the volume dropping to 18.6% of the year 2000 volume.

3.5.7 Summary

Evaporation of Salton Sea water could successfully serve as a way to remove salt on a moderate scale. The cost of operation and maintenance to convey high salinity water for spraying will be high, and the footprint to build solar evaporation ponds will be too large to do large scale. In addition, large scale evaporation would also mean a lowering of the water volume to the Salton Sea.

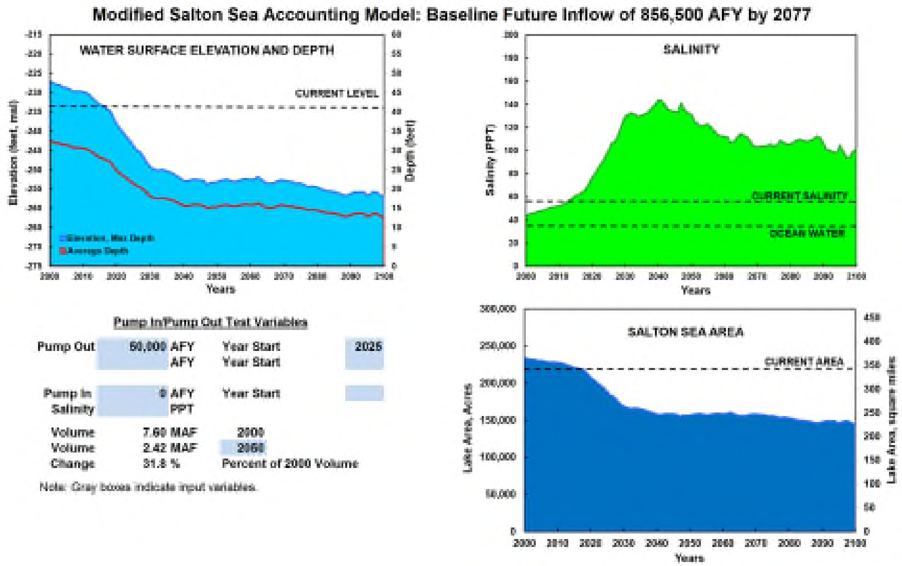

Figure 30 Evaporation Baseline Future Inflow

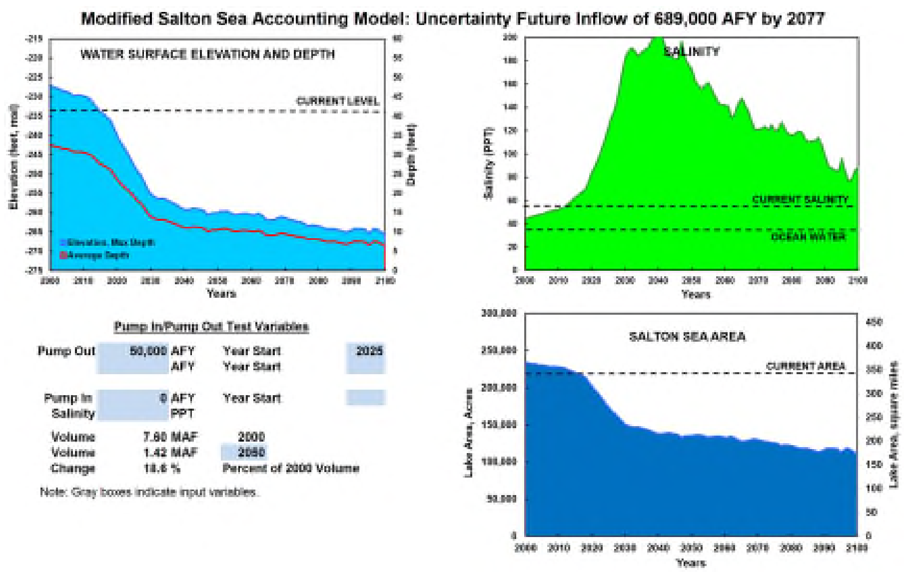

Figure 31 Evaporation Uncertainty Future Inflow

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4.0 Combined Water Source and Outlet Systems

As discussed earlier, the Salton Sea faces two coinciding problems which contribute to increasing salinity and other environmental problems: a critical need for a source of water to cope with inflow reductions, and a lack of an adequate outlet to remove accumulations of salt and other nutrients. Due to the dual nature of this problem, combined water source and outlet methods are described here. This review covers three possible combined water source and outlet systems: Salton Sea to Gulf of California, Salton Sea to Pacific Ocean, and Local Desalination. This analysis also considered four factors concerning the three methods reviewed: water quantity delivered and conveyed, the conveyance system and hydraulics necessary for importing and exporting water from the Sea, a consideration of capital and operational costs, and the institutional costs involved in implementing each option. An applicable screening level performance analysis using the Modified SSAM was also conducted for each alternative.

4.1 Salton Sea to Gulf of California

This option would essentially involve a combination of the alternative to import water from the Gulf of California to the Salton Sea from Section 2.0 and the alternative to export water from the Salton Sea to the Gulf of California discussed in Section 3.0. As mentioned previously, the Gulf of California is located about 120 miles away from the Salton Sea.

Figure 32 depicts a conceptual conveyance system for conveying between the Gulf of California and the Salton Sea.

4.1.1 Water Quantity

The quantity of water delivered to and conveyed from the Salton Sea would be constrained mainly by capital and annual operation costs associated with pumping large quantities of water over the 120 mile distance in both directions. Additional factors include maintaining the desired water level in the Salton Sea and the environmental impacts of discharging the higher salinity water from the Salton Sea into the Gulf of California.

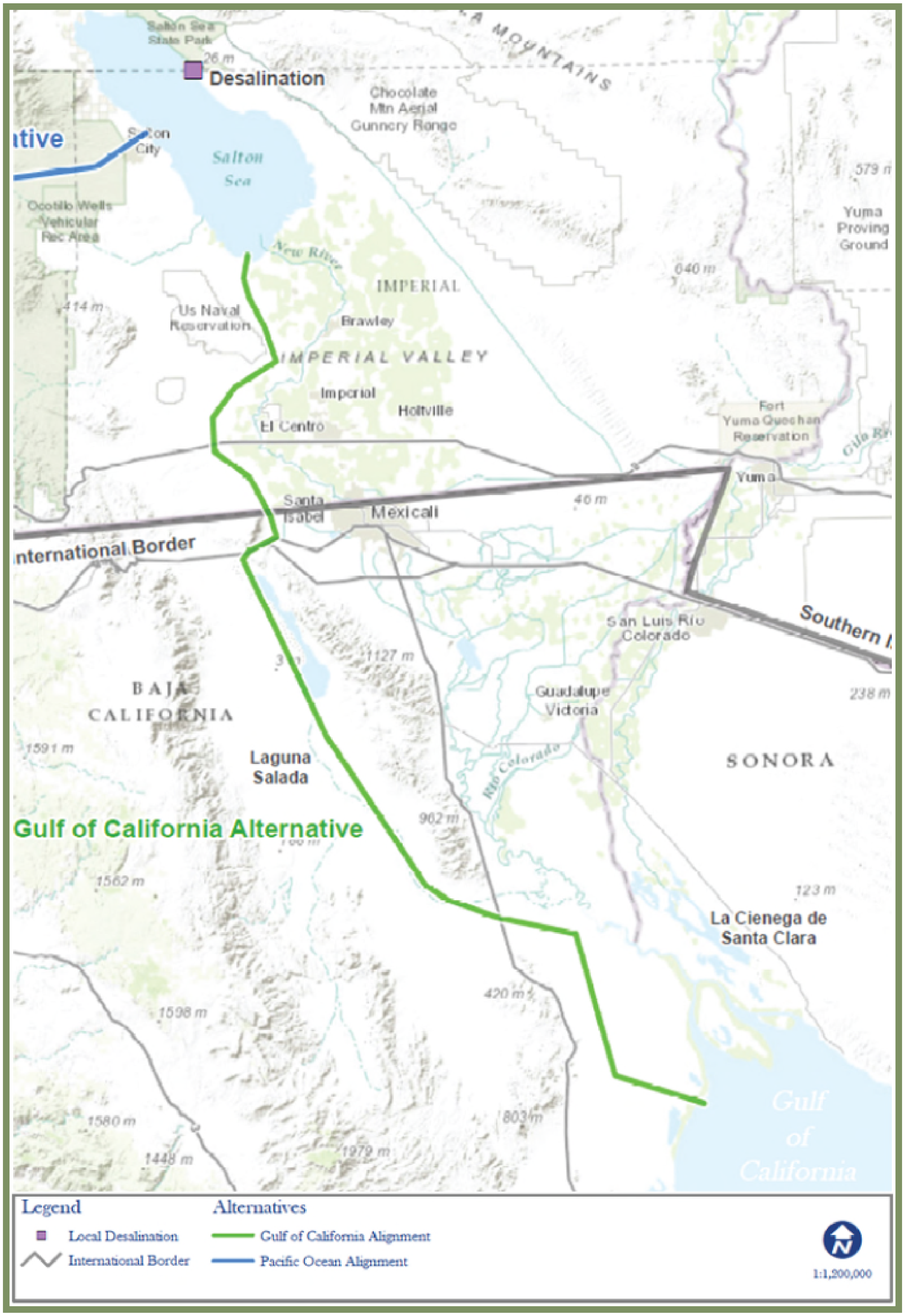

Figure 32 Salton Sea to Gulf of California

A proposed project for Salton Sea to Gulf of California restoration in conjunction with desalination was conceptualized in 2009 for the Authority. The concept developed for the study envisioned conveyance of up to 2.5 million AFY for the benefit of the Southwest United States as well as Baja Mexico. Conveyance of such a large quantity is unnecessary for the 7.5 million AF capacity Salton Sea, as this solution would quickly replace the volume of the Salton Sea in a period of time that is likely to be much shorter than the payback time period for the system itself.

4.1.2 Conveyance System and Hydraulics

To convey water from the Gulf of California to the Salton Sea, 120 miles of pipeline would be required. The flow rate has yet to be determined. For the purposes of this evaluation, however, it was assumed that the beneficial flow rate would be 150,000 AFY. This equates to a flow rate of 93,000 gpm. An 86-inch diameter pipeline would be necessary to deliver the flow at a velocity of 5 fps. The highest elevated point along the proposed pipeline alignment would occur near the Mexicali-Tecate Highway 2 located south of the international border. A conveyance system of similar magnitude would also need to be constructed to export water out of the Salton Sea into the Gulf of California, as well. The export pipeline would transport salt out of the Salton Sea, whereas the import pipeline would transfer less saline water into the Salton Sea in order to ultimately decrease the salinity level within the Salton Sea.

4.1.3 Consideration of Capital and Operational Cost

As mentioned for the individual options to singularly import water from or export water to the Gulf of California, the capital and annual operational costs per acre foot are lower in magnitude in comparison to the options such as SARI, MWD, and the YDP. Due to large quantities of water required for this option, however, the overall capital and operational costs for the entire system are extremely high and far exceed the costs for the options involving lower quantities of water and superior water qualities in regard to salinity. To assess the large cost of this plan, the Authority produced a cost estimate and compared this assessment with the Bay Delta Conservation Plan (BDCP), a similar large project.

In 2003, Reclamation prepared cost estimates for import/export pipelines to the Gulf of California for pipeline projects of varying capacities. The analysis was published in their status report to Congress (Reclamation 2003). From this analysis, total present value cost curves were prepared for both import and export pipelines which relate total estimated cost to flow capacity. The total present value combines capital construction costs with the present value of O&M costs. From these curves, cost estimates can be generated for pipelines of different capacities. The cost curves were incorporated in an

Import/Export Spreadsheet which can be used to determine the pipeline capacities needed to achieve long-term salinity and elevation goals in the Sea. The cost curves were generated in 2003 dollars and adjusted to 2015 dollars using the Engineering News Record Construction Cost Index for the City of Los Angeles, a factor amounting to about a 45% increase.

Using an elevation goal of -230’ NGVD and a salinity goal of 50 ppt, the Import/Export Spreadsheet was run for the combined import/export pipeline to the Gulf under both the baseline and uncertainty future inflow scenarios discussed in section 1.3. Figure 33 shows an estimate of $47.4 billion in 2015 dollars for baseline conditions, and Figure 34 shows an estimate of $61.2 billion in 2015 dollars for uncertainty conditions. As a point of comparison, these estimates can be compared cost estimates for the BDCP to assess their cost reasonableness.

Salton Sea Import/Export Salt Balance

Design Elevation (ft, MSL)		-230
Salinity Goal (PPT)		50
Percent Saltier than Ocean Water (35 PPT)		43%
Inflow Needed (AFY)		1,287,100
Expected Inflow Without Imports (AFY)		865,500
Inflow Difference to Maintain Elevation		421,600
Outflow to Remove Incoming Salt		64,400
Inflow Salinity		36
Outflow Salinity		50
Import Pipeline Capacity Needed (AFY)		1,735,714
Export Pipeline Capacity Needed (AFY)		1,314,114
Import Needed (MAFY)		1.74
Export Needed (MAFY)		1.31
Rough Cost Estimates for Pipelines		
Import Pipeline Present Value ($B)	$	26.0
Export Pipeline Costs ($B)	$	21.5
Total Present Value Estimate ($B)	**$**	**47.4**

Figure 33 Import/Export Spreadsheet Results for Baseline Future Inflow

Salton Sea Import/Export Salt Balance		
Design Elevation (ft, MSL)		-230
Salinity Goal (PPT)		50
Percent Saltier than Ocean Water (35 PPT)		43%
Inflow Needed (AFY)		1,287,100
Expected Inflow Without Imports (AFY)		689,000
Inflow Difference to Maintain Elevation		598,100
Outflow to Remove Incoming Salt		64,400
Inflow Salinity		36
Outflow Salinity		50
Import Pipeline Capacity Needed (AFY)		2,366,071
Export Pipeline Capacity Needed (AFY)		1,767,971
Import Needed (MAFY)		2.37
Export Needed (MAFY)		1.77
Rough Cost Estimates for Pipelines		
Import Pipeline Present Value ($B)	$	32.6
Export Pipeline Costs ($B)	$	28.6
Total Present Value Estimate ($B)	**$**	**61.2**

Figure 34 Import/Export Spreadsheet Results for Uncertainty Future Inflow

A cost range for the BDCP was estimated to be between approximately $25 and $54 billion for similar capacity pipes that are about 1/3 as long as the conveyance system required for large scale efforts needed to achieve elevation and salinity objectives at the Sea. According to *The Bay Delta Conveyance Facility: Affordability and Financing Considerations* report prepared by Blue Sky Consulting Group in November 2014, the BDCP will cost approximately $24.75 billion in constant 2012 dollars (10), and in June 2013, the Antioch Herald concluded that the total cost of the project would be as high as $54.1 billion (Restore the Delta par. 3). Therefore, a rough cost range of $25 to $54 billion for the BDCP was used in this report. As described in Blue Sky's 2014 report, the BDCP would consist of "two 40-foot diameter tunnels reaching maximum depths of more than 150 feet below ground that could carry up to 9,000 cubic feet per second (cfs) of water approximately 30 miles from the Sacramento River to the existing [State Water Project] SWP and [Central Valley Project] CVP pumps located approximately 17 miles southwest of Stockton at the Clifton Court Forebay" (9). In terms of AFY, this proposed system would have to convey up to 3.5 MAFY to satisfy project objectives for the BDCP, an amount similar to what is needed for baseline future inflow conditions at the Salton Sea. Note that since these estimates were developed some changes were made to make the BDCP to make it smaller and less costly.

Estimates indicate that baseline future inflow conditions at the Salton Sea will require pipelines with a capacity comparable to that required for the BDCP conveyance system. For the Salton Sea, calculations made using the Import/Export Spreadsheet (shown in Figure 33 and Figure 34) estimated that, depending on future inflow conditions, water requirements for import could range from approximately 1.74 MAFY for the baseline case to 2.37 MAFY for the uncertainty case, and water requirements for export could range from approximately 1.31 MAFY for the baseline case to 1.77 MAFY for the uncertainty case. This means that the total conveyance requirements for the Salton Sea would require pipeline with enough capacity to import/export about 3.0 MAFY for the baseline case and about 5.5 MAFY for the uncertainty case. These estimates indicate that the baseline case for the Salton Sea will require a pipeline capacity similar to the BDCP requirement while the uncertainty case for the Salton Sea will require a considerably larger pipelines. The length of pipelines between the Salton Sea and the Gulf of California would be about 120 miles, about three times the length of the estimated 40 miles of conveyance technology needed for the BDCP.

Based on the estimates for the BDCP being used here, it is reasonable to expect that the total present value of large scale efforts to import/export water to and from the Sea could cost between $47 and $61 billion. These estimates range from about twice the BDCP estimate at the low end to only about 25% greater at the high end. However, the length of the Salton Sea project would be three times the BDCP project length. In addition, the Salton Sea project would involve water with high salt concentrations compared to fresh water for BDCP, which would add to the capital costs for corrosion resistant pumps and pipelines and added O&M costs to deal with corrosion and fowling.

4.1.4 Institutional Considerations

The institutional considerations associated with this option are similar to the options to singularly transport water into and out of the Salton Sea. Easement and land acquisition along the pipeline alignment through Mexico and approval by Mexico are necessary. Because the proposed pipelines are significantly large in diameter, an alignment traversing open space and uninhabited areas would be ideal.

The cost-effectiveness of this option is questionable, given the high capital and operational costs associated with pumping water to and from the Gulf of California for an exchange of waters that are not very different in salinity. The salinity of the Salton Sea has reportedly varied from 44,000 ppm to 52,000 ppm, and the average salinity in the ocean is typically 35,000 ppm. In addition to these considerations, the environmental impact must also be evaluated, as the Gulf of California has reportedly lost a significant amount of coastal land over the last 50 years. There are several other alternatives that provide a far greater advantage in salinity gradient and do not require a transfer of water across international borders with distances of 120 miles each way and potentially damaging environmental concerns.

4.1.5 Screening Level Performance Analysis

The Modified SSAM was run for an import/export pipeline from the Gulf of California to the Salton Sea for both the baseline scenario and the uncertainty scenario. The baseline case assumes a future inflow of approximately 865,000 AFY by 2077, long after QSA mitigation flows end in 2017. The uncertainty case assumes a future inflow of approximately 689,000 AFY. The Modified SSAM and the future inflow assumptions are discussed in section 1.3 and in Salton Sea Funding and Feasibility Action Plan, Benchmark 2: Review and Update Existing Condition Data.

Estimates for required import/ export amounts were conducted using the Import/Export Spreadsheet discussed in section 4.1.3, and minor adjustments were made to the figures acquired from Spreadsheet runs to reach more manageable elevation and salinity objectives. Figure 33 shows the Spreadsheet run for the baseline future inflow scenario, and Figure 34 shows the Spreadsheet run for the uncertainty future inflow scenario. Figure 33 indicates that to reach an elevation goal of -230’ NGVD and a salinity goal of 50 ppt for the baseline scenario, approximately 1.31 million AFY would be required for export and 1.74 million AFY would be required for import. Therefore, the Modified SSAM was run for the Gulf of California to Salton Sea inflow/outflow alternative assuming an import value of 1.7 million AFY and an export value of 1.3 million AFY for the baseline case. Figure 34 indicates that to reach an elevation goal of -230’ NGVD and a salinity goal of 50 ppt for the uncertainty scenario, approximately 2.37 million AFY would be required for import and 1.77 million AFY would be required for an initial export. Building on these numbers, the Modified SSAM was run for the Gulf of California to Salton Sea inflow/outflow alternative assuming an import value of 2.3 million AFY and an initial export value of 1.8 million AFY for the uncertainty case.

The results of the model run for the baseline future inflow case of 865,000 AFY are shown in Figure 35, and the results of the model run for the uncertainty future inflow case of 689,000 AFY are shown in Figure 36. These results can be compared to the No Action scenarios illustrated in Figure 1 and Figure 2. For this screening level evaluation it was assumed that operation of a pipeline from the Gulf of California to the Salton Sea would begin in the year 2030. It was estimated that, from a decision point in 2017, it would take at least thirteen years to complete the environmental documentation, the design and permitting, right-of-way clearance and land acquisition for a project as large as this alternative.

For the baseline inflow case, the results shown in Figure 35 indicate that a pipeline importing 1.7 million AFY and exporting 1.3 million AFY would raise the lake level by about 3 to 5 feet above current Sea levels or about 17 to 19 feet higher than with No Action. At around the year 2035, salinity levels would drop just below current levels and be present at around 50 ppt, about 15 ppt above ocean level salinity.

Key results of the baseline inflow model run are as follows:

- The water surface would stabilize around the year 2060 at an elevation of about -230' NGVD which would result in an average water depth of about 29 to 30 feet and a maximum water depth of about 43 to 45 feet.
- Salinity would peak at about 135-140 ppt around year 2030 and then stabilize just under the current level at about 50 ppt around the year 2035.
- The lake area would stabilize just above 350 sq mi after the year 2060.
- The volume of water in the lake in the year 2050 is projected to be 5.87 MAF or about 77.2% of the lake volume as it was in 2000.

For the uncertainty inflow case, the results shown in Figure 36 indicate that the salinity would also eventually drop just below current levels and be present at around 50 ppt. The trends are similar to the previous scenario, but the salinity peak is cut somewhat and the time to reach a salinity of around 50 ppt is slightly shortened. For the scenario shown here, the pump out has been allowed to continue at the upper level of 1.8 MAFY until the year 2050 at which point it is reduced to 1.75 MAFY. The lake volume would be reduced to a smaller size than for the baseline inflow case, with the volume dropping to approximately 66.1% of the year 2000 volume. Additionally, the elevation would be about two or three feet lower than in the baseline case.

4.1.6 Summary

Although this option for the exchange of water between the Salton Sea and the Gulf of California is definitely possible, the benefits are outweighed by the cost, environmental concerns, and practicality. There are a number of other alternatives that do not require such high quantities of water to be imported because they are far lower in salinity, and it is recommended that other more feasible alternatives be considered.

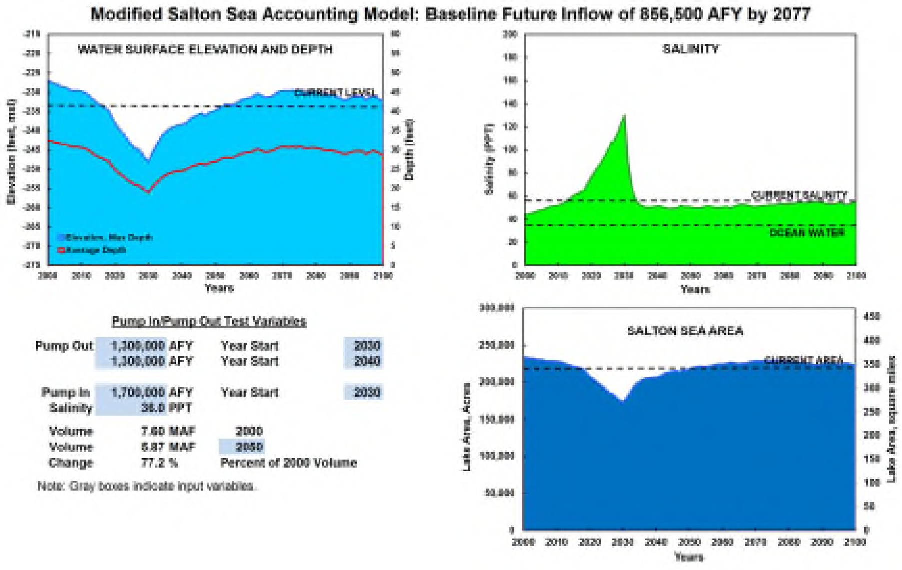

Figure 35 Salton Sea to Gulf Inflow/Outflow Baseline Future Inflow

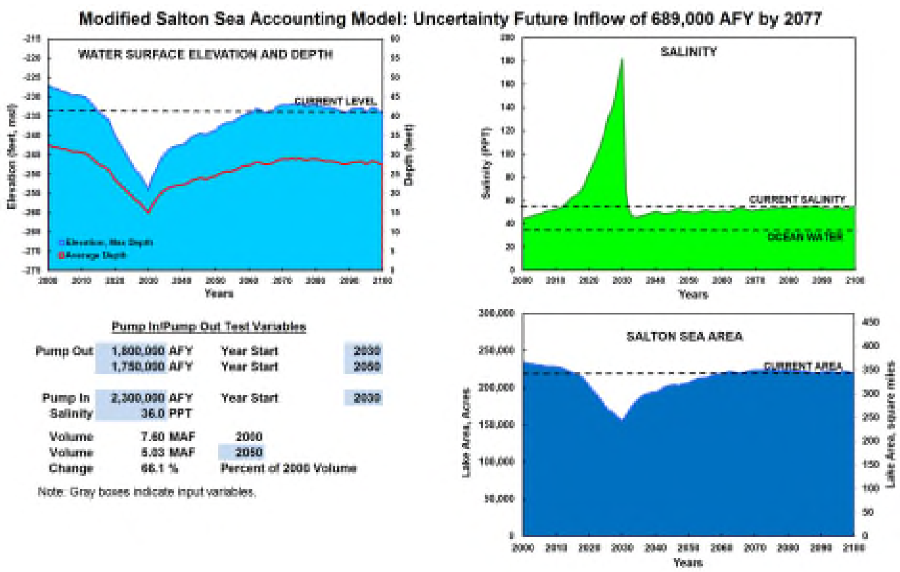

Figure 36 Salton Sea to Gulf Inflow/Outflow Uncertainty Future Inflow

4.2 Salton Sea to Pacific Ocean

The alternative to import water from the Pacific Ocean was presented in Section 2.0, and this proposed alternative involves the exchange of water between the Salton Sea and the Pacific Ocean. Similar to the option between the Salton Sea and the Gulf of California, this alternative would require the construction of a massive conveyance system to convey such large quantities of water over such a great distance.

Figure 37 depicts a conceptual conveyance system for conveying between the Pacific Ocean and the Salton Sea.

4.2.1 Water Quantity

As is the case with the Gulf of California option, the deliverable quantity of water would primarily be dominated by the capital and operational costs involved with pumping the water over the 120 miles between the Salton Sea and the Pacific Ocean. Other factors and limitations include the environmental impacts of discharging the higher salinity water from the Salton Sea into the Pacific Ocean and maintaining the desired water level in the Salton Sea.

4.2.2 Conveyance System and Hydraulics

In order to convey the proposed 150,000 AFY of water from the Pacific Ocean to the Salton Sea over the distance of 120 miles, a pipeline of 86-inch diameter is required for a flow velocity of 5 fps. A pipeline of similar magnitude would be required to convey water out of the Salton Sea into the Pacific Ocean. The pipelines would have to cross the Laguna Mountains at an elevation of 3,000 feet above sea level, and the communities between the Salton Sea and the Pacific Ocean are densely populated. This would make finding an alignment with room for two large-diameter pipelines at feasible depths very difficult at best. Additionally, a minimum of seven pump stations capable of a discharge head of 500 feet would be required for the proposed conveyance system.

4.2.3 Consideration of Capital and Operational Cost

The combined cost for the option between the Pacific Ocean and the Salton Sea is more than three times the overall cost for the option between the Gulf of California and the Salton Sea. Both of the capital and operational costs per acre foot are extremely high in magnitude in comparison to the other alternatives, and the overall costs are even greater in comparison due to the quantity of water required for conveyance between the Pacific Ocean and the Salton Sea. The transfer of such saline water over such a long distance and significant elevation difference is impractical in comparison to the other alternatives utilizing less saline water over shorter distances.

Figure 37 Salton Sea to Pacific Ocean

4.2.4 Institutional Considerations

The magnitude of the conveyance system and the capital and operational costs alone are significant enough to outweigh any water quality benefits associated with importing and exporting water between the Pacific Ocean and the Salton Sea. Coupled with these costs are the challenges associated with crossing through the densely populated and well-established communities that lie between the Salton Sea and the Pacific Ocean. Obtaining easements, land acquisitions, and approvals for two large diameter pipelines would be an immense challenge and pose numerous obstacles to such an endeavor.

4.2.5 Screening Level Performance Analysis

Estimates for both the Salton Sea to Pacific Ocean inflow/outflow alternative and the Salton Sea to Gulf of California inflow/outflow alternative assumed the same import/export amounts of water needed to reach an elevation goal of -235’ NGVD and a salinity goal of 45 ppt. The Modified SSAM was run for the Salton Sea to Gulf of California inflow/outflow alternative in section 4.1.5. Results of the model run for the baseline future inflow case of 865,000 AFY are shown in Figure 35, and the results of the model run for the uncertainty future inflow case of 689,000 AFY are shown in Figure 36. Section 4.1.5 also includes a summary of the results attained from running the model for the Salton Sea to Gulf of California inflow/outflow alternative.

4.2.6 Summary

Given that the salinity gradient between the Pacific Ocean and Salton Sea is minimal in comparison to the other options, the complications associated with crossing such highly populated communities using such an enormous and costly conveyance system seems highly impractical. As a one-way pipeline from the Pacific Ocean to the Salton Sea was deemed infeasible and impractical, an option between the Salton Sea and the Pacific Ocean is just as impractical, if not more.

4.3 Local Desalination

As treatment technologies have progressed, local treatment and desalination of the water in the Salton Sea has become an increasingly discussed alternative. The other alternatives address salinity through the import and export of water from the Salton Sea. Desalination of water from the Salton Sea could reduce the salinity of water. Therefore, this option is discussed for a comprehensive evaluation of alternatives. However, there are two major limiting factors to extensive desalination at the Salton Sea:

1. Because desalination will not address the decreasing water volume of the Salton Sea, it is not a stand-alone option, and

2. The desalination option would only serve to curtail the anticipated rise in salinity at a high cost.

Desalination is thought to be a local solution because it does not involve long conveyance pipelines and high energy consuming pumping. Only part of that is true. Local desalination which draws from the Salton Sea and discharges back to it, would most definitely require less pipeline infrastructure. However, the pumping and energy cost still is extremely high. In order to desalinate water, the water pressure is typically increased up to 1,000 psi before reaching membranes.

The benefit of local treatment, such as desalination, is that it allows for salt transfer out of the Salton Sea, whereas the majority of the water itself can be returned back into the Salton Sea without being exported or pumped a long distance for disposal at another location, such as the Gulf of California, Laguna Salada, and La Cienega de Santa Clara. Yet, desalination would still generate an effluent (or waste) stream which would have to be addressed. Options for handling the effluent stream would include, discharge to evaporation ponds, concentration and conveyance to an ocean outfall or concentration and spreading the brine as a dust control measure.

Preliminary treatment technology options include nanofiltration, ultrafiltration, and reverse osmosis. Additional water quality information is necessary to determine which of the available treatment technologies are applicable, to identify whether additional pre-treatment processes are required, and to confirm the current salinity of the Salton Sea.

As previously discussed, the two primary challenges for the Salton Sea are reducing water volume and increasing salinity. Local treatment of the water in the Salton Sea could reduce the salinity level of the Salton Sea, but would not be incapable of slowing or preventing the water volume reduction by evaporation.

Figure 32 and Figure 37 feature a concept location for a desalination plant adjacent to the Salton Sea.

4.3.1 Water Quantity

The quantity of water available is variable and dependent on several defining factors and objectives. Based on the desired flow quantities evaluated for the other alternatives, a range of 50,000 AFY to 100,000 AFY would be comparable. These options would require a system ranging in capacity from approximately 50 MGD to 100 MGD. Currently, the Poseidon Carlsbad Desalination Plant is the largest proposed desalination facility in the United

States and is in construction to treat water to drinking water standards. It has been designed for 50 MGD capacity, and its estimated cost is $1 billion.

Various configurations are possible, and additional investigation is required to determine the optimal configuration in terms of cost and efficiency. One consideration in treatment of the highly saline water from the Salton Sea is the efficiency and power requirement, such that if the raw water from the Salton Sea were blended with inflow water of lower salinity, then the power cost would reduce and efficiency increase. As a result, one potential configuration would be to divert 25,000 AF of inflow water from a selected location and pump out 25,000 AF of water from the Salton Sea for treatment. With the 50 percent split of water, it would then be considered feasible to produce a water having 12,000 mg/L which is much lower than the current salinity level of around 44,000 mg/L.

Another potential configuration is to divert 25,000 AF of inflow water and pump out 50,000 AF of water from the Salton Sea. This combined quantity of 75,000 AF of water could be treated and further blended with 50,000 AF of inflow water to produce an effluent with a salinity of approximately 10,000 mg/L. There is a wide assortment of available configurations, and more detailed cost analyses and water quality information are required for identifying more specific details and design constraints.

Preliminary calculations demonstrate that local treatment is viable for salinity reduction. However, the cost is significant. The Salton Sea has approximately 7 million acre-feet in storage, and salt inflow will continue. Thus, pumping and treating 50,000 to 100,000 AFY will help reduce salinity rise, but it will not overcome the other factors leading to higher salinity, such as reduced inflows and evaporation. Hence, treatment is an option for salinity reduction, but it is costly and incapable of slowing or halting the loss of water volume that is projected.

4.3.2 Conveyance System and Hydraulics

The primary benefit of this option is its proximity to the Salton Sea. Unlike the other alternatives, this option does not involve the cycling of water in and out of the Salton Sea through miles of pipelines. Instead, this option involves pumping out water directly from the Salton Sea, blending it with existing inflows to the Salton Sea, and discharging the treated effluent back into the Salton Sea. All of this can be implemented along the shoreline of the Salton Sea. Thus, there would not be expansive conveyance systems required, and the technology involved with this alternative would not involve traversing mountain ranges or international border crossings.

However, large diameter pipeline would still be required to convey water from and back to the Salton Sea. Treatment would also require that water be pumped to a much higher pressure than conveyance would. Thus, fewer pump stations would be required, but the pumping facility immediately upstream of the desalination plant would be much larger. Finally, treatment would also produce an effluent stream that would require conveyance to a disposal location. Options for disposal range from evaporation ponds to ocean outfall. Thus, conveyance systems with a large pump lift and long length of disposal pipeline will still be required. These facilities will be lower cost than options to pump the water to further locations, but the other options do not have associated cost for treatment.

4.3.3 Consideration of Capital and Operational Cost

In terms of costs per acre foot, the local treatment option is high in magnitude, but when evaluating on that basis, desalination is not the most expensive of all of the alternatives.

The overall costs are significantly less than some other alternatives. The overall capital costs are similar in magnitude to the overall capital cost for constructing a conveyance system between La Cienega de Santa Clara and the Salton Sea, and the overall operational costs for local treatment are among the lowest values associated with any of the alternatives provided. Additionally, the local treatment option provides great operational flexibility in the sense that all of the water going in and out of the Salton Sea is contained within the local boundaries of the Salton Sea and does not involve coordination with other agencies that are responsible for the water being imported to the Salton Sea or the receiving location for any water that is exported out of the Salton Sea.

4.3.4 Institutional Considerations

Regulatory approvals are required for the construction of a treatment plant, and environmental studies must be conducted to ensure that the intake structure for the treatment plant will not adversely affect the species and habitat within the Salton Sea. There are extensive resources and research available in regard to intake structures associated with ocean desalination, and it is anticipated that a similar variety of options and considerations would be applicable to the construction of a desalination facility at the Salton Sea. Similarly, return flows of the treated water should be discharged back into the Salton Sea in a manner that is not obtrusive to the native habitat. A possible solution would be to utilize existing channels that currently discharge into the Salton Sea. Additionally, a local treatment option would not involve regulatory approvals and buy-in from as many agencies and would be independent of approval by Mexico, versus other importation and exportation options.

Energy consumption is a primary concern in regard to membrane desalination, and the energy footprint could be offset with the installation of RE sources, such as solar panels or wind turbines, adjacent to the treatment facility at the Salton Sea. Because all of the necessary facilities would be in close proximity, RE is a viable option for offsetting any increases in energy requirements.

4.3.5 Conceptual Plans

Conceptual plans prepared for the Local Desalination alternative can be found in Appendix 11.7. These plans were used to form the basic concept for the pipeline route and its key components. Conceptual level cost estimates were then developed from the layouts presented in these plans. Appendix 11.7 contains the following conceptual drawings:

- A pump station mechanical plan and section;
- An intake structure; and
- A discharge header.

4.3.6 Cost Evaluation

An evaluation of project costs was conducted including the following components: mobilization and demobilization, intake systems and facilities, intake pump station, intake pumps, intake pump station mechanical piping, intake pump station auxiliary items, conveyance pipe, pressure reducing station, buildings and/or vaults, outlet system facilities, onshore additional structures, and electrical/instrumentation. Treatment and pipe flow for this alternative were based on a middle range capacity of 75,000 AFY. The cost provided in Table 7 provides a preliminary conceptual estimate based on the best currently available data and is subject to change. As shown, treatment would be a very expensive approach for addressing salinity, and the additional timeframe for a benefit is uncertain as the Salton Sea volume would continue to reduce and concentrate the existing salt.

4.3.7 Screening Level Performance Analysis

For this alternative, the Modified SSAM was run for both the baseline and uncertainty future inflow scenarios. The baseline case assumes a future inflow of approximately 865,500 AFY, long after QSA mitigation flows end in 2017. The uncertainty case assumes a future inflow of about 689,000 AFY. The Modified SSAM and the future inflow assumptions are discussed in section 1.3 and in Salton Sea Funding and Feasibility Action Plan, Benchmark 2: Review and Update Existing Condition Data.

Table 7 Cost Estimate for Desalination

Description	Quantity	Unit	Unit Price	Total
1 Mobilization/Demobilization	1	LS	$44,894,000	$44,894,000
2 Intake Structure	1	LS	$9,851,000	$9,851,000
3 Intake Pump Station	1	LS	$4,908,000	$4,908,000
4 Intake Pumps	1	LS	$5,397,000	$5,397,000
5 Intake Pump Station Mechanical Piping	1	LS	$267,000	$267,000
6 Intake Pump Station Auxilary Items	1	LS	$1,073,000	$1,073,000
7 Desalination Treatment Plant	1	LS	$865,000,000	$865,000,000
8 Evaporation Pond	1	LS	$500,000	$500,000
9 Outlet System/Facility (Evap Pond), onshore	1	LS	$142,000	$142,000
10 Outlet System/Facility (Salton Sea), offshore	1	LS	$1,946,000	$1,946,000
11 Additional Structures	1	LS	$3,299,000	$3,299,000
12 Electrical / Instrumentation	1	LS	$5,499,000	$5,499,000
			Design, Project and Construction Management (25% Items 2-6, 8-12)	$8,221,000
			Subtotal	$950,997,000
			Contingency (30%)	$285,299,000
			Total	$1,236,296,000

Current outlines for this alternative include blending inflow water with Salton Sea water both upstream and downstream of treatment to drop the salinity level of inflow to the Salton Sea. Due to this blending approach, a detailed analysis of this alternative is not simply a matter of inflow and outflow to the Sea as the Modified SSAM is set up for. However, the model was run assuming reasonable inflow/outflow amounts to attain a rough estimate of the potential results of this alternative. Therefore, the model was run for both future inflow scenarios with a theoretical outflow amount of 75,000 AFY, a theoretical inflow amount of 67,000 AFY, and a theoretical salinity of 12 ppt.

The results of the model run for the baseline future inflow case of 865,000 AFY are shown in Figure 38, and the results of the model run for the uncertainty future inflow case of 689,000 AFY are shown in Figure 39. These results can be compared to the No Action scenarios illustrated in Figure 1 and Figure 2. For this screening level evaluation it was assumed that operation of the Local Desalination Alternative would begin in the year 2025. It was estimated that, from a decision point in 2017, it would take about eight years to complete the environmental documentation, the design and permitting, right-of-way clearance and land acquisition, and thus result in a 2025 start up.

For the baseline inflow case, the results shown in Figure 38 indicate that the Sea level would drop to about 20 feet by the year 2100. This drop in Sea level would be about 6 feet lower than what is expected to occur with No Action in the year 2100. In the year 2100, however, salinity levels would drop just below 80 ppt, which is much lower than what would occur under No Action.

Key results of the baseline inflow model run are as follows:

- The water surface would dramatically decline until the year 2030, and it would gradually stabilize after the year 2030 at an elevation of about -250' to -255' NGVD. This would result in an average water depth of about 15 feet and a maximum water depth of about 20 feet.

- Salinity would peak at about 115-120 ppt between the years 2030 to 2050 and then drop gradually by the year 2070 after a more dramatic decrease between the years 2050 and 2070. In the year 2100, salinity is expected to be about 20 ppt over the current level at around 80 ppt.
- The lake area would stabilize between -240 and -250 sq mi after the year 2040.
- The volume of water in the lake in the year 2050 is projected to be 2.65 MAF or about 34.9% of the lake volume as it was in 2000.

For the uncertainty inflow case, the results shown in Figure 39 indicate that the salinity would drop more dramatically and be present at around 60 ppt by the year 2100. Additionally, the lake volume would be reduced to a smaller size than for the baseline inflow case, with the volume dropping to approximately 19.2% of the year 2000 volume, and the elevation would be about ten feet lower than in the baseline case.

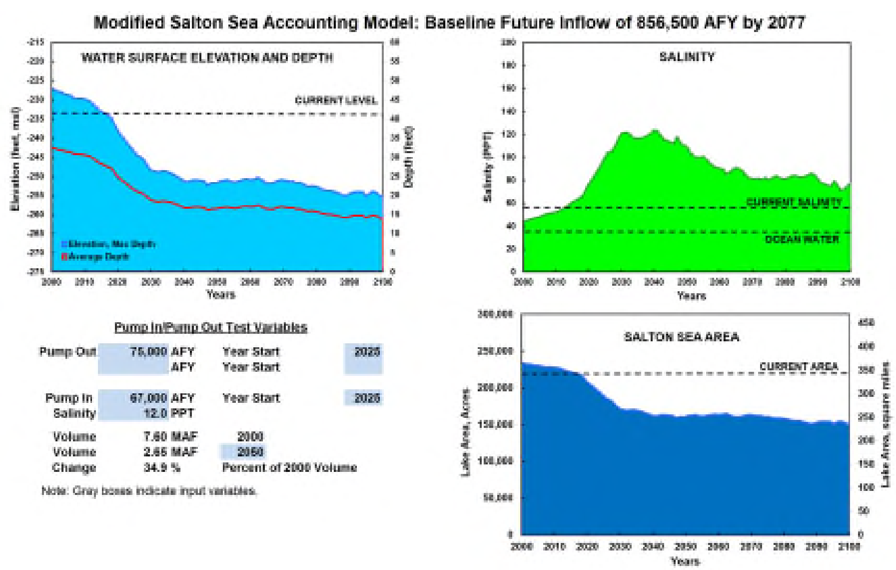

Figure 38 Local Desalination Baseline Future Inflow

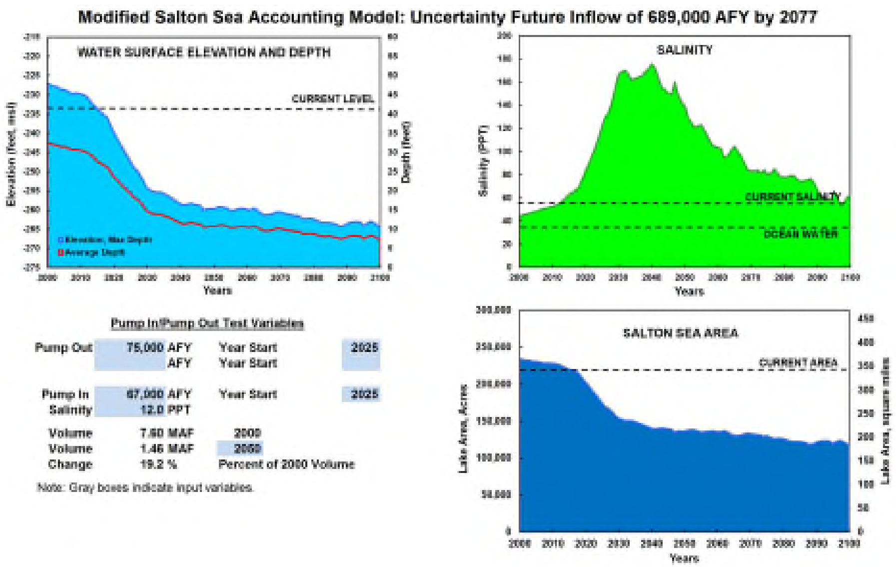

Figure 39 Local Desalination Uncertainty Future Inflow

4.3.8 Summary

In consideration of the variety of options and alternatives proposed for the Salton Sea, this is the single comprehensive option that is completely located within close proximity to the Salton Sea. No aspect of this project requires importing water from great length or exporting water across international borders. Therefore, this option provides greater design and operational flexibility, given that this option does not require such extensive coordination and collaboration with other agencies and parties as the other alternatives. This solution also eliminates the potential for environmental impacts to separate ecosystems and habitats away from the Salton Sea, especially those as sensitive and protected as La Cienega de Santa Clara. Local treatment of the Salton Sea is currently the most favorable and viable option for addressing salinity issues at the Salton Sea.

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5.0 Evaluation of Import/Export Alternatives

Due to the wide variety of methods for conveying water into and away from the Sea, an analysis of the different alternatives is presented here for assessment. This section also explains a ranking system used to evaluate the various methods. See Table 9 for a ranking of inflow conveyance alternatives, Table 10 for a ranking of Outlet Alternatives, and Table 11 for a ranking of combined inlet and outlet alternatives.

Evaluation of the alternatives requires consideration of quantifiable elements such as volumes of water and distance of conveyance, as well as implementation elements with many unknown, unquantifiable, or to be determined elements, such as regulatory and agency approvals, impacts to nearby communities, and environmental studies and mitigation.

5.1 Evaluation Methods

The quantifiable engineering-based elements include the following:

- Length of pipeline [feet] – based on a conceptual pipeline alignment from start and end points
- Hydraulic lift [feet] – determined based upon the highest single elevation along the conceptual pipeline alignment
- Water quantity (Rank 1 to 5)
- Water quality of water sources and outlet impact for outlets (Rank 1 to 5)
- Magnitude of capital cost (Rank 1 to 5) – a rank of the total capital cost for each alternative
- Magnitude of annual operation cost (Rank 1 to 5) – a rank based on calculation of the annual energy use to pump water to and from the Salton Sea, and accounting for additional cost when treatment is necessary for the water source

Operational costs for each alternative were evaluated with the most significant costs identified as the cost to pump water and the cost to operate treatment facilities (when applicable). The capital costs for each alternative were evaluated, which revealed that the most significant contribution came from the length and size of conveyance pipelines and the number of pump stations required.

Table 8 provides a summary of the cost estimates that were prepared for the most promising import and export options.

Table 8 Summary of Cost Evaluations

Alternatives	Flow (AF)	Subtotal	Contingency (30%)	Total
Inflow to Salton Sea - MWD Concentrate	43,000	$132,845,000	$39,854,000	**$172,699,000**
Inflow to Salton Sea - YDP Concentrate	32,000	$243,775,000	$73,133,000	**$316,908,000**
Inflow to Salton Sea - Local WWTPs	15,700	$24,783,000	$7,435,000	**$32,218,000**
Outflow from Salton Sea - Laguna Salada	150,000	$405,142,000	$121,543,000	**$526,685,000**
Outflow from Salton Sea - Gulf of California	150,000	$910,043,000	$273,013,000	**$1,183,056,000**
Outflow from Salton Sea - Evaporation Ponds	50,000	$34,765,000	$10,430,000	**$45,195,000**
Inflow/Outflow at Salton Sea - Desalination	75,000	$950,997,000	$285,299,000	**$1,236,296,000**

The implementation elements include the following:

- Time, cost, and environmental studies and conditions necessary to gain permits and approvals (Rank 1 to 5)
- Impacts to communities and acquisition of land or easements (Rank 1 to 5)

The implementation rankings are based on a combination of time and cost factors related to the approvals required for construction and potential impacts to nearby communities. The factors include the following: the number of agencies involved, proximity to inhabited communities in the United States and Mexico, changes to water exchanges between the United States and Mexico, modification of water supply to habitat areas (La Cienega de Santa Clara), impacts and studies of impacts to local groundwater, the footprint of constructed facilities for the alternative which directly impacts the size and number of environmental studies, and easement or land acquisition.

An evaluation matrix has been developed to capture the various elements and summarize overall considerations. The alternatives have been analyzed based on a summary of factors and utilizing best judgment of how the alternative ranks for each particular evaluation element. A scoring system has been implemented that gives the highest rank as a value of "5" and lowest rank as a value of "1". Each of the categories of evaluation is evenly weighted. The evaluation matrix has enabled ranking of the alternatives, as follows.

From the evaluation, it was determined the most viable alternatives are the MWD Concentrate Pipeline and increased inflow from local wastewater treatment plants, followed by options to deliver treated or untreated water from Yuma, Arizona.

The MWD Concentrate Pipeline is highly ranked as it is a feasible project that is mutually beneficial to the Salton Sea and MWD. Upon initial evaluation, the largest constraint on this alternative is the dependency on MWD to decide to construct treatment, and the coordination for approval and design of facilities to treat and convey concentrate pipeline from the Julian Hinds Pump Station site.

Increasing the flow and efficiency of delivery to the Salton Sea is highly ranked as this will also be a joint benefit alternative. Several of the existing plants have plans in place for expansion, which will require approval of increase discharge flows, or construction of new equipment and processes to treat to tertiary levels for use as recycled water. There are three wastewater treatment plants initially identified in the evaluation which currently deliver treated effluent to the Coachella Valley Stormwater Channel, which ultimately flows to the Salton Sea. To capture the normal or baseline effluent flow from the plants and convey through a section of lined channel or pipeline would increase the annual inflow to the Salton Sea and make best use of this water source.

Alternatives to convey water from the Salton Sea exhibit less variability than those for inflow. This is largely due to similar outlet impacts and cost benefit. The largest influencing factors for outflow alternatives are distance of conveyance and pumping hydraulics and environmental impacts, such as the significance of conveying much higher salinity through the Bypass Drain which reaches La Cienega de Santa Clara.

Through the evaluation two high ranking alternatives were identified: Laguna Salada and local evaporation. These are two very different options, with completely different facilities necessary to be constructed and different limitations on what volume of water can be discharged. The Laguna Salada is an established and large area, capable of receiving a large volume of water from the Salton Sea. The main considerations for flow to the Laguna Salada will be the environmental and community impacts, as well as approvals from the Mexican Government. With local evaporation, the limitations will be the footprint of the facilities and establishment of agreements or acquisition of land upon which to operate.

The evaluation of combined inlet and outlet alternatives showed that exchanging water between the Salton Sea and the Gulf of California or Pacific Ocean was not practical. The long distance of conveyance and hydraulic requirements drove the operational and capital cost benefit severely down. A far more advantageous alternative appears to be desalination of the Salton Sea water. Through this alternative a beneficial flow rate can be identified and the two main objectives of salt content removal and water level maintenance can be pursued in unison. The alternative is the only one that reduces salinity without either requiring new water sources with a high flow rate or removing salt by continuously discharging or evaporating a large volume of Salton Sea water.

5.2 Conclusions

There are many factors that influence which are the best alternatives for water conveyance to and from the Salton Sea. In addition, the factors are a combination of quantifiable and implementation or nonquantifiable elements that encompass the benefit cost and steps necessary to ultimately design and construct each alternative. With so many different alternatives having been considered in the past, the goal of this report has been to identify the most viable alternatives, to be studied in further depth and conceptually designed in greater detail.

The alternatives for importing concentrate flows from MWD and the YDP both possessed strong financial benefits in terms of cost-effectiveness, and export of water from the Salton Sea to Laguna Salada was the least costly option out of the three primary outflow alternatives. All of these options, however, require significant collaboration and coordination with key stakeholders. In terms of cost efficiency and overall benefit to the Salton Sea, the local desalination alternative proves to be the greatest opportunity. It is not only financially competitive with the other alternatives, if not more cost effective, it is also the only option that provides a locally sourced solution for addressing the issues at the Salton Sea.

The screening analyses suggest that some of the concepts presented here would have only minimal benefits to the full Salton Sea under the projected inflows. However, some of these options could be reviewed again when combined with smaller lake plans discussed in Benchmark 4, Volume 2.

Table 9
Ranking Matrix of Alternatives for Inflow to Salton Sea

	Water Source		Conveyance System		Institutional Considerations		
SALTON SEA IMPORTS	Water Quantity	Water Quality	Operational Cost Benefit	Capital Cost Benefit	Approvals and Environmental	Community Impacts and Easements	TOTAL
SARI	1	1	1	1	2	1	7
MWD	2	3	4	3	3	4	19
Yuma Desalting Plant (Concentrate)	2	3	3	3	3	4	18
MODE Pipeline	4	3	4	4	1	1	17
From Gulf of California	5	2	1	1	1	2	12
In from Pacific Ocean	5	2	1	1	1	1	11
Colorado Excess	n/a	-	-	-	-	-	-
Hyperion WWTP	5	4	1	1	1	1	13
Point Loma WWTP	5	4	1	1	1	1	13
Local WWTPs	2	4	4	4	2	3	19
Coachella Channel	1	4	5	3	1	3	17

Table 10
Ranking Matrix for Outlet Alternatives

SALTON SEA EXPORTS	Outlet		Conveyance System		Institutional Considerations		TOTAL
	Water Quantity	Outlet Impact	Operational Cost Benefit	Capital Cost Benefit	Approvals and Environmental	Community Impacts and Easements	
Laguna Salada	5	2	5	5	2	2	21
La Cienega de Santa Clara	5	1	5	4	1	1	17
To Gulf of California	5	4	4	3	2	1	19
Evaporation Facilities Dust Mitigation Evaporation Ponds Enhanced Evaporation	2	4	5	4	3	3	21
To Pacific Ocean	5	4	2	3	1	1	16
Palen Dry Lake	5	1	1	5	3	2	17

Table 11
Ranking Matrix of Combined Inlet and Outlet Alternatives

SALTON SEA – COMBINED IN/OUT	Water Source		Conveyance System		Institutional Considerations		TOTAL
	Water Quantity	Outlet Impact	Operational Cost Benefit	Capital Cost Benefit	Approvals and Environmental	Community Impacts and Easements	
Sea to Sea Gulf	5	1	2	2	2	1	13
Sea to Sea Pacific	5	1	1	2	1	1	11
Local Desalination	4	5	4	3	3	4	23

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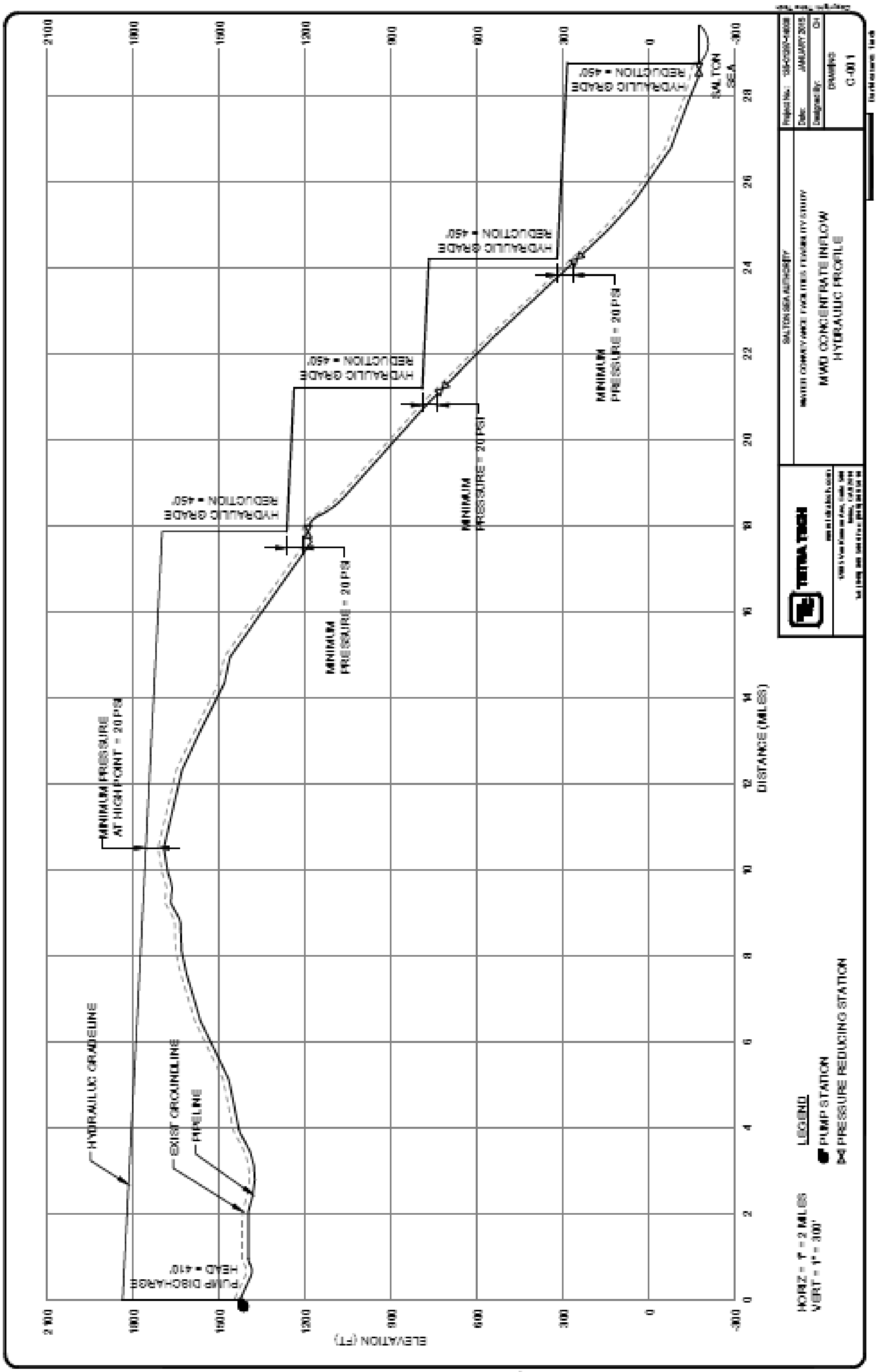
7.0 Appendices

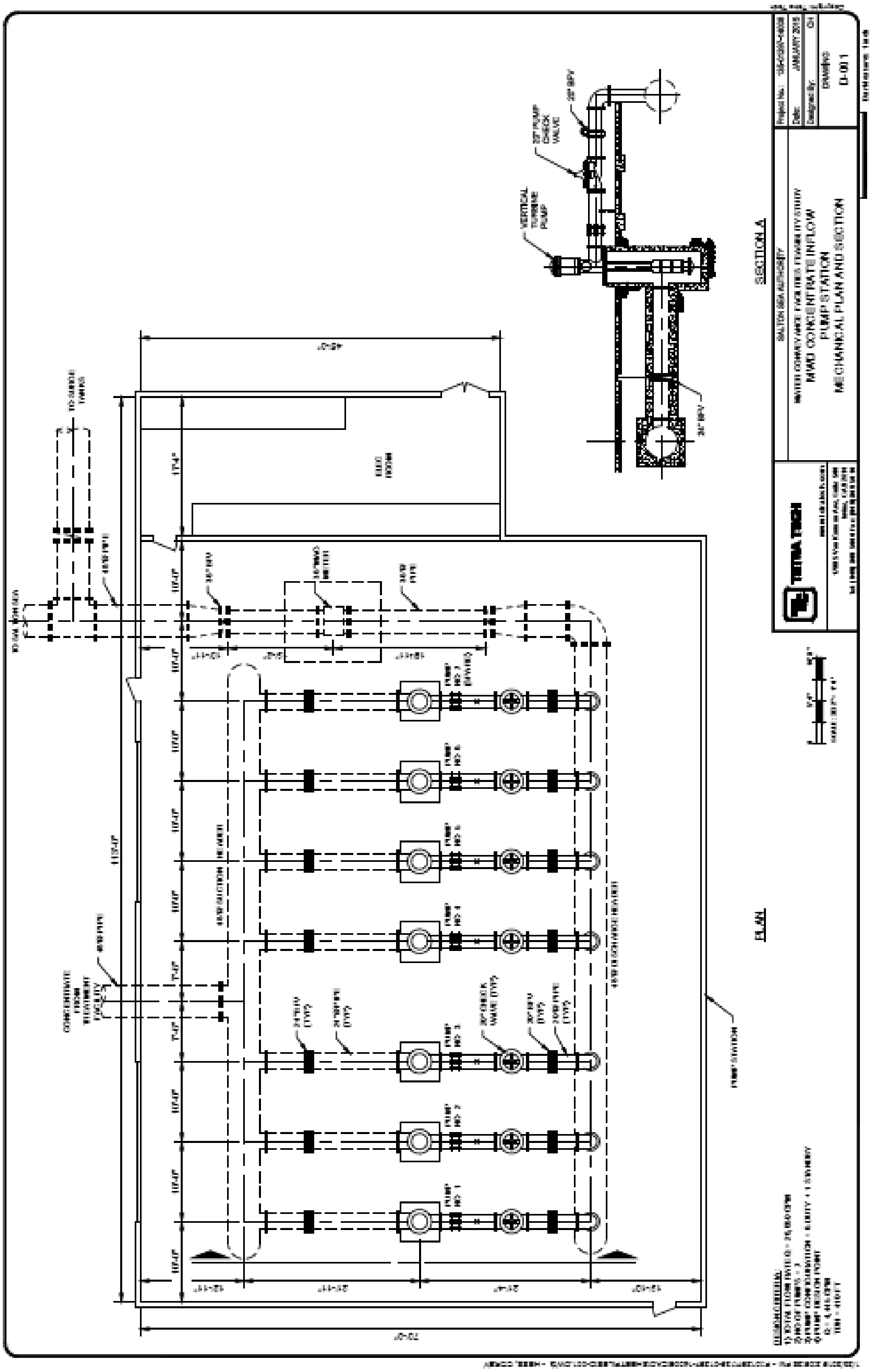
This section contains conceptual drawings pertinent to the following restoration options: The MWD Concentrate Pipeline, the YDP, Local WWTPs, using the Laguna Salada Basin as an outlet, using the Gulf of California as an outlet, Evaporation, and Desalination.

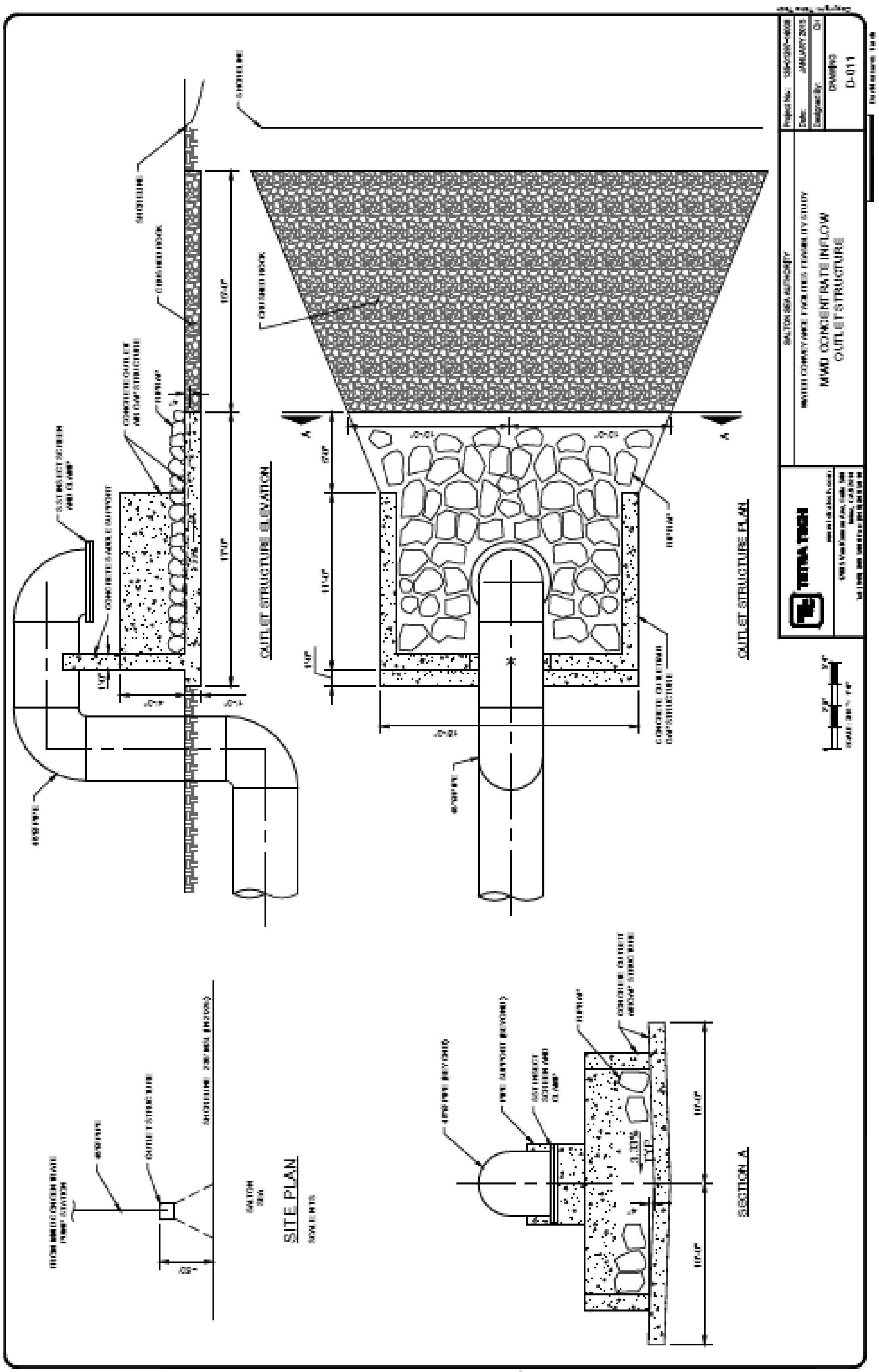
7.1 Appendix A: MWD Concentrate Pipeline Attachments

Conceptual plans prepared for the MWD Concentrate Pipeline alternative can be found on the following pages. The following conceptual drawings are provided:

- Hydraulic profile;
- A pump station mechanical plan and section; and
- Outlet structure.


HYDRAULIC GRADELINE
EXIST GROUNDLINE
PIPELINE
PUMP DISCHARGE HEAD = 410'
MINIMUM PRESSURE AT HIGH POINT = 20 PSI
MINIMUM PRESSURE = 20 PSI
HYDRAULIC GRADE REDUCTION = 450'
SALTON SEA
DISTANCE (MILES)
ELEVATION (FT)
HORIZ = 1" = 2 MILES
VERT = 1" = 300'
LEGEND
PUMP STATION
PRESSURE REDUCING STATION
TETRA TECH
SALTON SEA AUTHORITY
MWD CONCENTRATE INFLOW
HYDRAULIC PROFILE
C-001

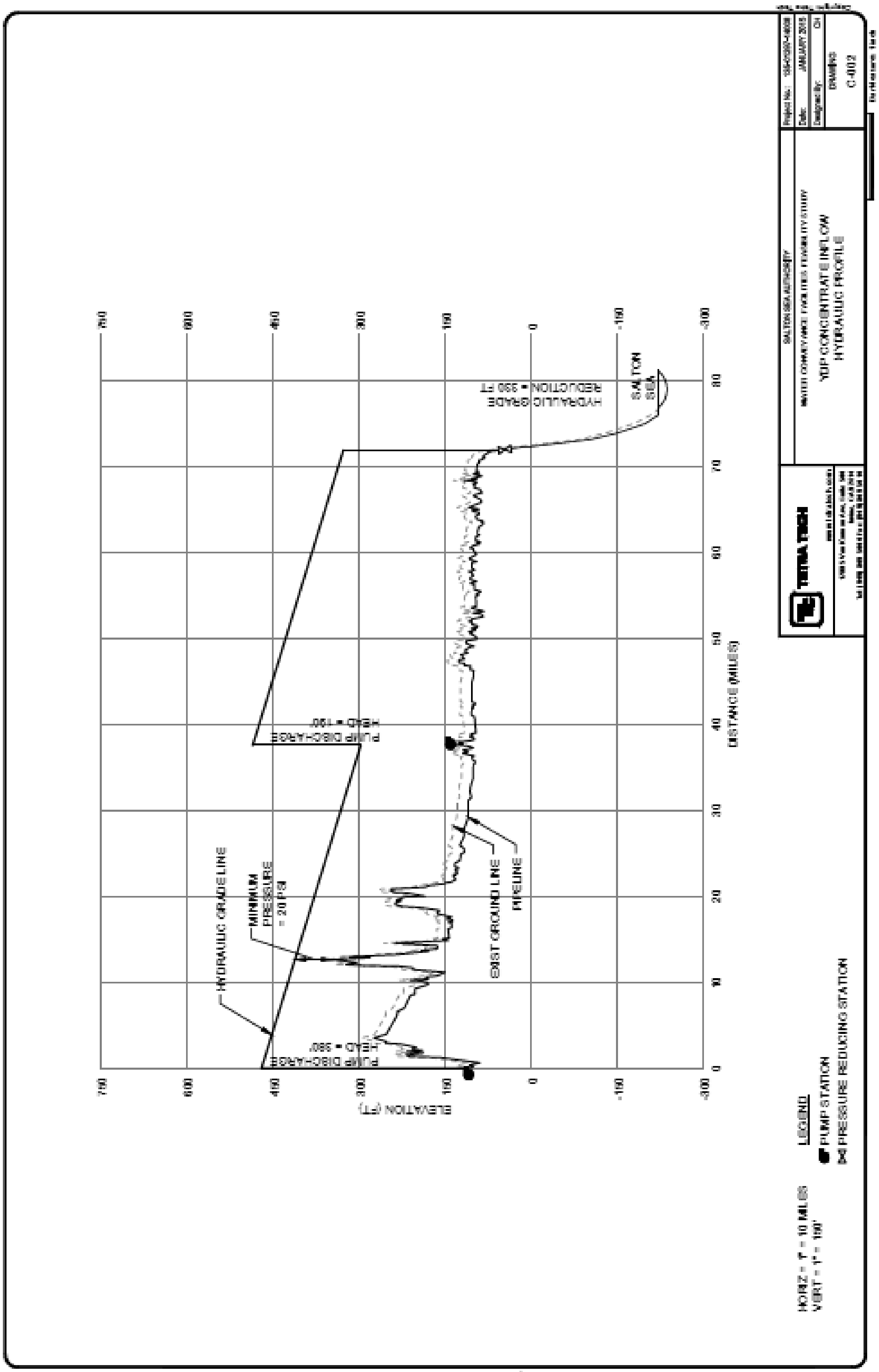

SECTION A
PLAN
MWD CONCENTRATE INFLOW
PUMP STATION
MECHANICAL PLAN AND SECTION
D-001
TETRA TECH

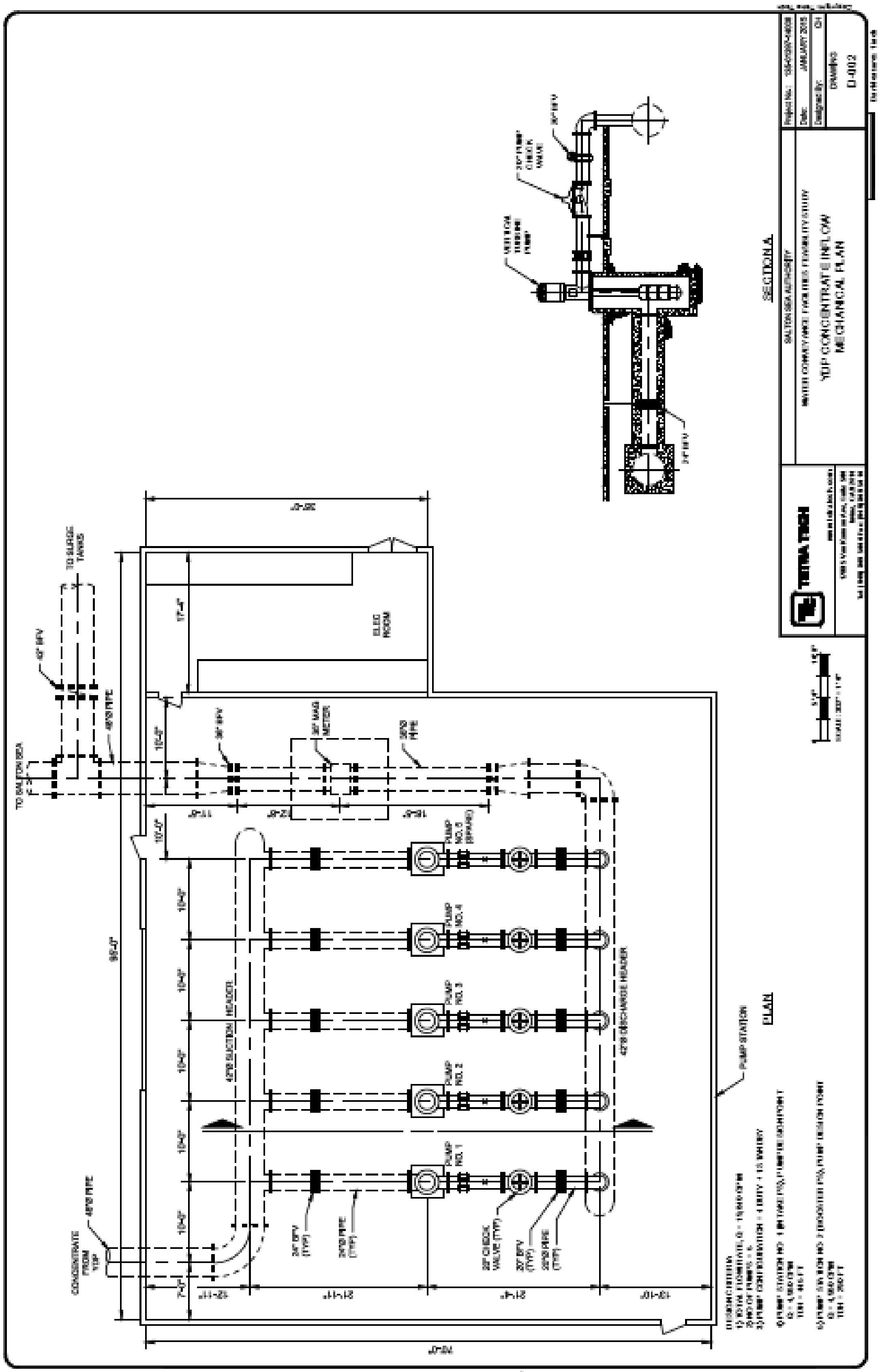

OUTLET STRUCTURE ELEVATION
OUTLET STRUCTURE PLAN
SITE PLAN
SECTION A
TETRA TECH
NWD CONCENTRATE INFLOW
OUTLET STRUCTURE
D-011

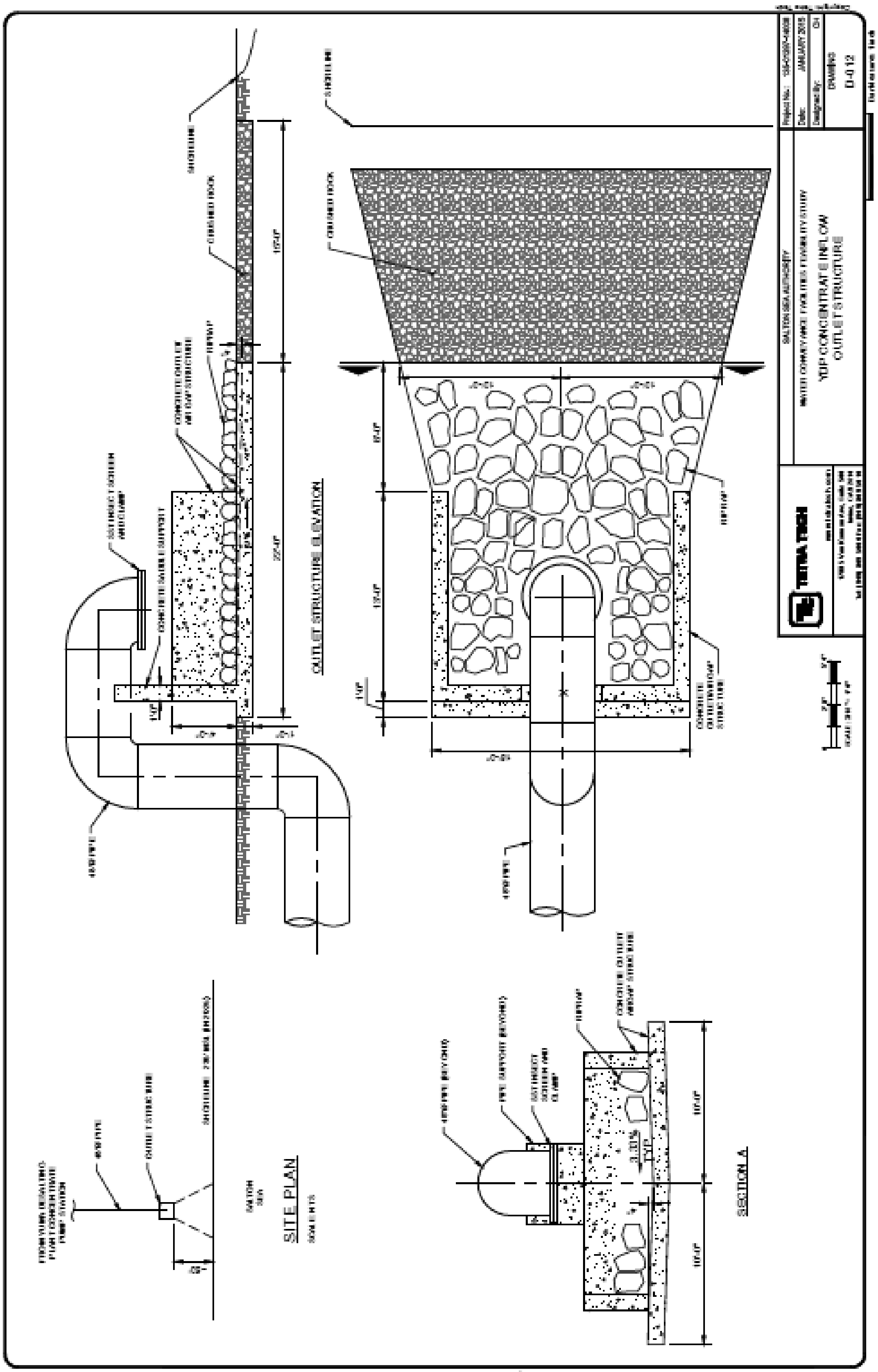
7.2 Appendix B: YDP Attachments

Conceptual plans prepared for the YDP alternative can be found on the following pages. The following conceptual drawings are provided:

- Hydraulic profile;
- A pump station mechanical plan and section; and
- Outlet structure.


HYDRAULIC GRADE LINE
MINIMUM PRESSURE = 20 PSI
EXIST GROUND LINE
PIPELINE
PUMP DISCHARGE HEAD = 380'
PUMP DISCHARGE HEAD = 190'
HYDRAULIC GRADE REDUCTION = 330 FT
SALTON SEA
ELEVATION (FT)
DISTANCE (MILES)
HORIZ = 1" = 10 MILES
VERT = 1" = 150'
LEGEND
PUMP STATION
PRESSURE REDUCING STATION
TETRA TECH
YDP CONCENTRATE INFLOW HYDRAULIC PROFILE
C-002

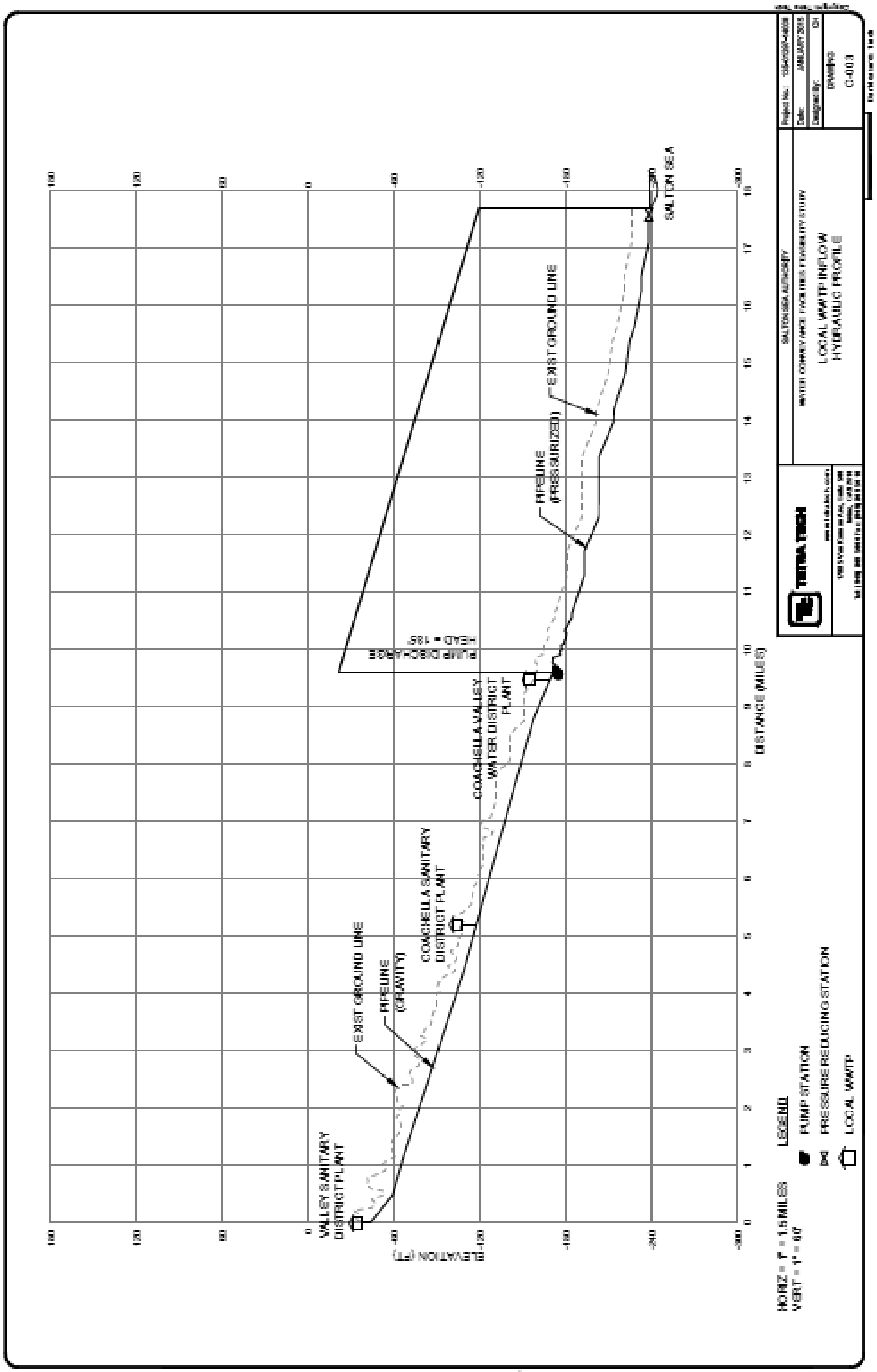

SECTION A
PLAN
YDP CONCENTRATE INFLOW
MECHANICAL PLAN
D-002

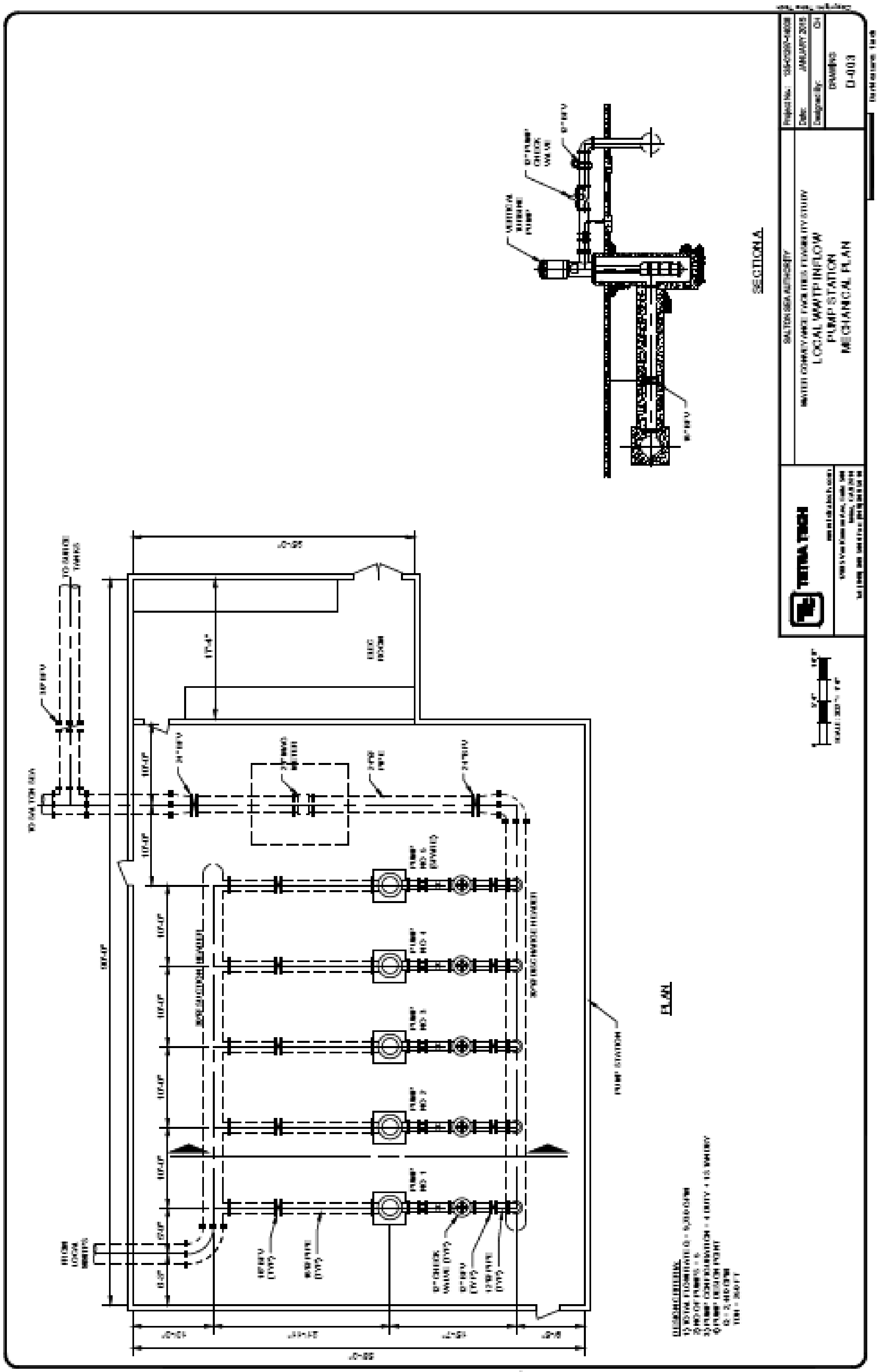

OUTLET STRUCTURE ELEVATION
SITE PLAN
SECTION A
YDP CONCENTRATE INFLOW
OUTLET STRUCTURE
D-012

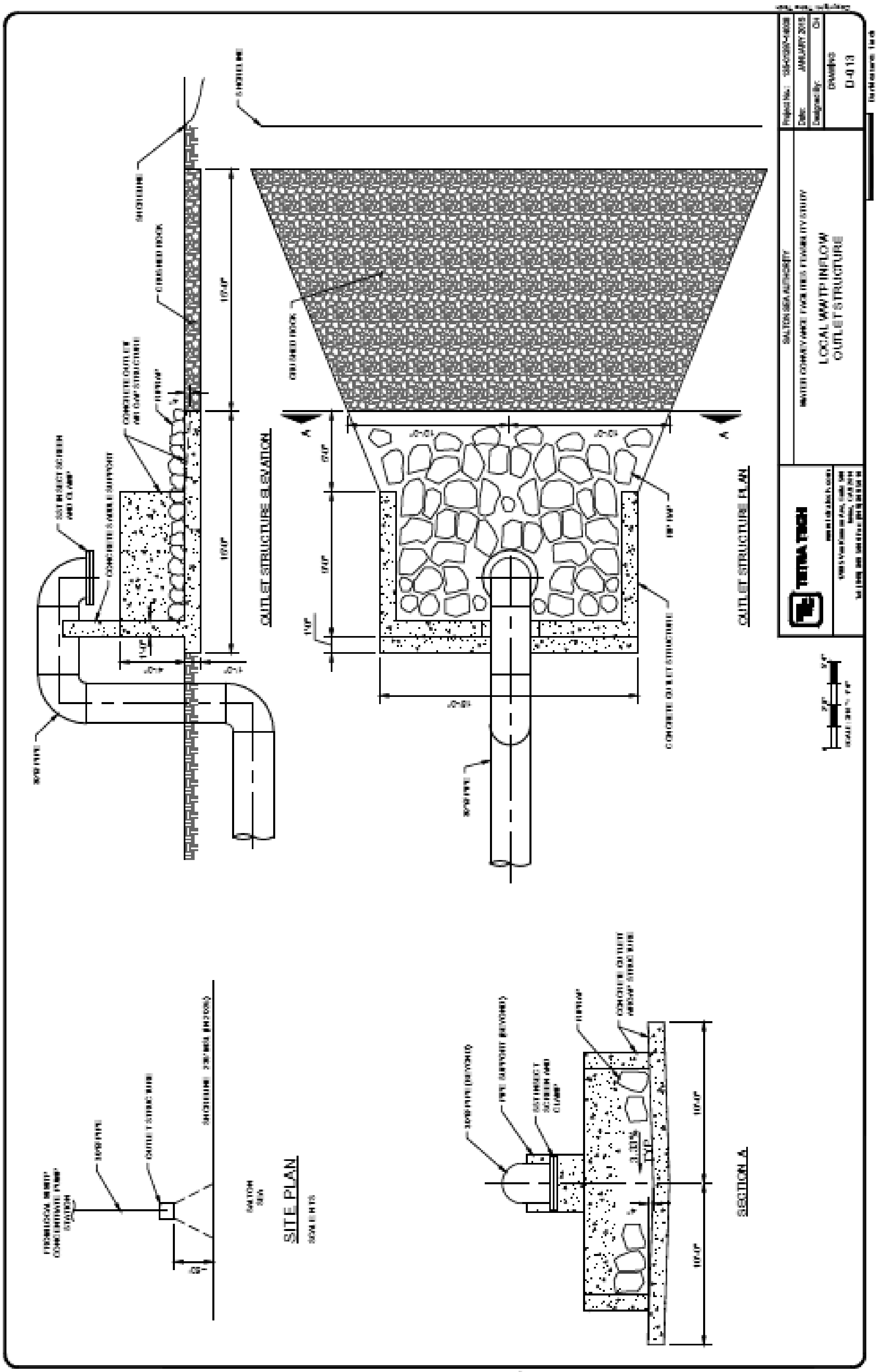
7.3 Appendix C: WWTP Attachments

Conceptual plans prepared for the WWTP alternative can be found on the following pages. The following conceptual drawings are provided:

- Hydraulic profile;
- A pump station mechanical plan and section; and
- Outlet structure.


SALTON SEA
EXIST GROUND LINE
PIPELINE (PRESSURIZED)
PUMP DISCHARGE HEAD = 185'
COACHELLA VALLEY WATER DISTRICT PLANT
COACHELLA SANITARY DISTRICT PLANT
EXIST GROUND LINE
PIPELINE (GRAVITY)
VALLEY SANITARY DISTRICT PLANT
ELEVATION (FT)
DISTANCE (MILES)
HORIZ = 1" = 1.5 MILES
VERT = 1" = 60'
LEGEND
PUMP STATION
PRESSURE REDUCING STATION
LOCAL WWTP
TETRA TECH
SALTON SEA AUTHORITY
LOCAL WWTP INFLOW
HYDRAULIC PROFILE
JANUARY 2016
C-003

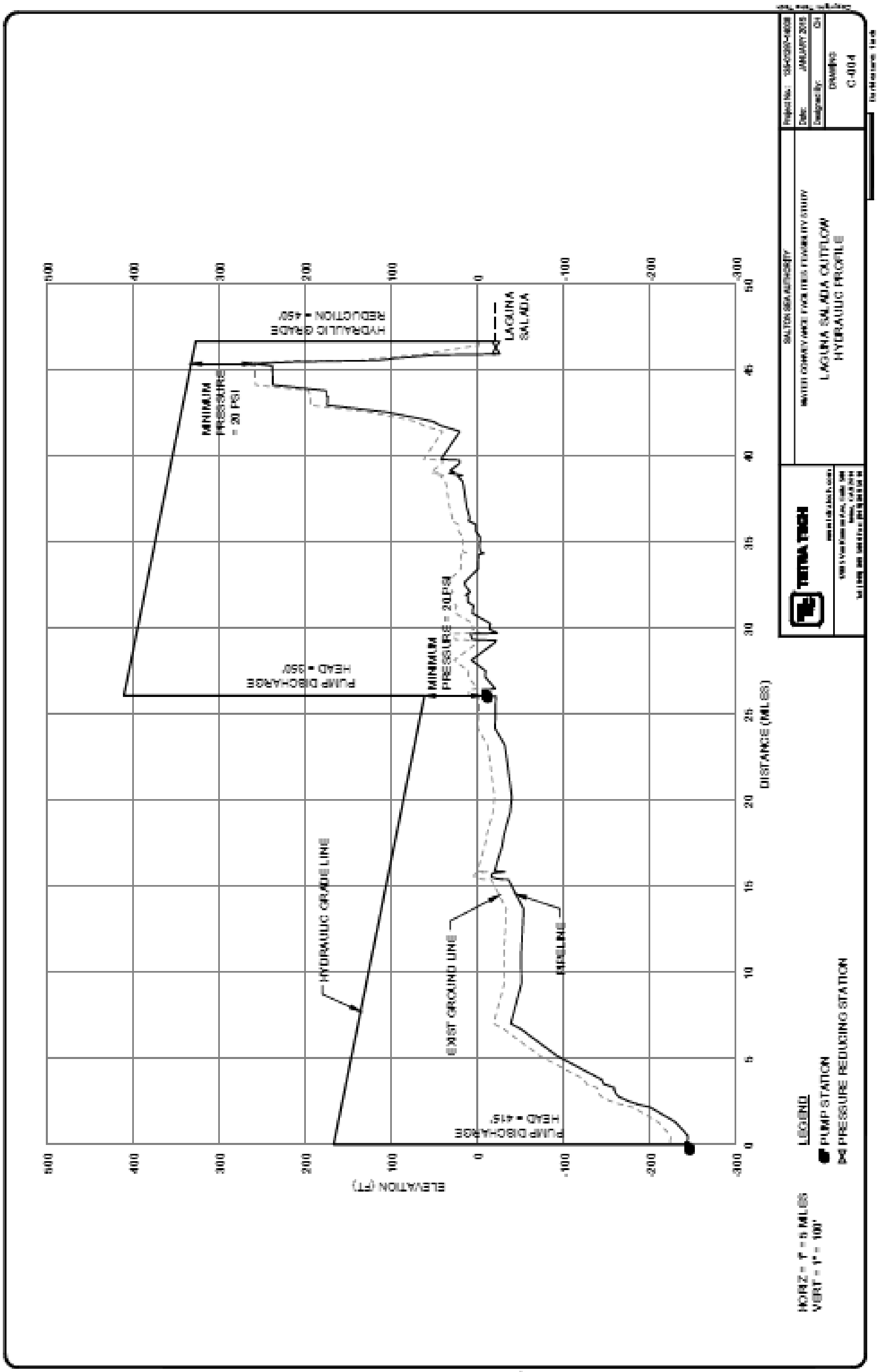

SECTION A
PLAN
TETRA TECH
SALTON SEA AUTHORITY
LOCAL WATP INFLOW
PUMP STATION
MECHANICAL PLAN
D-003

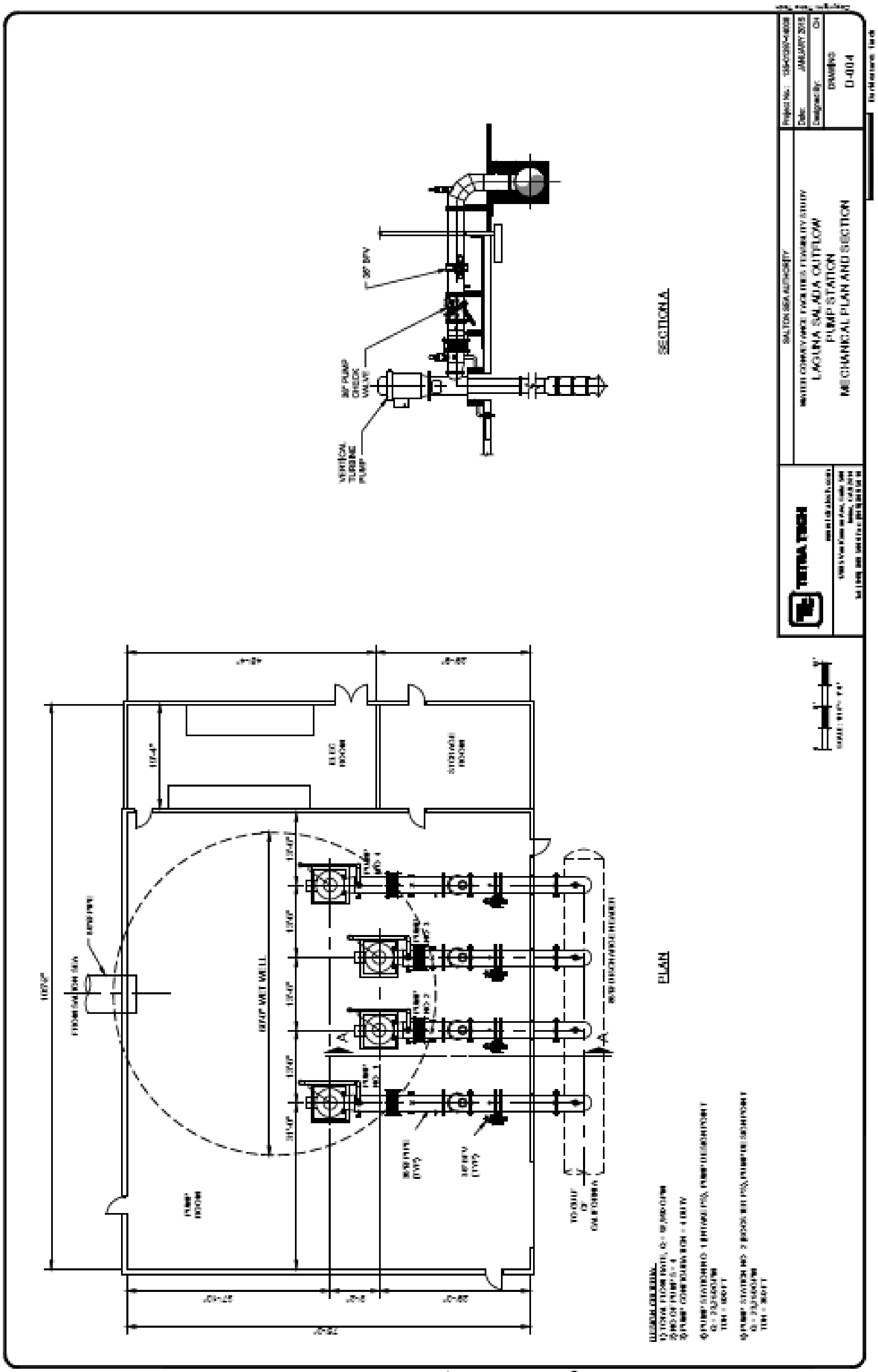

OUTLET STRUCTURE ELEVATION
OUTLET STRUCTURE PLAN
SITE PLAN
SECTION A
SALTON SEA AUTHORITY
LOCAL WWTP INFLOW
OUTLET STRUCTURE
TETRA TECH
D-013

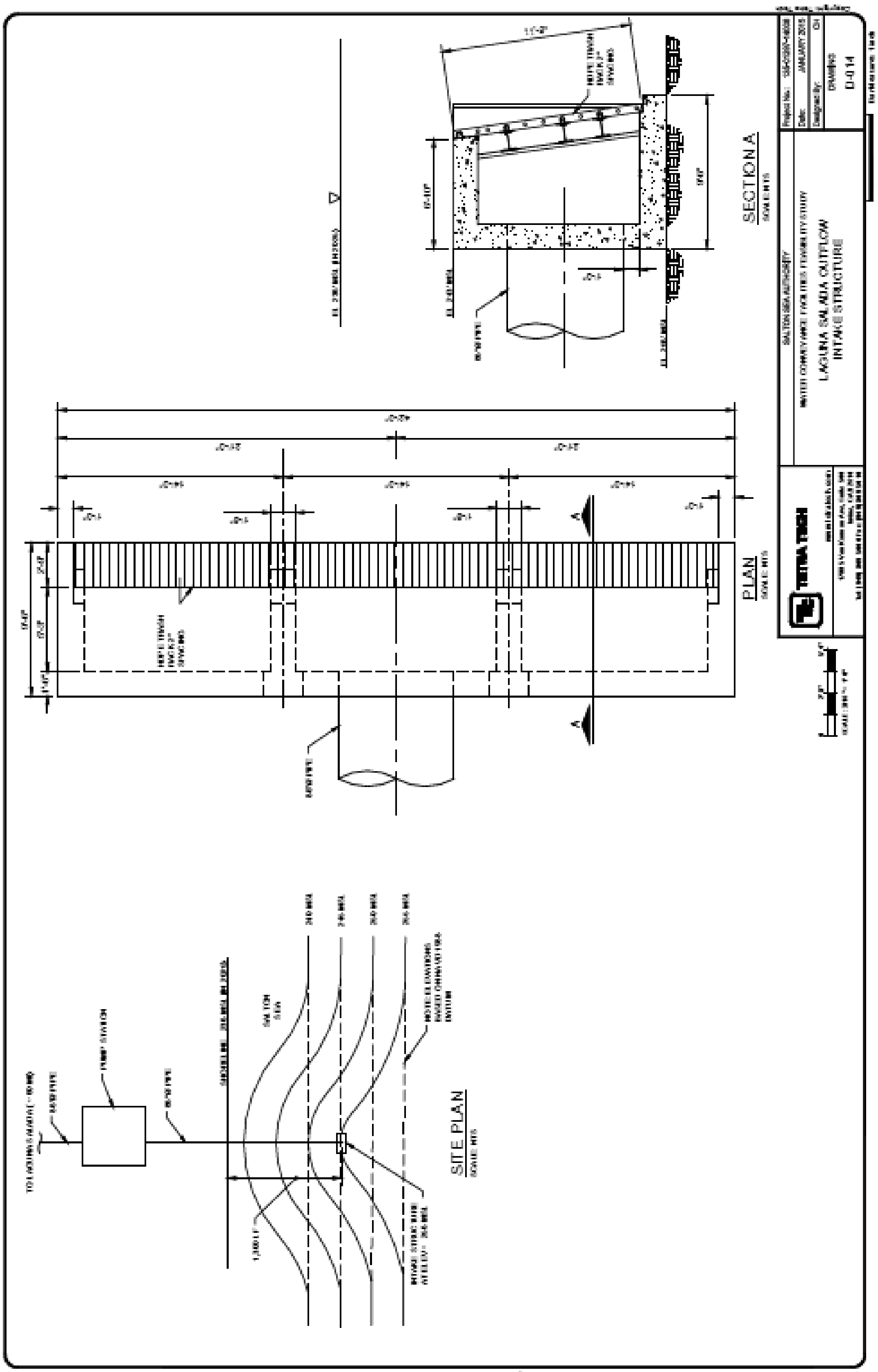
7.4 Appendix D: Laguna Salada Attachments

Conceptual plans prepared for the Laguna Salada Pipeline alternative can be found on the following pages. The following conceptual drawings are provided:

- Hydraulic profile;
- A pump station mechanical plan and section; and
- Intake structure.


SALTON SEA AUTHORITY
LAGUNA SALADA OUTFLOW
HYDRAULIC PROFILE
C-004
TETRA TECH
HYDRAULIC GRADE LINE
EXIST GROUND LINE
PIPELINE
PUMP DISCHARGE
HEAD = 415'
PUMP DISCHARGE
HEAD = 350'
MINIMUM
PRESSURE = 20 PSI
HYDRAULIC GRADE
REDUCTION = 450'
LAGUNA
SALADA
DISTANCE (MILES)
ELEVATION (FT)
LEGEND
PUMP STATION
PRESSURE REDUCING STATION
HORIZ = 1" = 5 MILES
VERT = 1" = 100'

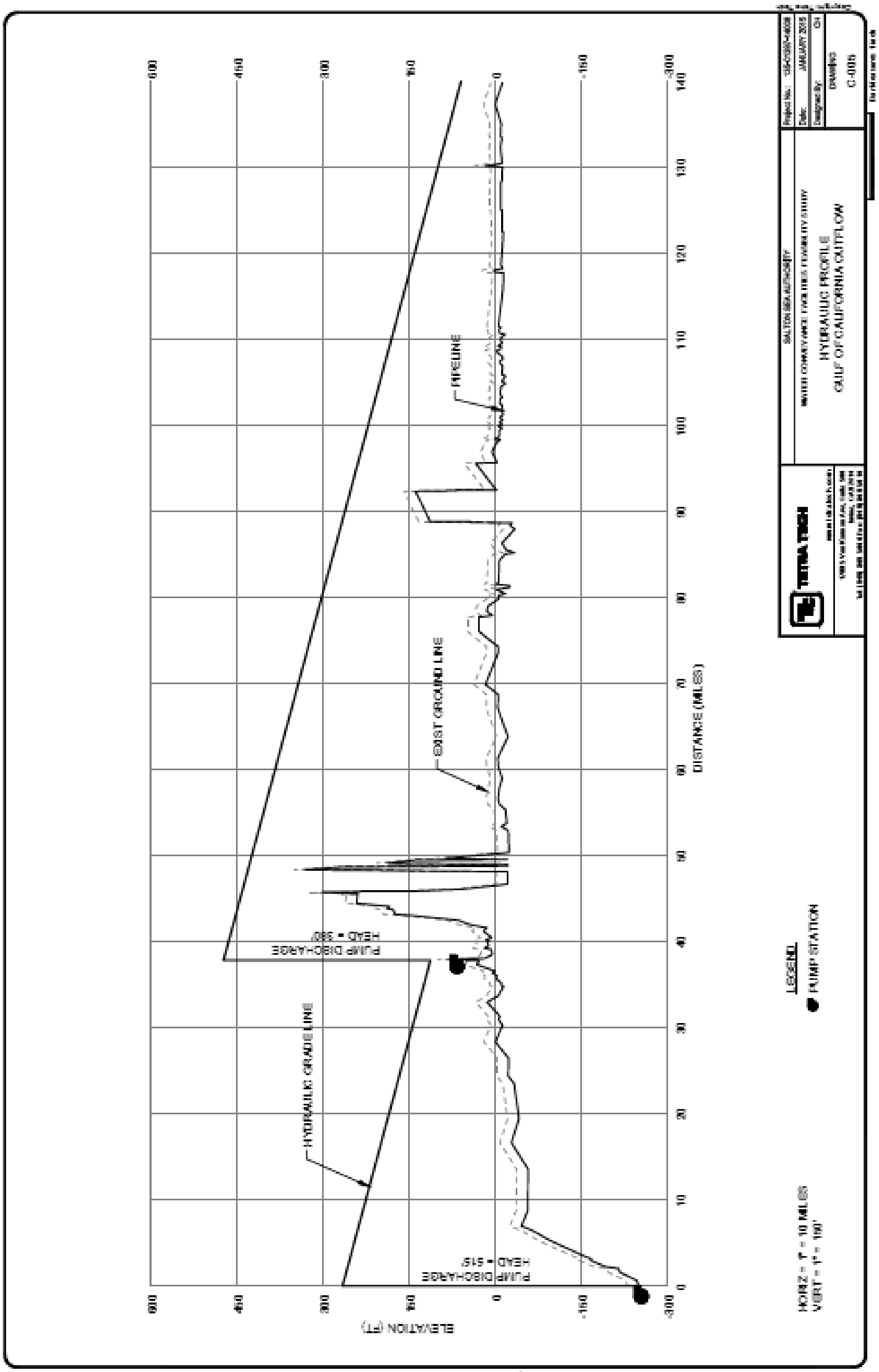

SECTION A
PLAN
VERTICAL TURBINE PUMP
TETRA TECH
SALTON SEA AUTHORITY
LAGUNA SALADA OUTFLOW
PUMP STATION
MECHANICAL PLAN AND SECTION
JANUARY 2016
D-404

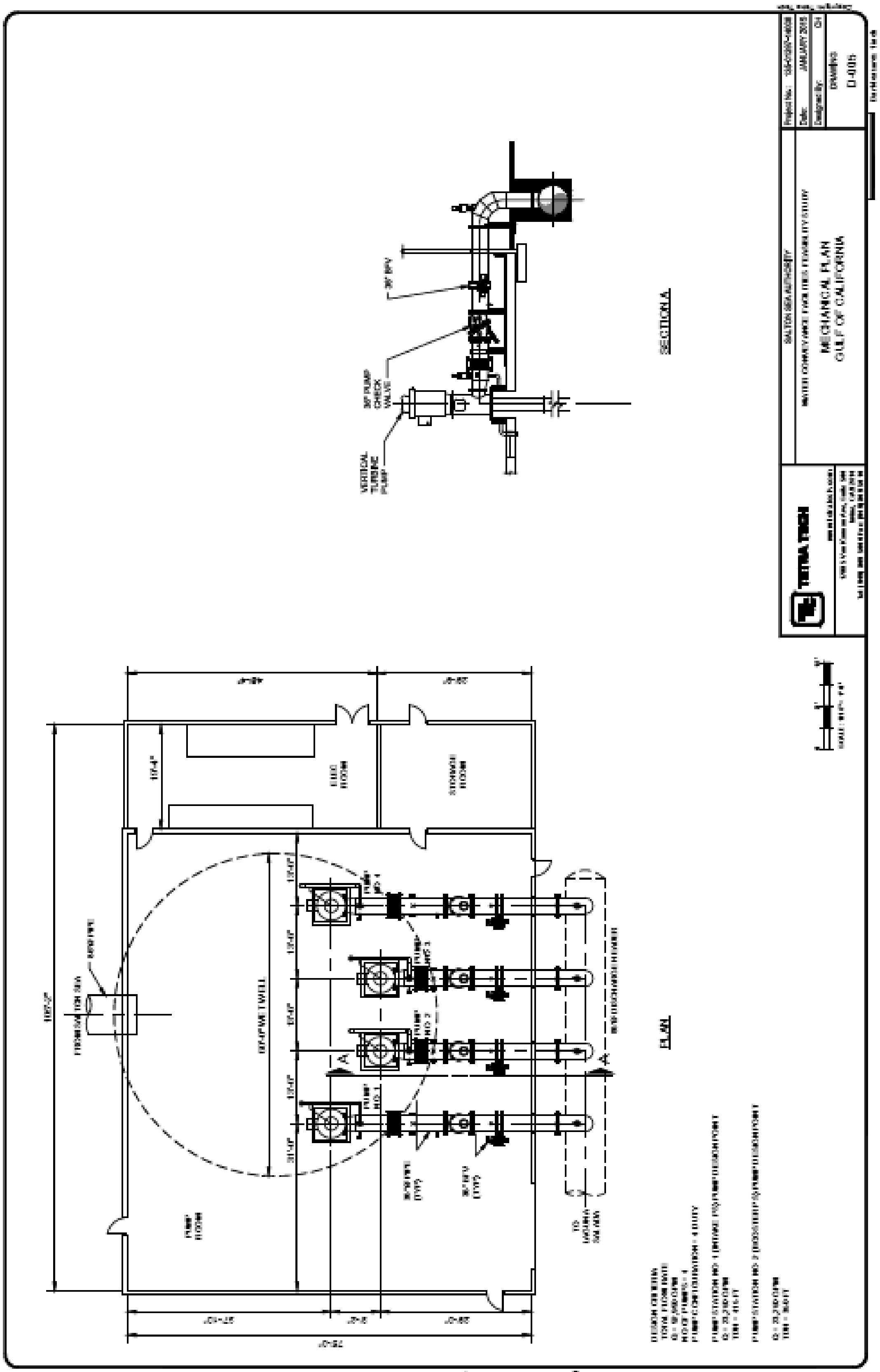

SECTION A
PLAN
SITE PLAN
SALTON SEA AUTHORITY
LAGUNA SALADA OUTFLOW
INTAKE STRUCTURE
TETRA TECH
D-014

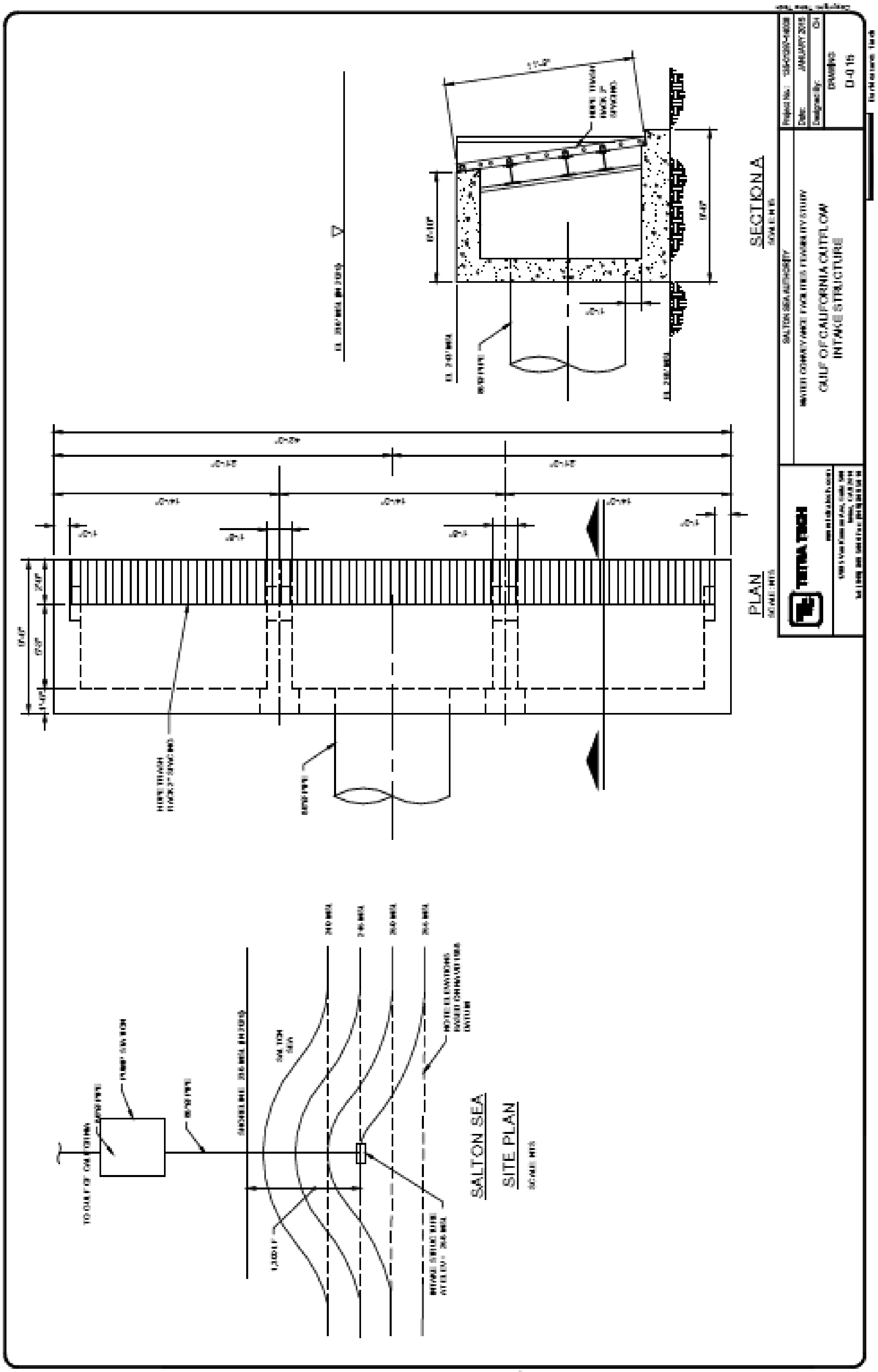
7.5 Appendix E: Gulf of California Attachments

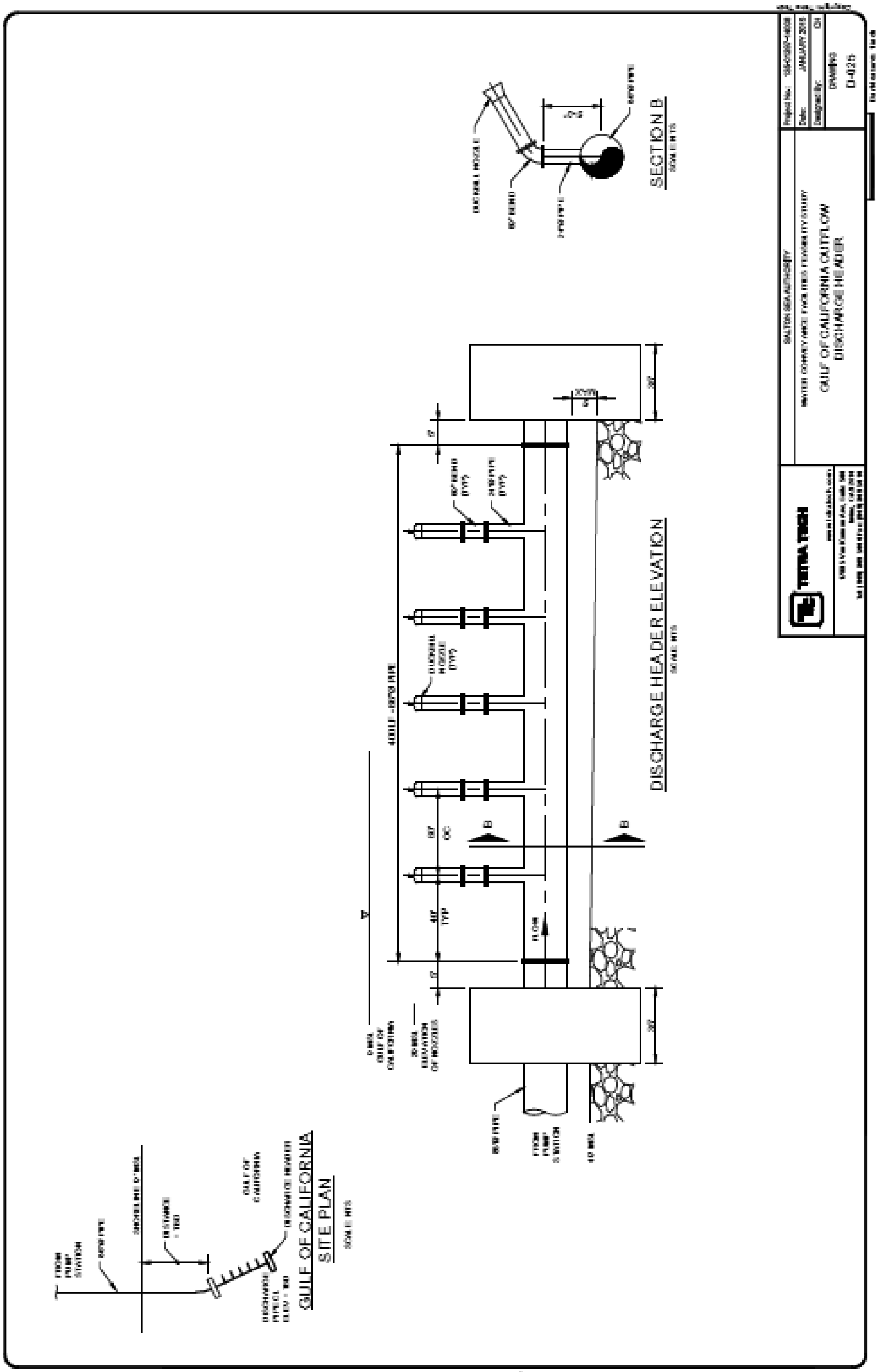
Conceptual plans prepared for the Gulf of California alternative can be found on the following pages. The following conceptual drawings are provided:

- Hydraulic profile;
- A pump station mechanical plan and section; and
- Intake structure.


SALTON SEA AUTHORITY
HYDRAULIC PROFILE
GULF OF CALIFORNIA OUTFLOW
TETRA TECH
HYDRAULIC GRADE LINE
EXIST GROUND LINE
PIPELINE
PUMP DISCHARGE
HEAD = 515'
PUMP DISCHARGE
HEAD = 580'
DISTANCE (MILES)
ELEVATION (FT)
LEGEND
PUMP STATION
HORIZ = 1" = 10 MILES
VERT = 1" = 150'


SECTION A
PLAN
MECHANICAL PLAN
GULF OF CALIFORNIA
TETRA TECH
D-005

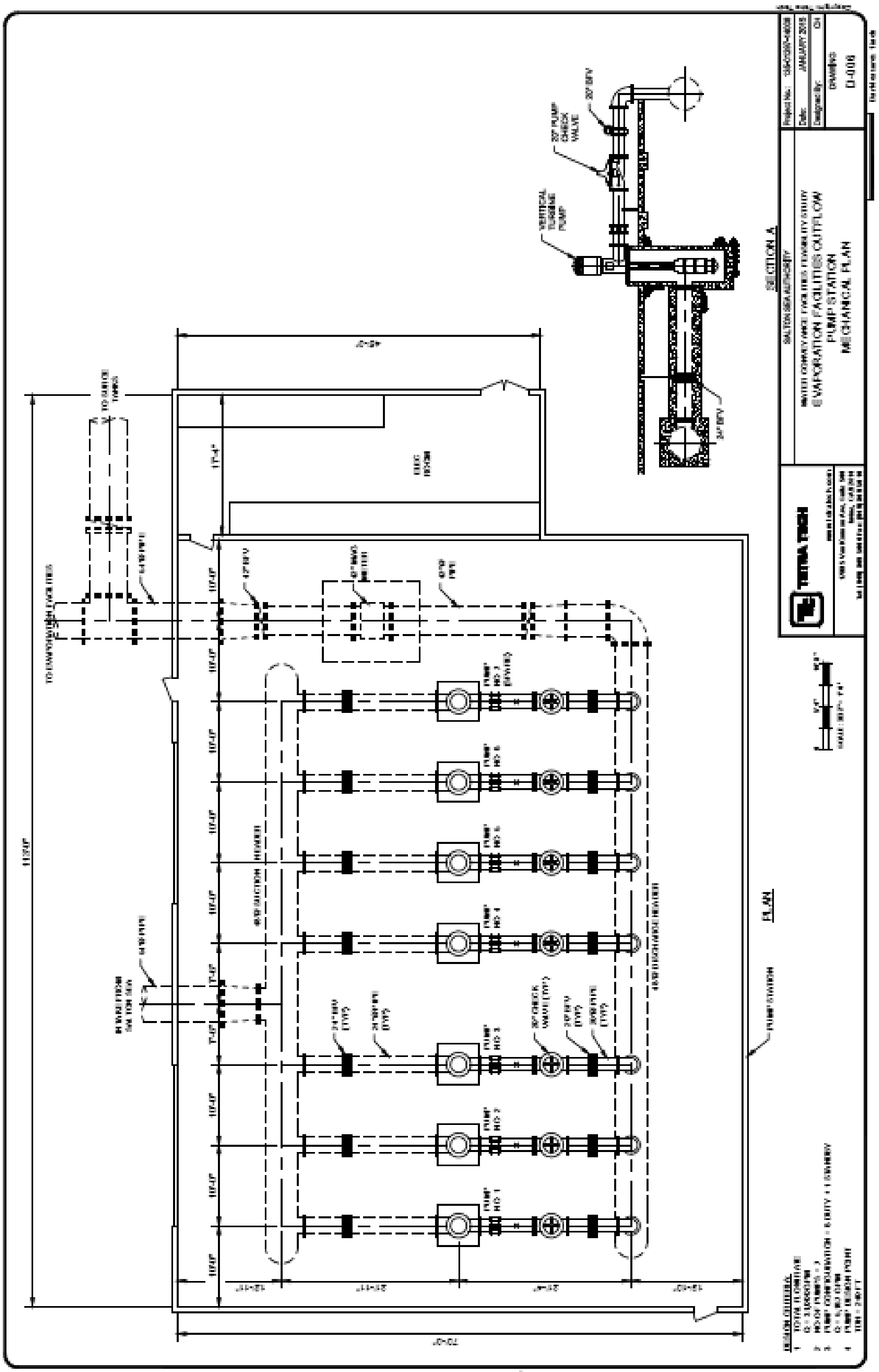

SECTION A
PLAN
SALTON SEA
SITE PLAN
GULF OF CALIFORNIA OUTFLOW
INTAKE STRUCTURE
TETRA TECH

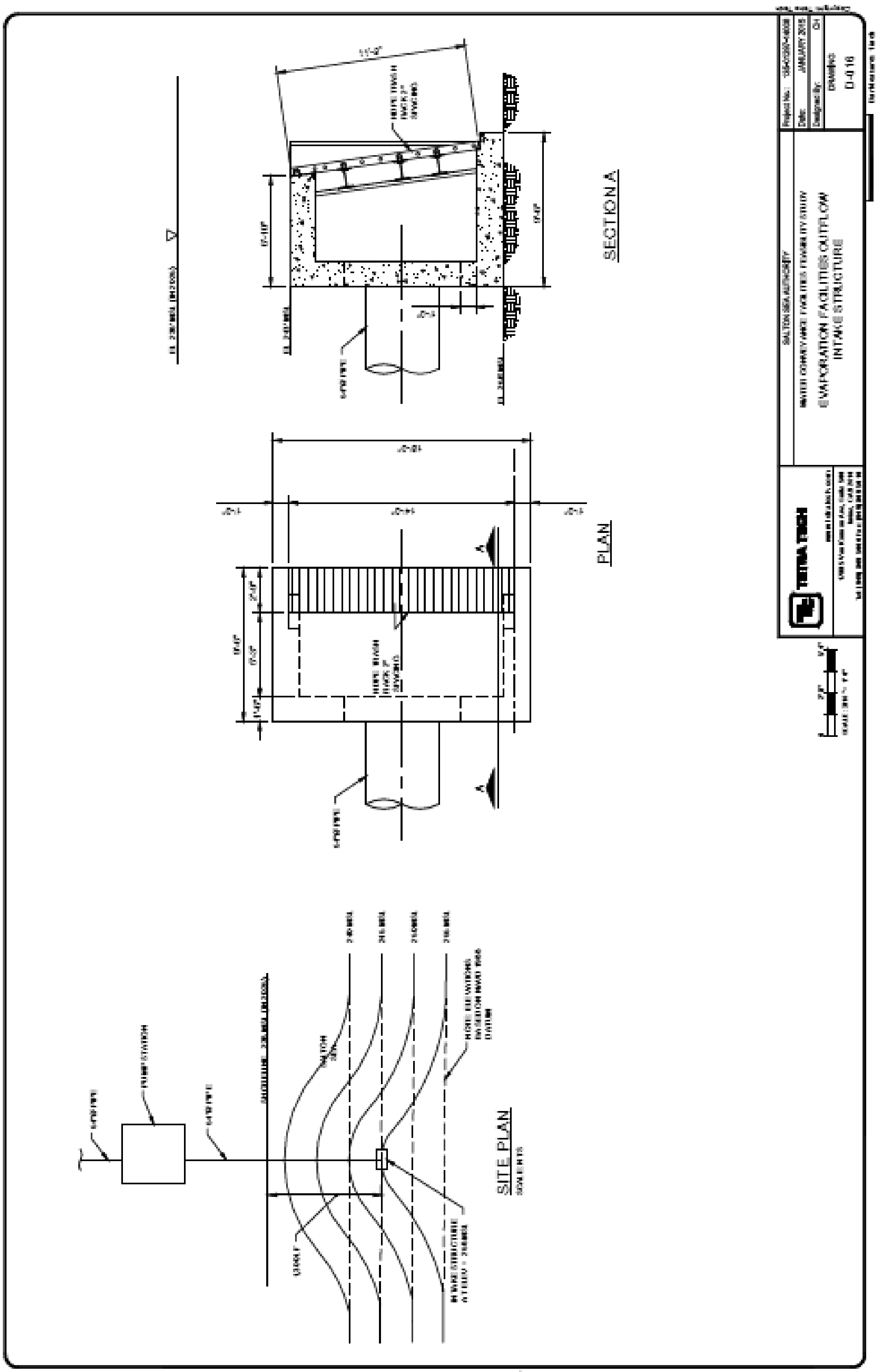

SECTION B
DISCHARGE HEADER ELEVATION
GULF OF CALIFORNIA
SITE PLAN
SALTON SEA AUTHORITY
GULF OF CALIFORNIA OUTFLOW
DISCHARGE HEADER
TETRA TECH
D-025

7.6 Appendix F: Evaporation Attachments

Conceptual plans prepared for the Evaporation alternative can be found on the following pages. The following conceptual drawings are provided:

- A pump station mechanical plan and section; and
- Intake structure.

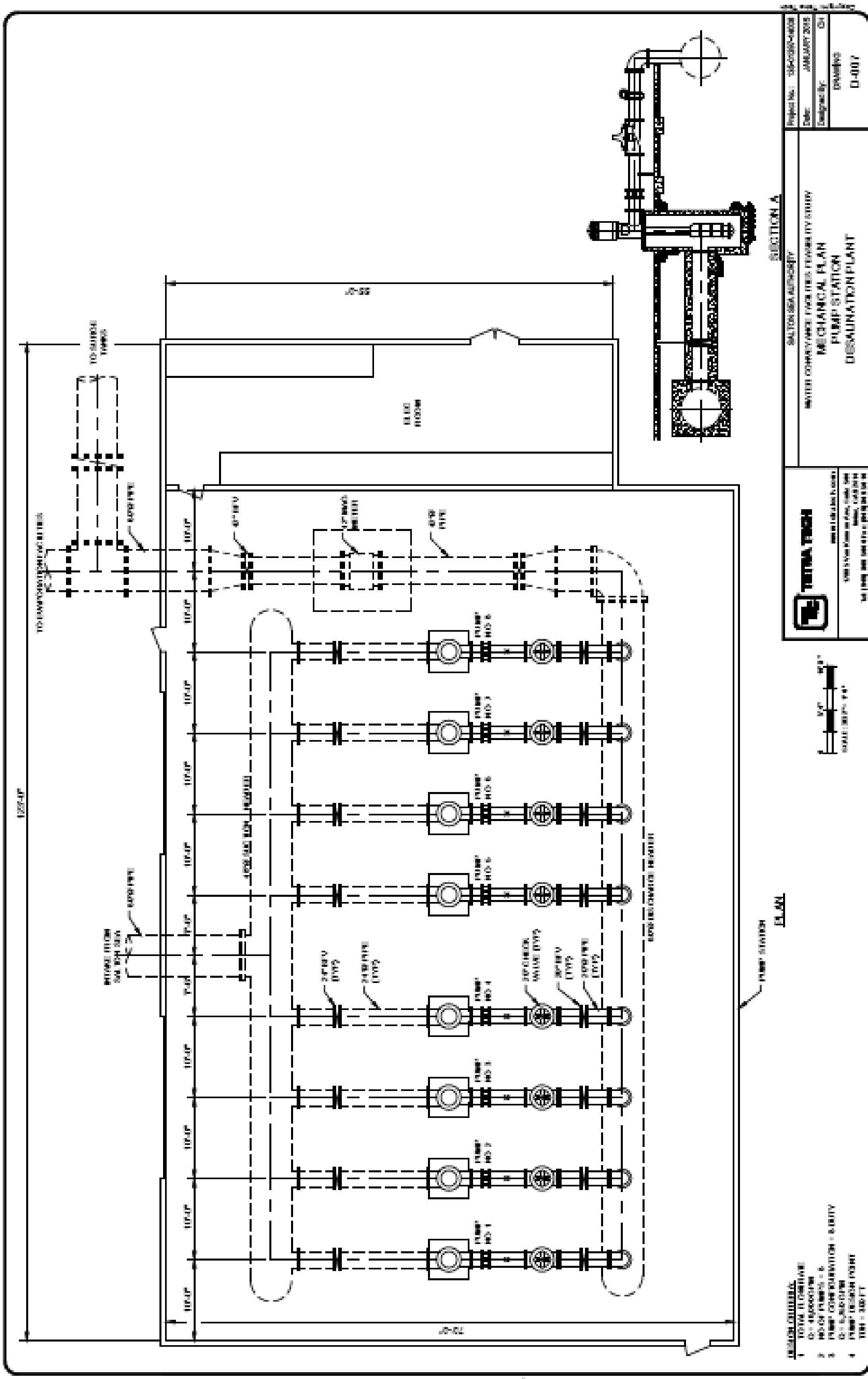


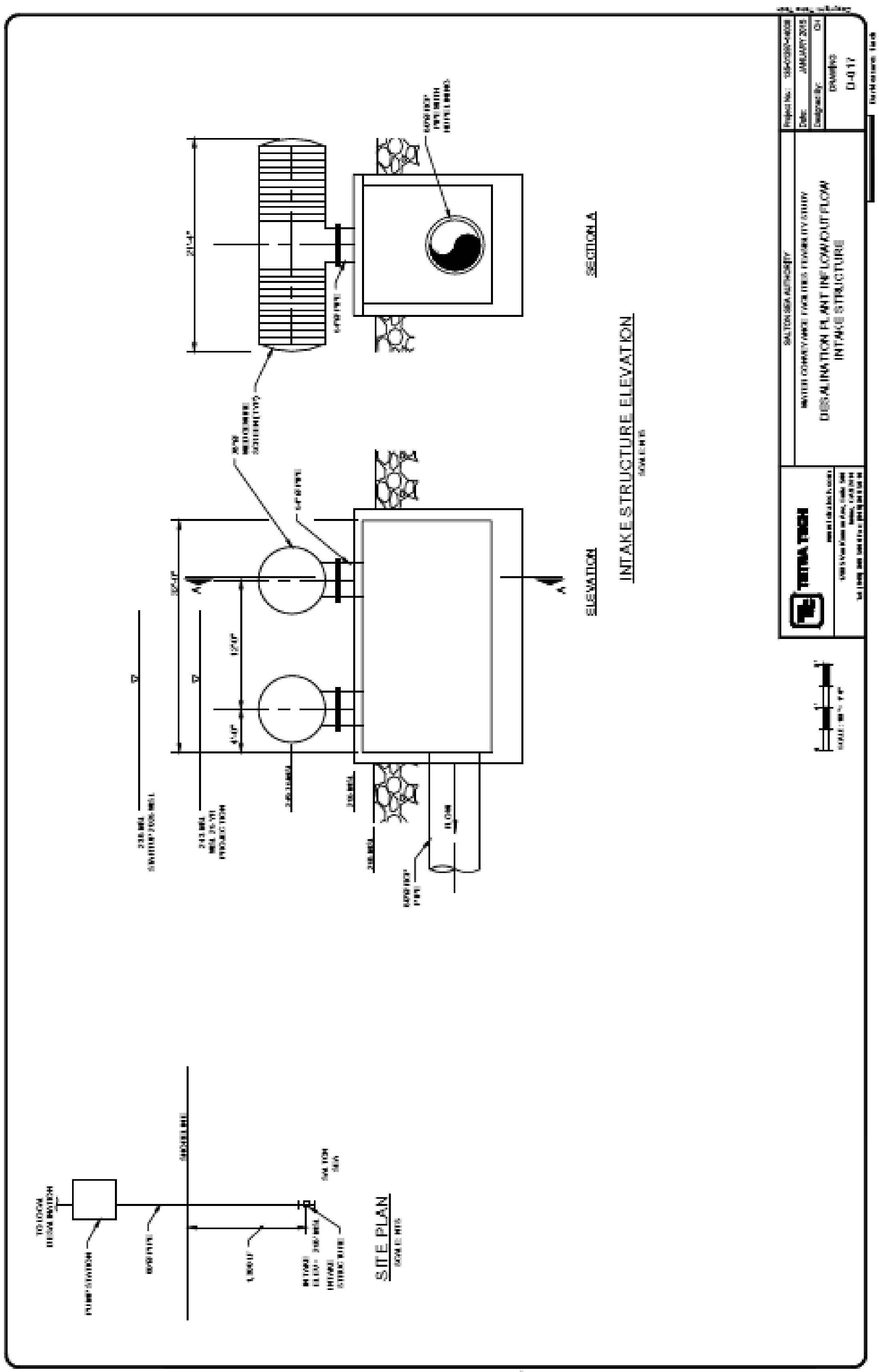

SECTION A
PLAN
SITE PLAN
SALTON SEA AUTHORITY
EVAPORATION FACILITIES OUTFLOW
INTAKE STRUCTURE
TETRA TECH
D-016

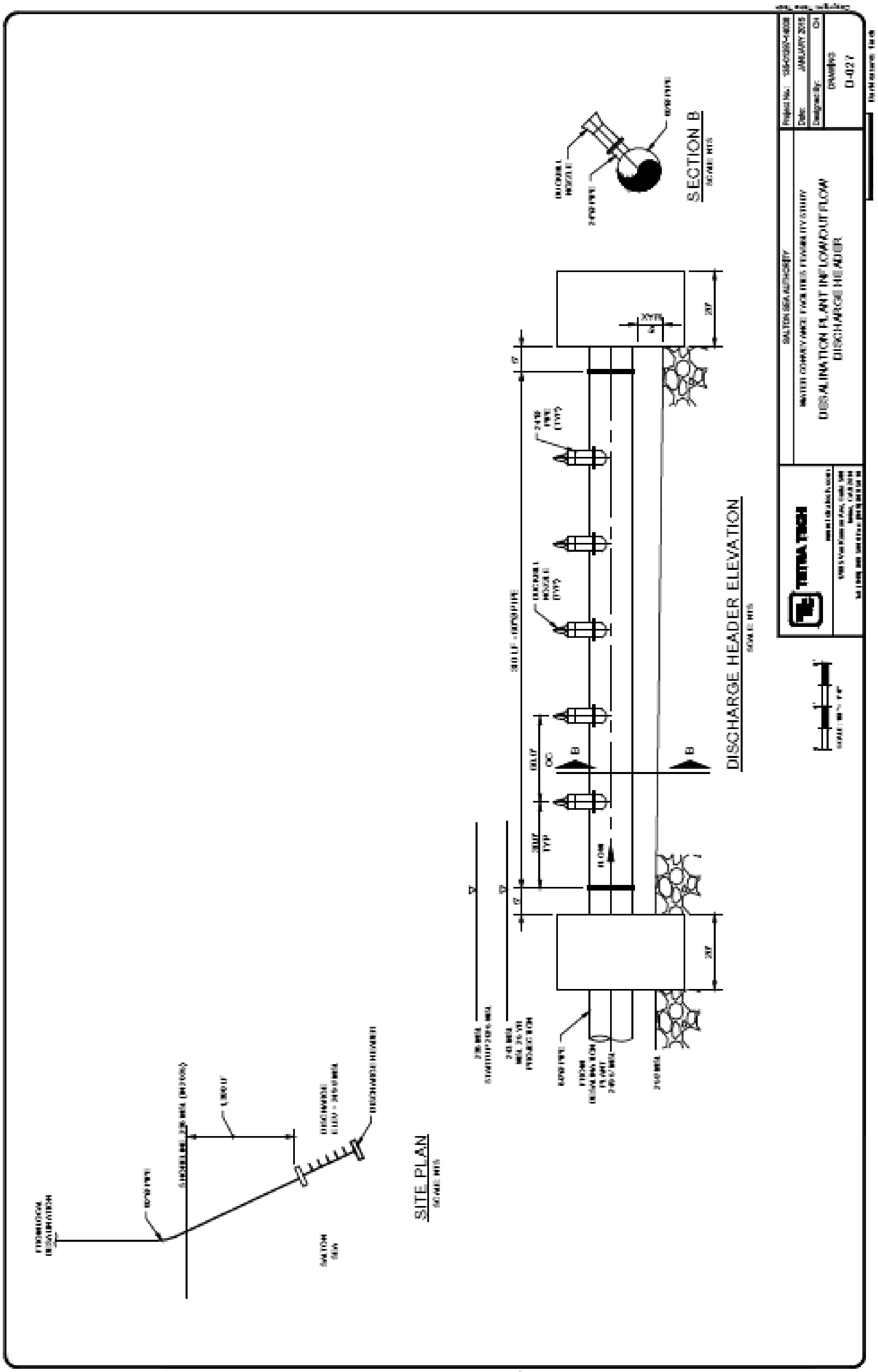
7.7 Appendix G: Desalination Attachments

Conceptual plans prepared for the Desalination alternative can be found on the following pages. The following conceptual drawings are provided:

- A pump station mechanical plan and section;
- An Intake Structure; and
- A Discharge Header


MECHANICAL PLAN
PUMP STATION
DESALINATION PLANT
SECTION A
PLAN
TETRA TECH
D-007


SITE PLAN
SCALE: NTS
ELEVATION
SECTION A
INTAKE STRUCTURE ELEVATION
SCALE: NTS
SALTON SEA AUTHORITY
DESALINATION PLANT INFLOW/OUTFLOW
INTAKE STRUCTURE
TETRA TECH
JANUARY 2016
D-017


SECTION B
DISCHARGE HEADER ELEVATION
SITE PLAN
DESALINATION PLANT INFLOW/OUTFLOW
DISCHARGE HEADER
TETRA TECH
D-027