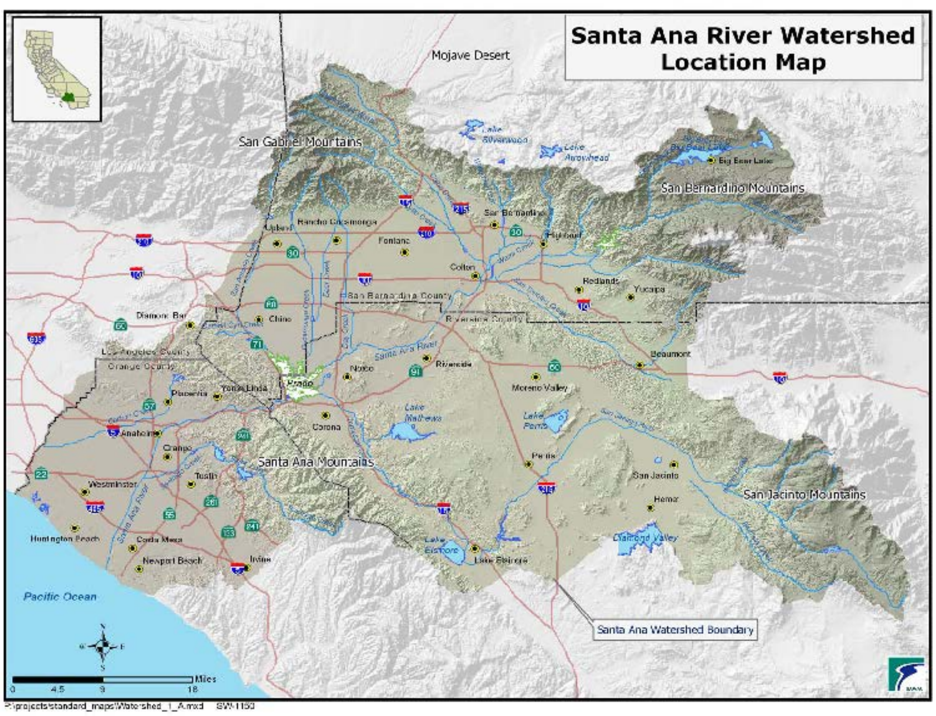
RECLAMATION
Managing Water in the West

Technical Memorandum No. 3.0
Executive Summary

Inland Empire Interceptor Appraisal Analysis

Santa Ana Watershed Basin Study, California
Lower Colorado Region



U.S. Department of the Interior
Bureau of Reclamation
Southern California Area Office

Santa Ana Watershed
Project Authority

May 2013

Mission Statements

The mission of the Department of the Interior is to protect and provide access to our Nation's natural and cultural heritage and honor our trust responsibilities to Indian Tribes and our commitments to island communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

BUREAU OF RECLAMATION
Engineering Services Office
Lower Colorado Regional Office, LC-6000

Technical Memorandum No. 3.0
Executive Summary

Inland Empire Interceptor Appraisal Analysis

Santa Ana Watershed Basin Study, California
Lower Colorado Region

Prepared by: Thomas Nichols, P.E.
Civil Engineer (Hydrologic)
Engineering Services Office, LC-6233
Lower Colorado Region

Reviewed by: Douglas B. Blatchford, P.E. (TM 3.2 & TM 3.4)
Richard Eastland, P.E. (TM 3.2 & TM 3.3)
Kevin Margetts, P.E. (TM 3.3)
Robert Owen, E.I. (TM 3.4)

This page intentionally left blank.

Contents

Tables

Introduction

Santa Ana Watershed Project Authority and Inland Empire Brine Line

The Santa Ana Watershed Project Authority (SAWPA) is a joint powers authority comprised of five member water districts that serve the vast majority of the Santa Ana Watershed. The area served by SAWPA is located within Orange, Riverside and San Bernardino Counties of California, bounded by the Pacific Ocean on the west, the San Bernardino Mountains to the north, and the San Jacinto Mountains to the east.

The five SAWPA Member Agencies are:

- Eastern Municipal Water District (EMWD),
- Western Municipal Water District (WMWD),
- Inland Empire Utilities Agency (IEUA),
- San Bernardino Valley Municipal Water District (SBVMWD), and
- Orange County Water District (OCWD).

These five agencies serve most of the Santa Ana Watershed. Population within the watershed has increased significantly in recent years, and this urban growth has put enormous pressure on the regional water supply, water quality and environmental/recreation resources.

SAWPA’s mission is to plan and build facilities to protect water quality and enhance the water supply within the Santa Ana River Watershed. This mission includes the goal of achieving a salt balance in the upper Santa Ana Watershed. SAWPA developed the Inland Empire Brine Line (Brine Line), which was formerly known as the Santa Ana Regional Interceptor (SARI), for the purpose of exporting salt from the Santa Ana Watershed. Exportation of salt prevents its accumulation in the watershed and protects the quality of the potable water supply. The future of the potable water supply will continue to be dependent upon an economical means of collection, treatment and disposal of brine. The Brine Line collects and disposes of brine flow from the Santa Ana Watershed and is critical to SAWPA’s mission success.

The Brine Line includes approximately 72 miles of pipeline in multiple branches which converge in the vicinity of Prado Dam near the City of Corona. It has a planned capacity of approximately 32.5 million gallons per day (MGD) and was planned for collection and exportation of approximately 271,000 tons of salt per year from the upper Santa Ana Watershed, east of the Santa Ana Mountains. Currently (2010 & 2011), average system flows are approximately 11.7 MGD and over 75,000 tons of salt are exported per year.

An additional 21 miles of pipeline convey the combined flows to Orange County Sanitation District (OCSD) facilities for treatment and disposal by discharge to the Pacific Ocean. This pipeline has a nominal capacity of 30 MGD. The planned capacity of the Brine Line system (32.5 MGD) exceeds the hydraulic capacity of the pipeline from the Brine Line convergence near Prado Dam to the OCSD facilities. Furthermore, the present agreement between SAWPA and OCSD allows Brine Line flows to the OCSD system up to only 17.0 MGD, with a contractual right to purchase up to 30.0 MGD capacity.

Project Background

The One Water One Watershed (OWOW) Plan is the integrated water management plan for the Santa Ana Watershed that is administered by the Santa Ana Watershed Project Authority (SAWPA). This plan is being updated by One Water One Watershed 2.0 which will evaluate current water supply for the watershed and will address:

- climate change,
- increasing water demands,
- water quality, and
- future water supply needs.

The Bureau of Reclamation's Southern California Area Office (SCAO) and SAWPA submitted a proposal in June 2010 for funding of a Santa Ana Watershed Basin Study (Basin Study) in support of One Water One Watershed 2.0. In August 2010, this Basin Study was selected by Reclamation for funding. This Inland Empire Interceptor Appraisal Analysis (Appraisal Analysis) is one component of the Basin Study.

A study entitled ***Santa Ana Watershed Salinity Management Program*** (Salinity Management Program) was completed in 2010 by a team of consultants led by Camp, Dresser & McKee (CDM), which addressed the Brine Line capacity limitations. The Salinity Management Program identified and evaluated six strategies for managing flows in the Brine Line system, which were identified as follows:

- Option 1: Baseline Condition – continued discharge to OCSD.
- Option 2a: SARI (Inland Empre Brine Line (IEBL)) flow reduction via a centralized treatment, concentration, and reclamation plant.
- Option 2b: SARI (IEBL) flow reduction via a decentralized brine minimization projects installed at each groundwater desalter.
- Option 3a: Direct ocean discharge of SARI (IEBL) brine without brine minimization.
- Option 3b: Direct ocean discharge of SARI (IEBL) brine with brine minimization projects as described under Option 2b.

- Option 4: Rerouting all SARI (IEBL) system flows for discharge to Salton Sea.

Four Options (2a, 2b, 3a and 3b) involve changes to the method and/or degree of treatment of Brine Line flows. Option 4 is a proposed new Brine Line outfall to the Salton Sea, which would replace the existing Brine Line outfall from the system convergence near Prado Dam to the OCSD system, referred to in this Appraisal Analysis as the Inland Empire Interceptor, or IEI.

The ***Phase 2 SARI Planning Technical Memorandum*** of the Santa Ana Watershed Salinity Management Program also included estimated costs (indexed to Year 2010) and present worth analyses for each strategy.

After delivery of the Santa Ana Watershed Salinity Management Program report by CDM, SAWPA staff prepared a report entitled ***Inland Empire Brine Line Disposal Option Concept Investigation*** (SAWPA Investigation) in which four alternative conceptual designs for the portion of Option 4 in the Santa Ana Watershed were developed and evaluated.

Appraisal Analysis Objectives

As mentioned above, Option 4 described above is the subject of this Appraisal Analysis and is identified as the Inland Empire Interceptor (IEI).

The purpose of this Appraisal Analysis is to help determine whether more detailed investigations of the proposed IEI are justified. Under Reclamation criteria set forth in in ***Reclamation Manual, Directives and Standards, FAC 09-01: Cost Estimating*** (Reclamation Manual), appraisal analyses "are intended to be used as an aid in selecting the most economical plan by comparing alternative features." Several alternative conceptual designs for the proposed IEI will be developed and evaluated in this Appraisal Analysis for the purpose of comparison.

Three of the four alternative conceptual designs for the portion of the proposed IEI in the Santa Ana Watershed addressed in the SAWPA Investigation described above were considered in this Appraisal Analysis.

Additionally, two alternative alignments were developed and evaluated in this Appraisal Analysis for the portion in the San Gorgonio Pass and Coachella Valley. The route of the proposed IEI through the San Gorgonio Pass and Coachella Valley areas in eastern Riverside County represents an opportunity for SAWPA to expand the Brine Line service area.

Executive Summary and Technical Memoranda

This Executive Summary (Technical Memorandum No. 3.0) presents the major conclusions and recommendations drawn from this Appraisal Analysis, followed by brief summaries of three of the four Technical Memoranda (TM) that were produced for the Analysis.

Technical Memorandum No. 3.1 presents the results of the initial review of previous studies and other available site-specific data pertinent to this Appraisal Analysis. Additional sources of information that were not cited in Technical Memorandum No. 3.1 were subsequently identified as useful for the preparation of this Appraisal Analysis. Those additional information sources are identified in the three subsequent technical memoranda.

The three other technical memoranda produced for this Appraisal Analysis are as follows:

- Technical Memorandum No. 3.2 – Summary of Brine and Flow Data
- Technical Memorandum No. 3.3 – Options and Strategies
- Technical Memorandum No. 3.4 – Summary of Costs and Recommended Options

Feasibility Analysis and Benefit-Cost Analysis

As discussed above, the purpose of an Appraisal Analysis is to help determine whether more detailed investigations of a proposed project are justified, the criteria for which are set forth in the Reclamation Manual. The Reclamation Manual also describes criteria for "a project Feasibility Study and Feasibility-level cost estimate, which are intended to support funding authorization for new construction" and "cannot be conducted without authorization and appropriation of funds by the Congress."

Also, as a Federal agency, Reclamation must perform benefit-cost analyses (BCA) for proposed water resources projects at the appropriate stage of project planning. The main set of guidelines for a BCA is the ***Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies***, U. S. Water Resources Council, 1983 (P&Gs). For Reclamation projects, BCAs are typically performed at the Feasibility level of study.

The purpose of a BCA is to compare the benefits of a proposed project to its costs. The total costs of the project are subtracted from the total benefits to measure net benefits. If the net benefits are positive (benefits exceed costs), then the project could be considered economically justified. Conversely, if net benefits are negative (costs exceed benefits), then the project would not be economically justified. When multiple alternatives are being considered for a project, the alternative with the greatest positive net benefit would be preferred from an economic perspective.

A BCA is comprised of four "accounts" identified as the National Economic Development (NED) account, the Regional Economic Development (RED) account, the Environmental Quality (EQ) account, and the Social Effects (OSE) account. The NED and RED accounts are used to evaluate the economic effects of proposed alternative plans.

A RED analysis focuses on economic impacts to the region in which the project is located. The RED analysis recognizes the NED benefits accruing to the local region plus the transfers of income into the region.

A NED analysis focuses on economic impacts to the entire Nation. The *P&Gs* require Reclamation to analyze the NED effects so as not to favor one area of the country over another. Economic justification is determined solely by the benefit-cost analysis and must be demonstrated on the basis of NED benefits exceeding NED costs.

Conclusions and Recommendations

Introduction

The results of the present worth analyses of the estimated costs for the proposed IEI are presented in TM 3.4. A simple comparison of those results with the present worth analyses for the other Options presented in the Salinity Management Program indicates that the costs of the proposed IEI are greater than the costs of other Options. However, certain aspects of the proposed IEI distinguish this Option 4 from the other options considered in the Salinity Management Program, and further investigation and analysis of the proposed IEI warrants consideration.

Significant opportunities are available for refinement of the conceptual designs for the proposed IEI presented in this Appraisal Analysis. Further investigation and analysis of these opportunities could help refine the estimated costs, reduce the multiplier applied to estimated costs for contingencies, and evaluate the benefits associated with the project. These refinements could lead to a more favorable present worth comparison of the proposed IEI with the other Options.

Opportunities to refine the scope, conceptual designs, estimated costs, and benefits associated with the proposed IEI are identified and discussed in TM 3.4. In general, these Opportunities represent the Conclusions of this Appraisal Analysis. Suggested Optimization Strategies for the proposed IEI are also identified and discussed in TM 3.4. These suggested Optimization Strategies describe recommended next steps (or Recommendations) for further investigation and analysis of the proposed IEI.

As discussed above, a Feasibility level of study “cannot be conducted without authorization and appropriation of funds by the Congress” and represents a substantial commitment to a project. These Recommendations are suggested as interim stages of investigation and analysis of the proposed IEI. A Feasibility study and benefit-cost analysis of the proposed IEI would be warranted only if these additional investigations and analyses produce favorable results.

Conclusions

The Conclusions from this Appraisal Analysis are summarized as follows:

C1. Economic Development: The economic development potential associated with the proposed IEI is significant and unique to this option. If implemented, the proposed IEI would make brine management infrastructure available to prospective employers located in the San Gorgonio Pass and Coachella Valley areas.

C2. Net Impact: The proposed IEI would impact the Salton Sea in various ways, some of which may be considered beneficial and others negative. Further investigation and analysis of these aspects would help determine design criteria for associated components of the proposed IEI.

C3. Salton Sea Restoration: Delays to implementation of a restoration plan for the Salton Sea have contributed to uncertainties regarding salinity and water quality aspects of the proposed IEI. Improved understanding of progress toward restoration of the Sea would help determine appropriate project design criteria for the affected components of the proposed IEI.

C4. Basin Plan: Uncertainties regarding Salton Sea salinity and water quality regulatory requirements contribute to uncertainties regarding planning and design of associated components of the proposed IEI and the associated costs.

C5. Stakeholder Partnering: The standards established in the Basin Plan for salinity and water quality in the Salton Sea are a deterrent to potential new sources of water supply to the Sea. Community and stakeholder support would enhance the likelihood of adoption of changes to those standards.

C6. Salton Sea Salinity: The salts in the IEI flows would add to the existing rate of accumulation of salts in the Sea. Whether those salts would cause total dissolved solids (TDS) concentrations in the Sea to increase will depend on such factors as the magnitude of the Salton Sea water budget imbalance over time and progress toward implementation of a Salton Sea restoration plan.

C7. Salton Sea Water Quality: Similar to salinity, whether the total suspended solids (TSS) and biochemical oxygen demand (BOD) in the IEI flows would cause an adverse impact on the water quality in the Salton Sea will depend on such factors as the magnitude of the Salton Sea water budget imbalance over time and progress toward implementation of a Salton Sea restoration plan. The estimated cost of the proposed Water Quality Treatment Facility (TF) represents a substantial portion of the total estimated costs for the project, which calls for careful scrutiny of the design criteria for this facility.

C8. Brine Pre-treatment and Treatment Strategies: The proposed TF could function in place of the Brine Pre-treatment and Treatment Strategies presented in the Salinity Management Program, or it could function as part of a hybrid design in combination with a Strategy from the Salinity Management Program.

C9. Management of Surplus Energy: The large estimated costs of the proposed IEI Turbine Generator Stations and associated electric transmission facilities indicate that the time period necessary to recover that investment in would be long. The estimated cost of the proposed IEI could likely be significantly reduced by using an alternative approach to remove surplus energy from flows in the system.

C10. Other Opportunities: Examples of other opportunities to refine, reduce and/or eliminate estimated costs identified in this Appraisal Analysis include but are not limited to the following:

- Synthetic Membrane Liner - The synthetic membrane liner under the TF is the largest single component of the estimated cost of that facility; use of an alternative approach to soil permeability could likely significantly reduce that cost.
- Tunneling – Tunneling in lieu of direct bury of the proposed pipeline through the Badlands west of the City of Beaumont along the Gas Main Alignment may reduce impacts associated with construction of the project.
- Phasing - Phasing of certain project components could allow some project costs to be deferred.

Recommendations

The results of this Appraisal Analysis and the Conclusions listed above suggest appropriate recommended next steps for further investigation and analysis of the proposed IEI to refine the scope, conceptual designs, estimated costs and anticipated benefits of the proposed IEI. These Recommendations are summarized as follows:

R1. Economic Impact Analysis: In response to Conclusion C1 (Economic Development), perform an economic impact analysis for the proposed IEI to quantify the economic development and other benefits of the proposed IEI.

R2. Salton Sea Water Budget: In response to Conclusions C2, C3, C6 and C7, develop water budgets for the Salton Sea and for the planned Salton Sea restoration, or update available existing water budgets.

R3. Salton Sea Salinity and Water Quality Models: In response to Conclusions C2, C3, C6 and C7, develop models for salinity and water quality in the Salton Sea and for the planned Salton Sea restoration, or update available existing models.

R4. IEI Influence on Salton Sea Salinity: In response to Conclusions C2, C3 and C6, use the water budgets and the salinity models for the Salton Sea to evaluate the impact of proposed IEI flows on TDS concentrations in the Salton Sea, to evaluate the influence of those impacts on the IEI design, and to refine estimated costs for the proposed IEI.

R5. IEI Influence on Salton Sea Water Quality: In response to Conclusions C2, C3 and C7, use the water budgets and the water quality models for the Salton Sea to evaluate the impact of the proposed IEI flows on TSS and BOD concentrations in the Salton Sea, to evaluate the influence of those impacts on the IEI design, and to refine estimated costs for associated components of the proposed IEI.

R6. Salton Sea Restoration Influence on IEI Design: In response to Conclusion C2, C3, C6 and C7, use the water budgets and the salinity and water quality models for the Salton Sea restoration to evaluate the impact of the proposed IEI flows on the planned restoration, to evaluate the influence of the planned restoration on the IEI design, and to refine estimated costs for the proposed IEI.

R7. Basin Plan Amendment Process: In response to Conclusion C4 (Basin Plan), evaluate the process and technical requirements for a Basin Plan Amendment to modify Salton Sea salinity and water quality regulatory requirements for the proposed IEI.

R8. Identify, Investigate & Initiate Partnerships: In response to Conclusion C5 (Stakeholder Partnering), seek opportunities to partner with other Salton Sea stakeholders in support of regulatory changes to encourage new sources of water supply to the Salton Sea in support of restoration efforts. This effort may include:

- Establish a dialogue with other organizations serving the San Gorgonio Pass, Coachella Valley areas, and/or other areas adjacent to the Salton Sea,
- Investigate community support for changes to the regulatory approach to Salton Sea salinity and water quality standards to encourage new sources of water supply for the Salton Sea, and
- Develop specific proposals for suggested regulatory changes and identify benefits. Communicate the suggested regulatory changes and associated benefits to the community.

R9. Hybrid Strategies for Brine Treatment: In response to Conclusion C8 (Brine Pre-treatment and Treatment Strategies), identify and evaluate alternative strategies for treatment of the IEI flows, which may include hybrid designs incorporating Salinity Management Program brine pre-treatment strategies in combination with alternative configurations of the wastewater treatment ponds and/or constructed wetlands that comprise the TF considered in this Appraisal Analysis.

R10. Alternative Designs for Surplus Energy: In response to Conclusion C9 (Management of Surplus Energy), develop and evaluate alternative strategies for management of surplus energy in IEI flows such as low-head in-line turbine generators and pressure reducing valves.

R11. Alternative Liner Materials: In response to Conclusion C10 (Other Opportunities), investigate alternatives to the proposed synthetic membrane liner under the TF, including site-specific soil investigations to determine actual soil permeability to facilitate investigation of alternatives such as soil treatment using clay and suitability of a "leaky wetland".

R12. Tunneling: In response to Conclusion C10 (Other Opportunities), investigate the constructability of and the impacts associated with direct-bury of the proposed pipeline through the Badlands west of the City of Beaumont along the Gas Main Alignment and the feasibility of tunneling in lieu of direct bury in that area.

R13. Phasing of Improvements: In response to Conclusion C10 (Other Opportunities), investigate opportunities for phasing of selected project components (e.g. use of dual pipelines in Coachella Valley) to defer costs until warranted by system flows, including a Present Worth analysis of the phased project costs.

Summary

The Conclusions (Opportunities) and the associated Recommendations (Optimization Strategies) identified above are summarized in **Table 1** on the next page. Priority rankings are assigned in **Table 1** to those Recommendations, which are loosely based on the potential influence on the estimated project costs and/or the value of anticipated benefits.

Table 1 – Summary of Conclusions and Recommendations

		RECOMMENDATIONS (OPTIMIZATION STRATEGIES)												
CONCLUSIONS (OPPORTUNITIES)		R1 - Economic Impact Analysis	R2 - Salton Sea Water Budget	R3 - Salton Sea Salinity & Water Quality Model	R4 - IEI Influence on Salton Sea Salinity	R5 - IEI Influence on Salton Sea Water Quality	R6 - Influence of Salton Sea on IEI Design	R7 - Basin Plan Amendment Process	R8 - Identify, Investigate, & Initiate Partnerships	R9 - Hybrid Strategies for Brine Treatment	R10 - Alternative Designs for Surplus Energy	R11 - Alternative Liner Materials	R12 - Tunneling in Lieu of Direct Bury	R13 - Phasing of Improvements
	PRIORITY	1	2	2	2	2	2	3	4	5	6	7	7	7
C1 - Economic Development	1	X												
C2 - Net Impact	2		X	X	X	X	X							
C3 - Salton Sea Restoration	2		X	X	X	X	X							
C4 - Basin Plan	3							X						
C5 - Stakeholder Partnering	4								X					
C6 - Salton Sea Salinity	2		X	X	X		X							
C7 - Salton Sea Water Quality	2		X	X		X	X							
C8 - Brine Pre-treatment and Treatment	5									X				
C9 - Management of Surplus Energy	6										X			
C10 - Other Opportunities	7											X	X	X

Technical Memorandum No. 3.2: Summary of Brine and Flow Data

General Description

TM 3.2 addresses analysis of available historical Brine Line flow data and forecasting of future flows from the existing Brine Line service area and from the San Gorgonio Pass and Coachella Valley areas. TM 3.2 also addresses analysis of available historical data for Total Dissolved Solids (TDS), Total Suspended Solids (TSS) and Biochemical Oxygen Demand (BOD) in the Brine Line flows and forecasting of those constituents in future flows.

Summary of Total Forecasted Brine Line Flows

The total forecasted flows (in millions of gallons per day) from the existing Brine Line system service area in the Santa Ana Watershed (SAW), from the San Gorgonio Pass and Coachella Valley (CV) areas, and from the combined SAW and CV areas are listed in **Table 2** below.

Table 2 – Total Forecasted Brine Line Flows

	2010	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**	**2050**	**2060**
Subtotal - SAW	11.7	12.21	15.95	20.22	26.06	29.59	31.67	31.98	32.06
Subtotal – CV	0	0	0	0	0	12.38	33.53	38.24	43.04
Total Brine Flow	**11.7**	**12.21**	**15.95**	**20.22**	**26.06**	**41.97**	**65.20**	**70.22**	**75.10**

Technical Memorandum No. 3.3: Options and Strategies

General Description

TM 3.3 presents conceptual designs and results of hydraulic analyses for the various alternatives for the proposed Inland Empire Interceptor (IEI) under consideration in this Appraisal Analysis, and addresses various options and strategies, including:

- Proposed modification to the existing Brine Line system.
- Existing easements and rights-of-way.
- Salton Sea considerations, including:
    - Salton Sea restoration plans.
    - Increased water supply to the Salton Sea.
    - Water quality (Total Suspended Solids and Biochemical Oxygen Demand concentrations).
    - Salt load (Total Dissolved Solids concentration).
- Brine pre-treatment strategies.
- Alternative alignments considered.
- Alternative designs considered.
- Pumping requirements.
- Energy recovery strategies.
- Permit requirements.

Potential strategies for treatment of the Brine Line (IEI) flows are also presented in TM 3.3 as alternatives to the brine pre-treatment strategies discussed in the Salinity Management Program.

Colorado River Basin Regional Water Quality Control Board Basin Plan

The State of California's Colorado River Basin Regional Water Quality Control Board adopted the ***Water Quality Control Plan: Colorado River Basin - Region 7*** (Basin Plan), with the intent "to provide definitive guidelines" and to "optimize the beneficial uses of state waters within the Colorado River Basin Region of California by preserving and protecting the quality of these waters."

If implemented, the projected flows in the proposed IEI would provide a reliable new source of water to the Salton Sea. But the projected TDS, TSS and BOD concentrations in the IEI flows would not comply with the adopted Basin Plan standards for those parameters. Approval of a Basin Plan Amendment would likely be necessary for implementation of the proposed IEI.

The high water quality standards in the Basin Plan are a deterrent to any potential new sources of water to the Salton Sea. If new sources of water are to be encouraged in support of Salton Sea restoration efforts, then a change to the regulatory approach to water quality standards warrants serious consideration.

Water Quality (TSS and BOD) Impacts

The proposed Inland Empire Interceptor Water Quality Treatment Facility (TF), if needed, would represent a substantial portion of the cost of implementation of the proposed IEI. If further study or design development for the proposed IEI is performed, those efforts should include more detailed investigation and analysis of the specific water quality characteristics of the projected IEI flows, the water quality standards established in the Basin Plan, water quality projections for the Salton Sea, and the influence of Salton Sea restoration planning on the design of the proposed IEI and associated treatment facility.

Salinity (TDS) Impacts

Though the projected concentrations of TDS in the IEI flows (up to 6,800 mg/L) are much lower than existing TDS concentrations in the Sea (approximately 48,000 mg/L), the salts in the IEI flows would add to the existing rate of accumulation of salts in the Sea. If the brine pool proposed as part of various Salton Sea restoration plan alternatives was not available to remove the salt load from IEI flows, then a separate facility would be necessary to reduce or mitigate for accumulation of that salt in the Salton Sea. If further study or design development for the proposed IEI is performed, those efforts should include more detailed investigation and analysis of the brine characteristics of the projected IEI flows, the TDS standards in the Basin Plan, Salton Sea water budget projections, and the influence of Salton Sea restoration planning on the design of the proposed IEI and associated treatment technologies under consideration.

Economic Development Considerations

Brine management infrastructure has been a valuable tool for economic development in the Santa Ana Watershed (SAW) and has great potential as a tool for economic development in the San Gorgonio Pass and Coachella Valley areas along the route of the proposed IEI.

SAW Alternatives Considered

The three SAW Alternatives considered in this Appraisal Analysis (SAW Alternatives 1, 2 and 4) are based upon two Primary Alignments, which are identified herein and in the SAWPA Investigation as the 'Gas Main Alignment' and the 'North Alignment'. These Primary Alignments are complemented by various combinations of Secondary Alignments to form the three SAW Alternatives. Several pump stations are necessary for each of the three SAW Alternatives.

All three SAW Alternatives begin with the Brine Line/IEBL Alignment at proposed pump station PS 1-BL near Prado Dam and terminate at a common point in the City of Beaumont in San Gorgonio Pass. This location is common with the point of beginning of both Coachella Valley Alignments. The three SAW Alternatives considered in this Appraisal Analysis are summarized in tabular form in **Table 3** below.

Table 3 – Proposed Santa Ana Watershed Alternatives

Alignment	**SAW Alternative No. with Alignment Length (Feet)**		
	1	**2**	**4**
Primary Alignments:			
Gas Main	228,700	228,700	0
North	0	0	278,900
Secondary Alignments:			
IEBL:			
BL-1a	12,500	12,500	12,500
BL-1b	0	0	24,000
EMWD North	94,100	0	0
IEUA	0	0	9,000
Total Length (Ft)	**335,300**	**241,200**	**324,400**

Note: SAW Alternative 3 was not selected for further consideration.

CV Alternatives Considered & Design Flows

Two alternative alignments are considered in this Appraisal Analysis (CV Alignments A and B) for the portion of the proposed IEI through the San Gorgonio Pass and Coachella Valley areas. CV Alignment A follows the Coachella Canal for a substantial portion of its length, and CV Alignment B follows the Whitewater River / Coachella Wash Storm Water Channel (CVSC). The point of beginning of both alignments is common with the point of termination of the three SAW Alternatives in the City of Beaumont; the point of termination common to both alignments is located near the north edge of the Salton Sea.

Conceptual designs are presented for both of the CV Alignments using design flows both with and without projected flows from the San Gorgonio Pass and Coachella Valley (CV) area. Energy Recovery Facilities are included in each of these alternative designs to maintain full pipe flow. These CV Alternatives and the projected Peak Flows are summarized in **Table 4** below.

Table 4 – Coachella Valley Alternatives – Peak Flows

Alignment	Alternative	Service Area	Projected Peak Flows at Salton Sea (2060)	
			(MGD)	(gpm)
CV Alignment A	A-1	Combined SAW & CV Areas	87.4	60,636
	A-2	Existing	37.3	25,937
CV Alignment B	B-1	Combined SAW & CV Areas	87.4	60,636
	B-2	Existing	37.3	25,937

Summary of Water Quality Treatment Facility Conceptual Design

A Water Quality Treatment Facility (TF) is proposed to remove TSS and BOD from IEI flows prior to discharge to the Salton Sea. Several alternative conceptual designs are considered for this TF; two (TF Alternatives 3 and 5) would provide pre-treatment in Facultative Treatment Ponds (FTP) followed by treatment in Free Water Surface Constructed Wetlands (FWS CW).

TF Alternative 3 is conceptually designed to produce TSS and BOD concentrations in discharges that would meet or exceed U.S. Environmental Protection Agency standards for wastewater effluent. The projected minimum surface areas of both the FTP and the FWS CW for TF Alternative 3 and the total area of the facility are summarized for both projected flows in **Table 5** on the next page.

Table 5 – Treatment Facility Alternative 3 Average Flows and Areas

	Avg. Flow (2060)	Minimum Surface Area			Minimum Total Area
		FTP	FWS CW	Subtotal	
	(MGD)	(Acres)	(Acres)	(Acres)	(Acres)
Existing SAWPA Service Area (Alt. 3-2)	32.1	1,391	1,039	2,430	3,159
Combined SAW & CV Areas (Alt. 3-1)	75.1	2,411	1,800	4,211	5,474

TF Alternative 5 is conceptually designed to treat partial flows, which would be blended with the balance of the IEI flows to produce discharges with average TSS concentration of approximately 200 mg/L. The projected minimum surface areas of the FTP and the FWS CW for TF Alternative 5 and the total area of the facility are summarized for both projected flows in **Table 6** below.

Table 3 – Treatment Facility Alternative 6 Average Flows and Areas

	Avg. Flow (2060)	Minimum Surface Area			Minimum Total Area
		FTP	FWS CW	Subtotal	
	(MGD)	(Acres)	(Acres)	(Acres)	(Acres)
Existing SAWPA Service Area (Alt. 5-2)	32.1	927	693	1,620	2,106
Combined SAW & CV Areas (Alt. 5-1)	75.1	1,434	1,071	2,505	3,257

Technical Memorandum No. 3.4: Summary of Costs and Recommended Options

General Description

TM 3.4 presents estimated capital construction costs and operation and maintenance costs for the alternative conceptual designs for the proposed IEI described in TM 3.3. These estimated costs are indexed to Year 2010 to facilitate comparison with the estimated costs presented for the various Options considered in the ***Salinity Management Program Phase 2 Technical Memorandum***. And a present worth analysis of the combination of alignment alternatives that would serve the combined Santa Ana Watershed (SAW) and San Gorgonio Pass & Coachella Valley (CV) areas with the lowest estimated cost is provided to facilitate comparison with the present worth analyses presented in the Salinity Management Program. Opportunities (Conclusions) and suggested Optimization Strategies for implementation of the proposed IEI (Recommendations) are also presented in TM 3.4.

A simple comparison of the results of these present worth analyses indicates that the present worth of the estimated costs of the proposed IEI are greater than the costs of other options considered in the Salinity Management Program. However, various aspects of the proposed IEI distinguish this option from the other options considered in the Salinity Management Program. For example, the proposed IEI has great potential as a tool for economic development in the San Gorgonio Pass and Coachella Valley areas along the route, making brine management infrastructure available to prospective employers in the area. This Economic Development Opportunity is unique to the proposed IEI among all the options considered.

Summaries of Cost Estimates for Santa Ana Watershed Alternatives

The estimated costs for the three SAW Alternatives considered (SAW Alternatives 1, 2 and 4) are summarized in **Table 7** on the next page. SAW Alternative 2 is the least-cost alternative for this portion of the proposed IEI.

Table 7 – Summary of Costs of SAW Alternatives

Description	SAW Alternative		
	1	**2**	**4**
Construction Costs	$344,029,200	$337,680,902	$368,539,425
Distributive Costs (25%)	$86,007,300	$84,420,226	$92,134,856
Contingencies (25%)	$86,007,300	$84,420,226	$92,134,856
Total Construction Costs	**$516,043,800**	**$506,521,354**	**$552,809,138**
Annual O&M Costs	$18,069,608	$20,249,464	$21,090,154

Summaries of Cost Estimates for Coachella Valley Alternatives

The estimated costs for the two CV Alternatives designed to serve the combined SAW & CV areas (CV Alternatives A-1 and B-1) are summarized in **Table 8** below. CV Alternative B-1 is the least-cost alternative for this portion of the proposed IEI serving the combined SAW & CV areas.

Table 8 – Summary of Costs of CV Alternatives (Combined SAW & CV Areas)

Description	CV Alternative	
	A-1	**B-1**
Construction Costs	$396,307,228	$309,420,966
Distributive Costs (25%)	$99,076,807	$77,355,241
Contingencies (25%)	$99,076,807	$77,355,241
Total Construction Costs	**$594,460,842**	**$464,131,449**
Annual O&M Costs	$6,536,048	$4,661,725

Treatment Facility Cost Estimates

The estimated costs of the proposed Water Quality Treatment Facility (TF) represent a substantial portion of the estimated costs for the overall project. Therefore, if implementation of the proposed IEI receives further consideration, the need for the TF and the applicable design criteria warrant careful scrutiny.

The estimated costs for the two TF Alternatives designed to serve the combined SAW & CV areas (TF Alternatives 3-1 and 5-1) are summarized in **Table 9** below. TF Alternative 5-1 is the least-cost alternative for this portion of the proposed IEI serving the combined SAW & CV areas.

Table 9 – Summary of Costs of TF Alternatives (Combined SAW & CV Areas)

Description	TF Alternative	
	3-1	5-1
Construction Costs	$745,972,900	$443,759,100
Distributive Costs (25%)	$186,493,225	$110,939,775
Contingencies (25%)	$186,493,225	$110,939,775
Total Construction Costs	**$1,118,959,350**	**$665,638,650**
Annual O&M Costs	$16,784,390	$9,984,580

Least Cost Alternatives

The least-cost combination of alternatives for the various components of the proposed IEI to serve the combined SAW & CV areas is SAW Alternative 2, CV Alternative B-1, and TF Alternative 5-1. The total estimated cost for this least-cost alternative is summarized in **Table 10** below.

Table 10 – Summary of Least Cost Alternatives (Combined SAW & CV Areas)

Description	Alternative			
	SAW Alt. 2	CV Alt. B-1	TF Alt. 5-1	TOTALS
Construction Costs	$337,680,902	$309,420,966	$443,759,100	$1,090,860,968
Distributive Costs (25%)	$84,420,226	$77,355,241	$110,939,775	$272,715,242
Contingencies (25%)	$84,420,226	$77,355,241	$110,939,775	$272,715,242
Total Construction Costs	**$506,521,354**	**$464,131,449**	**$665,638,650**	**$1,636,291,452**
Annual O&M Costs	$20,249,464	$4,661,725	$9,984,580	$34,895,769

The least-cost combination of alternatives for the various components of the proposed IEI to serve the existing SAWPA service area is SAW Alternative 2, CV Alternative B-2, and TF Alternative 5-2. The total estimated cost for this least-cost alternative is summarized in **Table 11** on the next page.

Table 11– Summary of Least Cost Alternatives (Existing SAWPA Service Area)

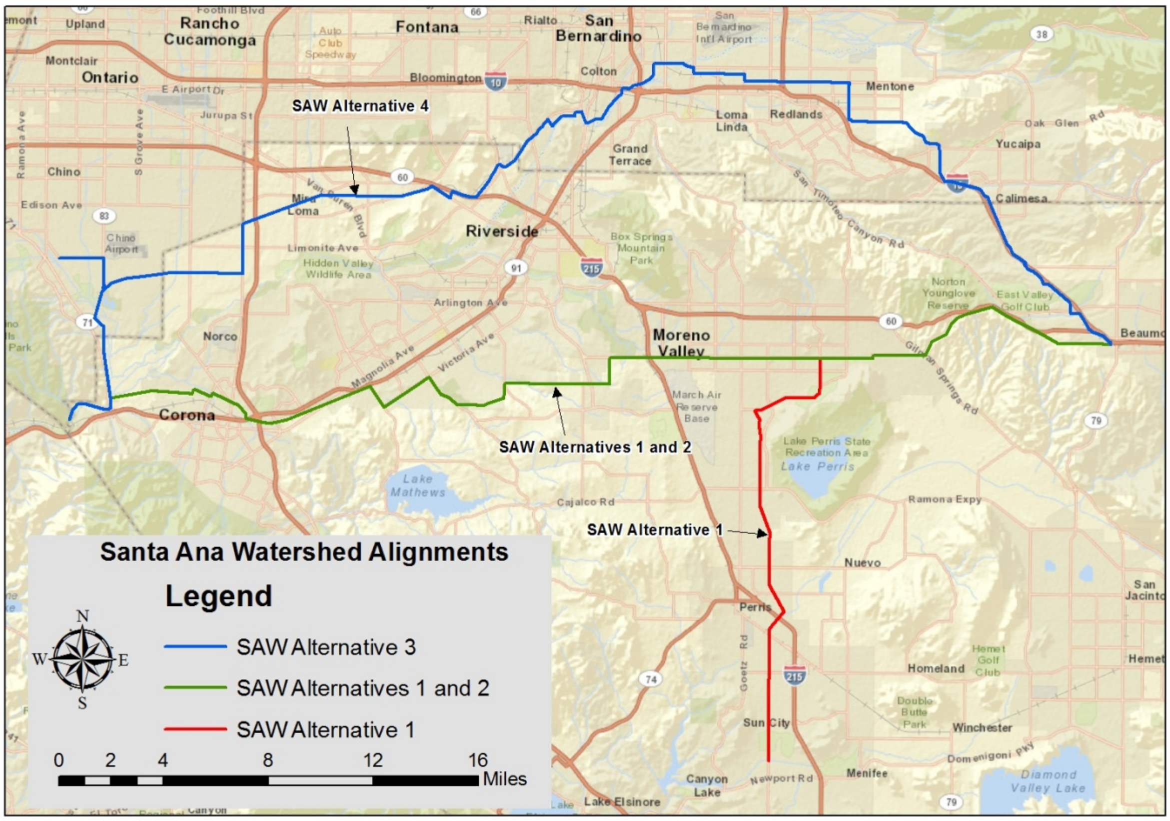
Description	Alternative			
	SAW Alt. 2	**CV Alt. B-2**	**TF Alt. 5-2**	**TOTALS**
Construction Costs	$337,680,902	$250,100,820	$286,984,800	$874,766,522
Distributive Costs (25%)	$84,420,226	$62,525,205	$71,746,200	$218,691,631
Contingencies (25%)	$84,420,226	$62,525,205	$71,746,200	$218,691,631
Total Construction Costs	**$506,521,354**	**$375,151,230**	**$430,477,200**	**$1,312,149,783**
Annual O&M Costs	$20,249,464	$3,756,286	$6,457,158	$30,462,908

Present Worth Analysis

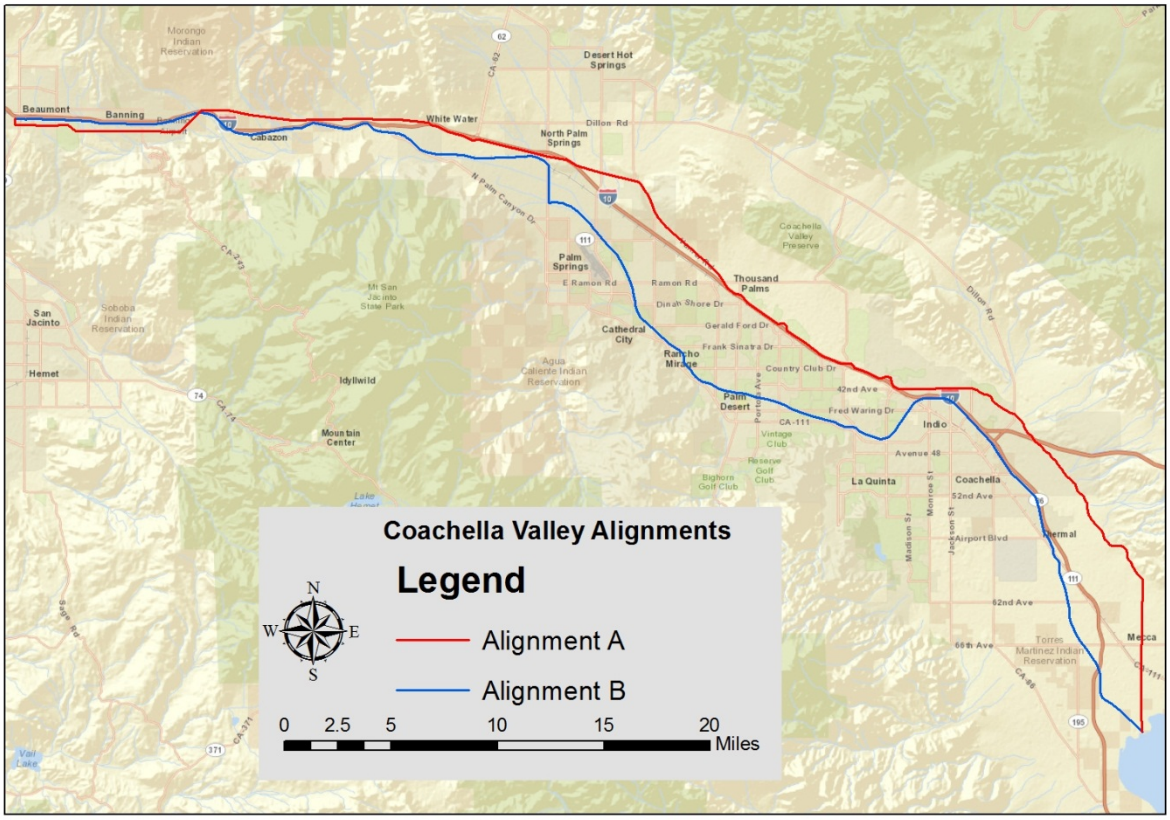
Present worth analyses were presented in the ***Salinity Management Program Phase 2 Technical Memorandum*** of the estimated costs for each of the options considered in that study to facilitate comparison. A similar present worth analysis is presented in TM 3.4 for the least-cost combination of alternatives identified above to facilitate comparison of the proposed IEI with the present worth analyses of the options considered in the Phase 2 Technical Memorandum.

Appendix – GIS Exhibits

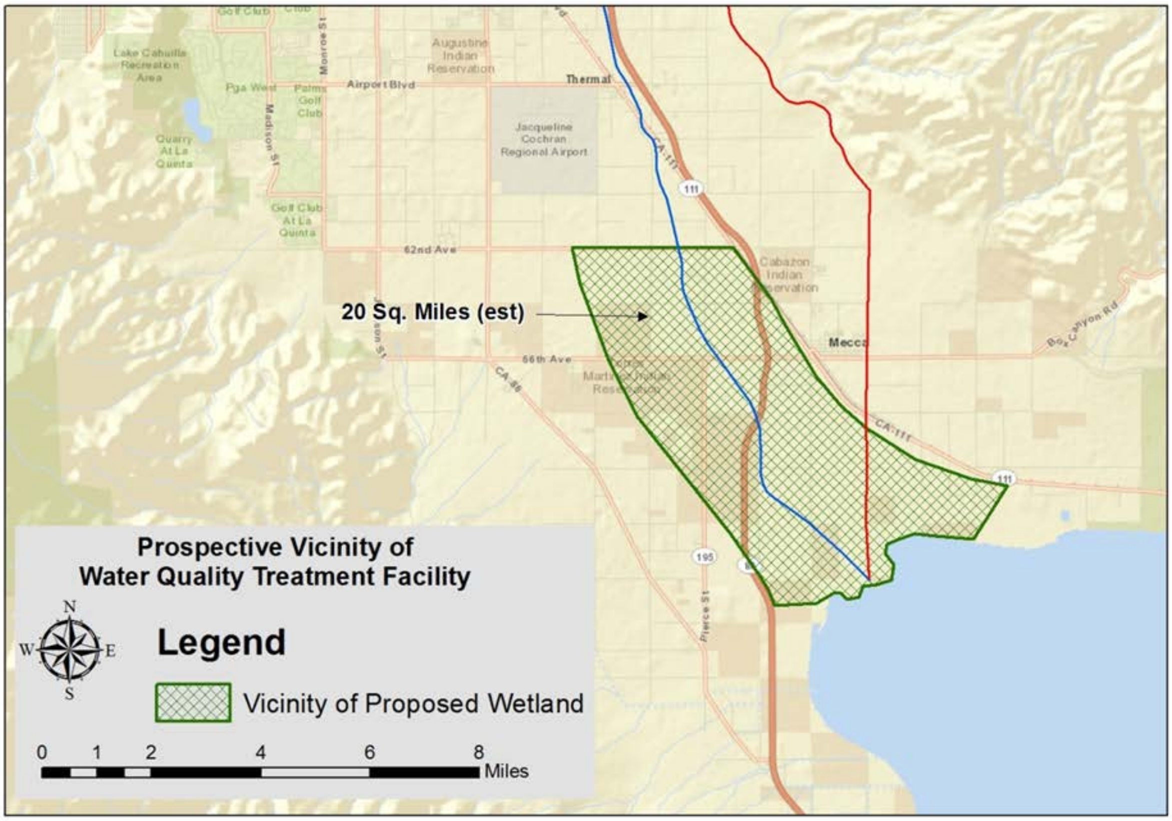
Santa Ana Watershed Alignments



Coachella Valley Alignments



Water Quality Treatment Facility

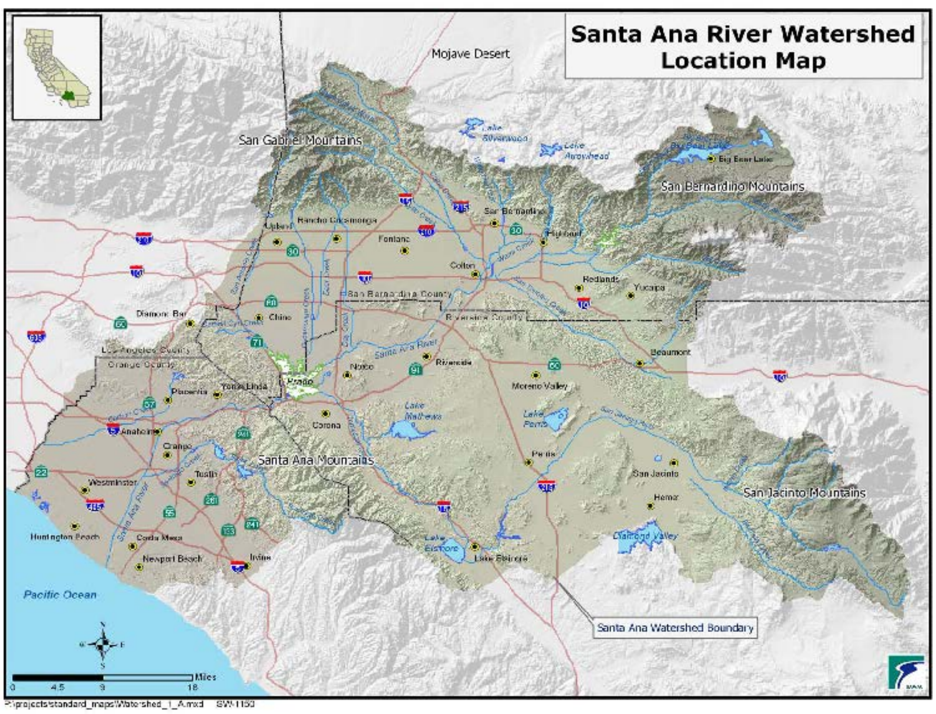


RECLAMATION
Managing Water in the West

Technical Memorandum No. 3.1
Project Background, Data Collection and Information Gathering

Inland Empire Interceptor Appraisal Analysis

Santa Ana Watershed Basin Study, California
Lower Colorado Region



U.S. Department of the Interior
Bureau of Reclamation
Southern California Area Office

Santa Ana Watershed
Project Authority

May 2013

Mission Statements

The mission of the Department of the Interior is to protect and provide access to our Nation's natural and cultural heritage and honor our trust responsibilities to Indian Tribes and our commitments to island communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

BUREAU OF RECLAMATION
Engineering Services Office
Lower Colorado Regional Office, LC-6000

Technical Memorandum No. 3.1
Project Background, Data Collection and Information Gathering

Inland Empire Interceptor Appraisal Analysis

Santa Ana Watershed Basin Study, California
Lower Colorado Region

Prepared by: **Thomas Nichols, P.E.**
Civil Engineer (Hydrologic)
Engineering Services Office, LC-6233
Lower Colorado Region

This page intentionally left blank.

Contents

Page

This page intentionally left blank.

Introduction

Project Background

The One Water One Watershed (OWOW) Plan is the integrated water management plan for the Santa Ana Watershed that is administered by the Santa Ana Watershed Project Authority (SAWPA). This plan is being updated by One Water One Watershed 2.0 which will evaluate current water supply for the watershed and will address:

- climate change,
- increasing water demands,
- water quality, and
- future water supply needs.

The Bureau of Reclamation's Southern California Area Office (SCAO) and SAWPA submitted a proposal in June 2010 for funding of a Santa Ana Watershed Basin Study (Basin Study) in support of One Water One Watershed 2.0. In August 2010, this Basin Study was selected by Reclamation for funding.

This Inland Empire Interceptor Appraisal Analysis (Appraisal Analysis) is one component of the Basin Study.

Santa Ana Watershed Project Authority

SAWPA is a joint powers authority comprised of five member water districts that serve the vast majority of the Santa Ana Watershed. The area served by SAWPA is located within Orange, Riverside and San Bernardino Counties of California, bounded by the Pacific Ocean on the west, the San Bernardino Mountains to the north, and the San Jacinto Mountains to the east.

The five SAWPA Member Agencies are:

- Eastern Municipal Water District (EMWD),
- Western Municipal Water District (WMWD),
- Inland Empire Utilities Agency (IEUA),
- San Bernardino Valley Municipal Water District (SBVMWD), and
- Orange County Water District (OCWD).

These five agencies serve most of the Santa Ana Watershed. Population within the watershed has increased significantly in recent years, and this urban growth has put enormous pressure on the regional water supply, water quality and environmental/recreation resources.

SAWPA first formed as a planning agency in 1967, and was reorganized in 1972 with the mission to plan and build facilities to protect water quality and enhance the water supply within the Santa Ana River Watershed. This mission includes the goal of achieving a salt balance in the upper Santa Ana Watershed. SAWPA developed the Inland Empire Brine Line (Brine Line), which was formerly known as the Santa Ana Regional Interceptor (SARI), for the purpose of exporting salt from the Santa Ana Watershed. Exportation of salt prevents its accumulation in the watershed and protects the quality of the potable water supply. The future of the potable water supply will continue to be dependent upon an economical means of collection, treatment and disposal of brine. The Brine Line collects and disposes of brine flow from the Santa Ana Watershed and is critical to SAWPA's mission success. Multiple branches of the existing Brine Line system converge in the vicinity of Prado Dam near the City of Corona.

Inland Empire Interceptor

The report entitled ***Santa Ana Watershed Salinity Management Program, Phase 2 SARI Planning Technical Memorandum***, prepared by CDM, et al, in May 2010 identified and investigated several alternatives for disposal of Brine Line flows. That study included a cursory review of a proposed new Brine Line outfall to the Salton Sea to replace the existing Pacific Ocean outfall, referred to in this Appraisal Analysis as the Inland Empire Interceptor, or IEI.

Appraisal Analysis Objectives

The purpose of this Inland Empire Interceptor Appraisal Analysis is to help determine whether more detailed investigations of the proposed Inland Empire Interceptor (IEI) are justified. Under Reclamation criteria (Reclamation Manual FAC 09-01), appraisal analyses "are intended to be used as an aid in selecting the most economical plan by comparing alternative features" and are to be prepared "using the available site-specific data." Several alternative conceptual designs for the proposed IEI will be developed and evaluated in this Appraisal Analysis for the purpose of comparison.

In consideration of these objectives, the Appraisal Analysis will address:

- Water quality and environmental considerations,
- Brine pre-treatment requirements,
- Environmental permitting requirements,
- Institutional constraints,
- Preliminary pipeline alignments,
- Pumping requirements, and
- Capital and Operation, Maintenance and Replacement (OM&R) costs.

Technical Memorandum No. 3.1

The purpose of Technical Memorandum No. 3.1 is to identify the information that has been gathered for use in performing the Inland Empire Interceptor Appraisal Analysis, including data from SAWPA and other agencies. The effort also includes obtaining and reviewing previous study reports and other available documents that may be useful in performing the Study.

Data Collection

Historic and Future Brine Flow

This Appraisal Analysis will present historic brine concentration and flow data for the Santa Ana Watershed that will be used in developing future brine concentration and flow projections. Current and projected flow data obtained from SAWPA member agencies (EMWD, IEUA, OCWD, SBVMWD and WMWD) may also be used to perform this analysis.

Inland Empire Brine Line

The Brine Line includes approximately 72 miles of pipeline in multiple branches which converge in the vicinity of Prado Dam near the City of Corona. It has a planned capacity of approximately 32.5 million gallons per day (MGD) and can collect and export approximately 271,000 tons of salt per year from the upper Santa Ana Watershed, east of the Santa Ana Mountains. In 2010 & 2011, the current average system flows were approximately 11.7 MGD and over 75,000 tons of salt were exported each year.

Another 21 miles of pipeline convey the combined flows to Orange County Sanitation District (OCSD) facilities for treatment and disposal by discharge to the Pacific Ocean. This pipeline has a nominal capacity of 30 MGD. The planned capacity of the Brine Line system (32.5 MGD) exceeds the hydraulic capacity of the pipeline from the Brine Line convergence near Prado Dam to the OCSD facilities. Furthermore, the agreement between SAWPA and OCSD allows Brine Line flows to the OCSD system up to only 17.0 MGD, with a contractual right to purchase up to 30.0 MGD capacity.

As discussed above, the report entitled ***Santa Ana Watershed Salinity Management Program, Phase 2 SARI Planning Technical Memorandum,*** identified and investigated several alternatives for disposal of Brine Line flows. That study included a cursory review of a proposed new Brine Line outfall to the Salton Sea to replace the existing Pacific Ocean outfall.

Appraisal estimates will be developed for the costs of the proposed IEI to the Sea. This Appraisal Analysis will address:

- water quality and ecological effects of discharging brine flow to the Sea,
- brine pre-treatment requirements,
- environmental permitting requirements,
- institutional considerations (e.g. interactions with the Salton Sea Advisory Committee and Indian Tribes),
- preliminary pipeline alignments,
- pumping requirements and energy demands, and
- appraisal estimates of the capital and operational, maintenance and replacement (OM&R) costs.

Information Gathering

Previous Studies

[1] ***One Water One Watershed, 2010 Integrated Regional Water Management Plan***, Santa Ana Watershed Project Authority, November 2010. http://www.sawpa.org/owow/the-plan/

[2] ***Inland Empire Brine Line Disposal Option Concept Investigation (Draft)***, Santa Ana Watershed Project Authority, October 2011.

[3] ***Santa Ana Watershed Salinity Management Program, Summary Report***, Camp, Dresser & McKee (CDM), et al for Santa Ana Watershed Project Authority, July 2010. http://www.sawpa.org/documents/SAWPASummaryReportJuly2010.pdf

[4] ***Santa Ana Watershed Salinity Management Program, Phase 2 SARI Planning Technical Memorandum***, Camp, Dresser & McKee (CDM), et al for Santa Ana Watershed Project Authority, May 2010. http://www.sawpa.org/wp-content/uploads/2012/07/8.-SAPWATM2_Final.pdf

[5] ***Southern California Regional Brine-Concentrate Management Study – Phase I, Executive Summary***, Bureau of Reclamation, October 2009. http://www.usbr.gov/lc/socal/reports/brineconcentrate/1ExecSumm.pdf

[6] ***Final Environmental Assessment SARI Repairs Upstream of Prado Dam***, Santa Ana Watershed Project Authority, April 2011. http://www.sawpa.org/documents/sari/Prado%20SARI%20LIne%20fdEA%20REPAIRS.pdf

[7] ***Restoration of the Salton Sea, Summary Report***, Bureau of Reclamation, September 2007.
http://www.usbr.gov/lc/region/saltnsea/FinalSummaryRpt.pdf

[8] ***Salton Sea Species Conservation Habitat Project Draft Environmental Impact Report*** by California Department of Water Resources (CDWR) & California Department of Fish and Game (CDFG), with assistance from Cardno ENTRIX, for U.S. Army Corps of Engineers and California Natural Resources Agency, August 2011.
http://www.water.ca.gov/saltonsea/habitat/eir2011.cfm

[9] ***Salton Sea Ecosystem Restoration Program Draft Programmatic Environmental Impact Report*** by CDWR & CDFG, with assistance from CH2M Hill, October 2006 and ***Salton Sea Ecosystem Restoration Program Final Programmatic Environmental Impact Report*** by CDWR & CDFG, with assistance from CH2M Hill, June 2007, for California Natural Resources Agency.
http://www.water.ca.gov/saltonsea/peir/

[10] ***Hazard, The Future of the Salton Sea with No Restoration Project***, Pacific Institute, May 2006.
http://www.pacinst.org/reports/saltonsea/report_lowres.pdf

Background Information

[11] ***Brine Line to the Salton Sea*** (PowerPoint Slides), Celeste Cantu, Santa Ana Watershed Project Authority.

[12] ***Inland Empire Brine Line (Santa Ana Regional Interceptor, SARI)*** (PowerPoint Slides), Rich Haller, Santa Ana Watershed Project Authority, March 2010.
http://www.sawpa.org/documents/sari/BrineLine3-23-10.pdf

Other Resources

[13] ***California Environmental Quality Act***, Public Resources Code Division 13, Section 21000, State of California Legislature.
http://leginfo.legislature.ca.gov/faces/codes.xhtml

[14] ***The California Coordinate System***, Caltrans Surveys Manual, Survey Datums, California Department of Transportation, May 2013.
http://www.dot.ca.gov/hq/row/landsurveys/SurveysManual/04_Surveys.pdf

[15] ***Reclamation Manual, Directives and Standards, FAC 09-01: Cost Estimating*** and ***FAC 09-02: Construction Cost Estimates and Project Cost Estimates***, Bureau of Reclamation, October 2007.
http://www.usbr.gov/recman/fac/fac09-01.pdf
http://www.usbr.gov/recman/fac/fac09-02.pdf

[16] ***Engineering Services Office Manual – Lower Colorado Region***, Bureau of Reclamation, 2011.

Additional Resources Cited in Technical Memo No. 3.2

The following Additional Resources are referenced in Technical Memorandum No. 3.2 by the numbers listed below, which are not cited in previous Technical Memoranda. Reference numbers are reused and duplicate numbers used in previous Technical Memoranda. Various Urban Water Management Plans (not listed) are also referenced in Technical Memorandum No. 3.2.

[5] ***Coachella Valley Final Water Management Plan***, Coachella Valley Water District in association with MWH Americas, Inc. and Water Consult, Inc., et al, September 2002.

[6] ***Coachella Valley Water Management Plan Update (Draft Report)***, MWH Americas, Inc. and Water Consult, Inc., et al for Coachella Valley Water District, December 2010.

[7] ***2010 Urban Water Management Plan (Final Report)***, Coachella Valley Water District in association with MWH Americas, Inc., July 2011.

[8] ***Draft Subsequent Program Environmental Impact Report (Administrative Draft)***, Coachella Valley Water District, July 2011.

[9] ***Final Subsequent Program Environmental Impact Report***, Coachella Valley Water District with assistance from MWH Americas, Inc. and Water Consult, Inc., January 2012.

Additional Resources Cited in Technical Memo No. 3.3

The following Additional Resources are referenced in Technical Memorandum No. 3.3 by the numbers listed below, which are not cited in previous Technical Memoranda. Reference numbers are reused and duplicate numbers used in previous Technical Memoranda.

[4] ***DRAFT Memorandum, Subject: Santa Ana Regional Interceptor (SARI) Solids Control Alternatives Conceptual Costs***, CDM for Santa Ana Watershed Project Authority, April 1, 2011.

[5] ***Central Arizona Salinity Study, Strategic Alternatives for Brine Management in the Valley of the Sun***, Bureau of Reclamation, January 2010.

[6] ***Restoration of the Salton Sea, Summary Report***, Bureau of Reclamation, September 2007.

[7] ***Salton Sea Species Conservation Habitat Project Draft Environmental Impact Report***, by CDFG and CDWR with assistance from Cardno ENTRIX, for U.S. Army Corps of Engineers and California Natural Resources Agency, August 2011.

[9] ***Salton Sea Revitalization & Restoration, Salton Sea Authority Plan for Multi-Purpose Project, Executive Summary***, Salton Sea Authority, June 2006.

[10] ***Manual: Constructed Wetlands Treatment of Municipal Wastewaters***, U.S. Environmental Protection Agency, 1999.

[11] ***Water Quality Control Plan: Colorado River Basin - Region 7***, Colorado River Basin Regional Water Quality Control Board, 2006.

[12] ***Evaporation Pond Sizing with Water Balance and Make-up Water Calculations***, Idaho National Engineering and Environmental Laboratory, Engineering Design File, 2001.

[13] ***Hydrologic Regimen of Salton Sea, California***, U.S. Geological Survey, Professional Paper 486-C, 1966.

[14] ***Membrane Concentrate Disposal: Practices and Regulation***, Desalination and Water Purification Research and Development Program Report No. 69, Bureau of Reclamation, September 2001.

[15] ***Principles of Design and Operations of Wastewater Treatment Pond Systems for Plant Operators, Engineers and Managers***, U.S. Environmental Protection Agency, 2001.

[16] ***Recommended Standards for Wastewater Facilities,*** ("Ten States Standards") Great Lakes Upper Mississippi River Board of State Public Health and Environmental Managers, 1990.

Additional Resources Cited in Technical Memo No. 3.4

The following Additional Resources are referenced in Technical Memorandum No. 3.4 by the numbers listed below, which are not cited in previous Technical Memoranda. Reference numbers are reused and duplicate numbers used in previous Technical Memoranda.

[7] ***Desert Aqueduct Project Development Plan Phase 1 Report (Draft)***, GEI/Bookman-Edmonston, et al for Coachella Valley Water District, et al, August 2007.

[8] ***RSMeans Facilities Construction Cost Data, 2011, 26th Annual Edition***, RSMeans, a division of Reed Construction Data, 2010.

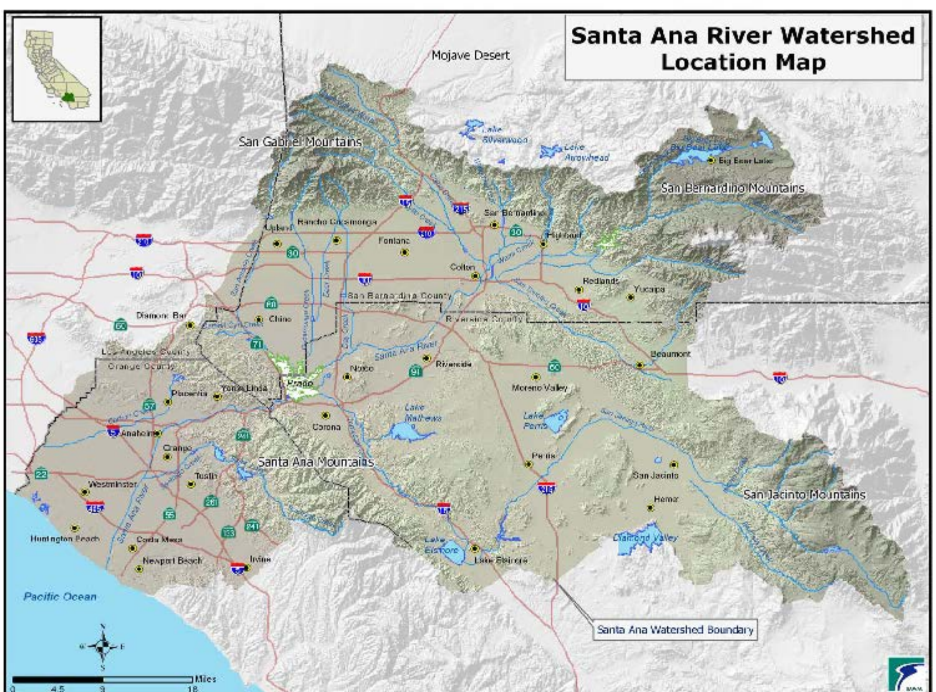
RECLAMATION

Managing Water in the West

Technical Memorandum No. 3.2
Summary of Brine and Flow Data

Inland Empire Interceptor Appraisal Analysis

Santa Ana Watershed Basin Study, California
Lower Colorado Region



U.S. Department of the Interior
Bureau of Reclamation
Southern California Area Office

Santa Ana Watershed
Project Authority

May 2013

Mission Statements

The mission of the Department of the Interior is to protect and provide access to our Nation's natural and cultural heritage and honor our trust responsibilities to Indian Tribes and our commitments to island communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

BUREAU OF RECLAMATION
Engineering Services Office
Lower Colorado Regional Office, LC-6000

Technical Memorandum No. 3.2
Summary of Brine and Flow Data

Inland Empire Interceptor Appraisal Analysis

Santa Ana Watershed Basin Study, California
Lower Colorado Region

Prepared by:	**Thomas Nichols, P.E.** **Civil Engineer (Hydrologic)** **Engineering Services Office, LC-6233** **Lower Colorado Region**
Reviewed by:	**Douglas B. Blatchford, P.E.** **Richard Eastland, P.E.**

This page intentionally left blank.

Contents

Page

Figures

Tables

Acronyms and Abbreviations

Organizations:

CA-DWR	California Department of Water Resources
CDM	Camp, Dresser & McKee
CRWQCB	Colorado River Basin Regional Water Quality Control Board, State of California
CVWD	Coachella Valley Water District
EMWD	Eastern Municipal Water District
ESO	Bureau of Reclamation's Engineering Services Office, Boulder City, Nevada
IEUA	Inland Empire Utilities Agency
MSWD	Mission Springs Water District
OCSD	Orange County Sanitation District
OCWD	Orange County Water District
Reclamation	Bureau of Reclamation
SAWPA	Santa Ana Watershed Project Authority
SBVMWD	San Bernardino Valley Municipal Water District
SCAO	Bureau of Reclamation's Southern California Area Office, Temecula, California
WMWD	Western Municipal Water District

Documents:

Appraisal Analysis	Inland Empire Interceptor Appraisal Analysis
Basin Plan	Water Quality Control Plan: Colorado River Basin Regional Water Quality Control Board
Basin Study	Santa Ana Watershed Basin Study
CVWMPU	Coachella Valley Water Management Plan Update
OWOW	One Water One Watershed
SPEIR	Subsequent Program Environmental Impact Report
TM	Technical Memorandum
UWMP	Urban Water Management Plan
WMP	Water Management Plan

Facilities and Processes:

Brine Line	Inland Empire Brine Line
CLMM	County Line Master Meter
CVSC	Coachella Valley Stormwater Channel
DOM	Domestic (Brine Generator Category)
DS	Desalter Facilities (Brine Generator Category)
IND	Industrial Facilities (Brine Generator Category)
IEBL	Inland Empire Brine Line
IEI	Inland Empire Interceptor
PP	Power Plants (Brine Generator Category)
RECYC	Recycled Water Facilities (Brine Generator Category)
RO	Reverse Osmosis
SARI	Santa Ana Regional Interceptor (aka “Brine Line”)
TEMP	Temporary (Brine Generator Category)
WH	Waste Haulers (Brine Generator Category)
WRF	Water Reclamation Facilities

Parameters and Units of Measure:

AF	Acre-Feet
AFY	Acre-Feet per Year
BOD	Biochemical Oxygen Demand (or Biological Oxygen Demand)
MGD	Million Gallons per Day
mg/L	Milligrams per Liter
MW	Megawatt
ppm	Parts per Million
TDS	Total Dissolved Solids
TSS	Total Suspended Solids

Introduction

Santa Ana Watershed Project Authority

The Santa Ana Watershed Project Authority (SAWPA) is a joint powers authority comprised of five member water districts that serve most of the Santa Ana Watershed. The area served by SAWPA is located within Orange, Riverside and San Bernardino Counties of California, bounded by the Pacific Ocean on the west, the San Bernardino Mountains to the north, and the San Jacinto Mountains to the east.

The five SAWPA Member Agencies are:

- Eastern Municipal Water District (EMWD),
- Western Municipal Water District (WMWD),
- Inland Empire Utilities Agency (IEUA),
- San Bernardino Valley Municipal Water District (SBVMWD), and
- Orange County Water District (OCWD).

Inland Empire Brine Line

SAWPA's mission is to plan and build facilities to protect water quality and enhance the water supply within the Santa Ana River Watershed. This mission includes the goal of achieving a salt balance in the upper Santa Ana Watershed. SAWPA developed the Inland Empire Brine Line (Brine Line), which was formerly known as the Santa Ana Regional Interceptor (SARI), for the purpose of exporting salt from the Santa Ana Watershed.

The Brine Line includes approximately 72 miles of pipeline in multiple branches which converge in the vicinity of Prado Dam near the City of Corona. Another 21 miles of pipeline convey the combined flows to Orange County Sanitation District (OCSD) facilities for treatment and disposal to the Pacific Ocean. The Brine Line has a capacity of approximately 32.5 million gallons per day (MGD), and the current average flows are approximately 11.7 MGD (in 2010 & 2011). It currently collects and exports over 75,000 tons of salt per year.

Exportation of salt prevents its accumulation in the watershed and protects the quality of the potable water supply. The future of the potable water supply will continue to be dependent upon an economical means of collection, treatment and disposal of brine. The Brine Line collects and disposes of brine flow from the Santa Ana Watershed and is critical to SAWPA's mission success.

Project Background

The One Water One Watershed (OWOW) Plan is the integrated water management plan for the Santa Ana Watershed administered by SAWPA. The Bureau of Reclamation's Southern California Area Office and SAWPA submitted a proposal in June 2010 for funding of a Santa Ana Watershed Basin Study in support of the OWOW Plan update, known as One Water One Watershed 2.0. In August 2010, the proposed Basin Study was selected by Reclamation for funding.

A study entitled ***Santa Ana Watershed Salinity Management Program*** [1] & [2] was prepared for SAWPA by a team of consultants led by Camp, Dresser & McKee (CDM) in 2010. The Salinity Management Plan report identified and evaluated several potential system configuration changes to address future system capacity limitations. One of the alternatives identified in the Salinity Management Program is a proposed new Brine Line outfall to the Salton Sea (identified as Option 4 in the Summary Report). This Brine Line outfall to the Salton Sea option is referred to in this Technical Memorandum (TM 3.2) as the Inland Empire Interceptor, or IEI.

The Salinity Management Program report did not include a detailed evaluation of the IEI alternative, though a limited discussion of the concept was provided in Section 3.2 of the ***Santa Ana Watershed Salinity Management Program, Phase 2 SARI Planning Technical Memorandum*** [1], and cost estimate information was presented in Appendix A. The magnitude of infrastructure costs and potential impacts associated with this option were noted. However, it was also suggested that SAWPA may choose to investigate this IEI option further.

After delivery of the Santa Ana Watershed Salinity Management Program report by CDM, SAWPA staff prepared a report entitled ***Inland Empire Brine Line Disposal Option Concept Investigation*** [3] (SAWPA Investigation) in which four alternative conceptual designs for the proposed IEI were developed and evaluated. The alternatives that will be considered in this Appraisal Analysis for the portion in the upper Santa Ana Watershed (west of San Gorgonio Pass) are based upon those investigated by SAWPA staff.

Appraisal Analysis Objectives

The purpose of this Inland Empire Interceptor Appraisal Analysis is to help determine whether more detailed investigations of the proposed Inland Empire Interceptor (IEI) are justified. Under Reclamation criteria (Reclamation Manual FAC 09-01) [4], appraisal analyses "are intended to be used as an aid in selecting the most economical plan by comparing alternative features" and are to be prepared "using the available site-specific data." Several alternative conceptual designs for the proposed IEI will be developed and evaluated in this Appraisal Analysis for the purpose of comparison.

The proposed IEI would replace the existing outfall from the Brine Line system convergence near Prado Dam in western Riverside County to the OCSD system, through which the flow is currently treated and discharged. The proposed IEI runs from a location near Prado Dam, eastward to San Gorgonio Pass and through Coachella Valley in eastern Riverside County. Three of the four alternative conceptual designs developed and evaluated in the SAWPA Investigation for the portion in the Santa Ana Watershed are under consideration in this Appraisal Analysis. And two alternative alignments were developed for the portion in the San Gorgonio Pass and Coachella Valley areas for consideration. The conceptual designs and estimated costs associated with each of these alternatives will be addressed in subsequent Technical Memoranda (TM) for this Appraisal Analysis.

The route of the proposed IEI through the San Gorgonio Pass and Coachella Valley areas in eastern Riverside County represents an opportunity for SAWPA to expand the Brine Line service area. This Appraisal Analysis will address this possibility.

This Appraisal Analysis will not include investigation of the benefits associated with the proposed IEI, but it is appropriate to note major categories of potential benefits. Benefits to stakeholders in the Santa Ana Watershed may include increased capacity for removal of salt from the watershed, a more reliable mechanism for treatment and disposal of brine, and an improved climate for economic development associated with improved infrastructure. Potential benefits to possible new stakeholders in San Gorgonio Pass and Coachella Valley may include opportunities for sharing of infrastructure necessary for removal of salt from the area and an improved economic development climate resulting from availability of this infrastructure. Potential benefits to Salton Sea stakeholders may include replacement of a portion of the looming water supply reduction.

A series of Technical Memoranda has been produced as part of this Appraisal Analysis in support of the final report. This Technical Memorandum No. 3.2 (TM 3.2) is the second of this series.

Technical Memorandum No. 3.2

This TM 3.2 addresses analysis of available historical Brine Line flow data and forecasting of future flows. It also addresses the potential expansion of the SAWPA / Brine Line service area to include the San Gorgonio Pass and Coachella Valley areas. The forecasts of future flows include those from both the existing Brine Line service area and from potential service area expansion.

TM 3.2 also addresses analysis of available historical data for water quality constituents of the Brine Line flows and forecasting of those constituents in future flows. These constituents include Total Dissolved Solids (TDS), Total Suspended Solids (TSS) and Biochemical Oxygen Demand (BOD).

Proposed Inland Empire Interceptor

Proposed Modifications to the Existing Brine Line Gravity Collection System

The conceptual design for the proposed Inland Empire Interceptor (IEI) will be described in a subsequent TM. However, a brief description is included here for background.

The existing Brine Line system operates by gravity-flow, including the existing outfall to the OCSD system. The IEI, as proposed, would replace the existing outfall. The route of the proposed IEI runs through upper Santa Ana Watershed, San Gorgonio Pass and Coachella Valley to the Salton Sea. The proposed IEI would begin at a location near the convergence of the existing system at Prado Dam in western Riverside County. It would run eastward to San Gorgonio Pass. The ground elevation at the high point in San Gorgonio Pass is nearly 2,100 feet above the lowest ground elevation along the route near Prado Dam. Therefore, pumping of the system flows will be necessary and the portion of the proposed IEI in Santa Ana Watershed will operate under pressure.

Proposed Inland Empire Interceptor in Santa Ana Watershed

As noted above, for the portion of the proposed IEI located in the Santa Ana Watershed, three alternatives have been selected for consideration in this Appraisal Analysis. Each alternative will begin at a pumping station located near Prado Dam. Additional pumping stations of various sizes will be necessary at various locations for each alternative.

All three alternatives will connect to the portion of the proposed IEI through San Gorgonio Pass and Coachella Valley. This connection is located at the City of Beaumont in western San Gorgonio Pass.

Proposed Inland Empire Interceptor in San Gorgonio Pass and Coachella Valley

Similarly, for the portion of the proposed IEI through San Gorgonio Pass and Coachella Valley, two alternative alignments have been selected for consideration in this Appraisal Analysis. Both alternatives begin at a point in the City of Beaumont in San Gorgonio Pass common to each of the other alternatives and terminate at the Salton Sea. This portion of the proposed IEI will operate by gravity-flow.

Potential Brine Line Service Connections in Coachella Valley

As noted above, the proposed IEI will provide an opportunity for existing or future brine generators in the San Gorgonio Pass and Coachella Valley areas to connect to the Brine Line. Coachella Valley Water District (CVWD) is the largest water supplier in the Coachella Valley area and potential new Brine Line stakeholder. The most recent long-term assessments of future water supplies and demands for the CVWD are the ***Coachella Valley Water Management Plan Update*** [6] (CVWMPU), dated December 2010, and the ***2010 Urban Water Management Plan*** [7]. The CVWMPU is supplemented by the ***Subsequent Program Environmental Impact Report (Administrative Draft)*** [8] and ***Final Subsequent Program Environmental Impact Report*** [9] (SPEIR), dated July 2011 and January 2012, respectively.

Like the Santa Ana River Watershed prior to development of the Inland Empire Brine Line, Coachella Valley is experiencing a salt imbalance that poses a long-term threat to the Valley water supply. The CVWMPU identifies a net import of salt into Coachella Valley of as much as 350,000 tons per year and proposes a Salt Management Program for the purpose of exporting salt from the Valley. The proposed program would provide desalination of drain water from the agricultural east portion of Valley to respond to the imbalance.

Analysis of Historical Flow Data for Existing SAWPA Service Area

SAWPA Member Agencies

As previously mentioned, SAWPA is composed of five member agencies. Four of these agencies, all located in the upper Santa Ana Watershed, contribute flows to the Brine Line system. These four member agencies are:

- Eastern Municipal Water District (EMWD),
- Western Municipal Water District (WMWD),
- Inland Empire Utilities Agency (IEUA), and
- San Bernardino Valley Municipal Water District (SBVMWD),

Orange County Sanitation District (OCSD), receives, treats and disposes of the flows from the Brine Line. Per the Santa Ana Watershed Salinity Management Program report by CDM, SAWPA owns 17 MGD of capacity in the OCSD system and has contractual rights to purchase additional capacity up to 30 MGD. The rate structure established in this agreement is based upon the Brine Line flows entering the OCSD system and the measured TSS and BOD concentrations of the flows. The flows and the TSS and BOD concentrations are measured at the County Line Master Meter (CLMM) located where the Brine Line crosses into Orange County.

SAWPA owns, operates and maintains the Brine Line system. The member agencies own rights to the system capacity. The individual member agencies can use capacity and/or make capacity available to third-party brine generators, up to their share of the system capacity. Like the OCSD agreement discussed above, the SAWPA rate structure is based upon the volume of the flows entering the Brine Line system as well as the TSS and BOD concentrations of the flows.

Analysis of Brine Line Flows

Forecasts of future flows for the existing SAWPA service area were previously prepared by CDM in support of the 2010 Santa Ana Watershed Salinity Management Program. These forecasts and available historical data were provided by SAWPA to Reclamation for this Appraisal Analysis. Reclamation used that information to develop flow projections for potential expansion of the SAWPA service area to include communities in the San Gorgonio Pass and Coachella Valley areas.

To develop those flow projections, the historical flow data were sorted into several Brine Generator Categories for analysis. The data were also sorted into the four SAWPA Member Agencies. Similarly, the forecasts of future flows for the existing SAWPA service area were also sorted by Brine Generator Categories and by SAWPA Member Agencies.

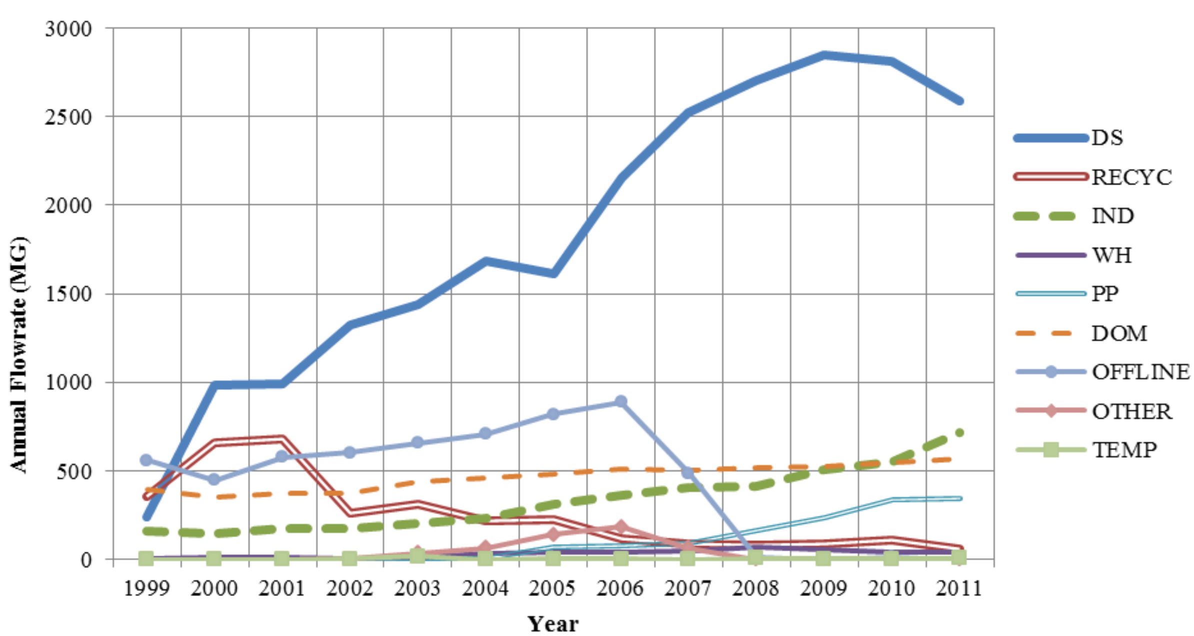
Historical Flow Data by Brine Generator Category

The Brine Generator Categories used in the analysis are designated as follows:

- Desalter Facilities DS
- Recycled Water Facilities RECYC
- Industrial Facilities IND
- Power Plants PP
- Waste Haulers WH
- Domestic DOM
- Offline OFFLINE
- Temporary TEMP
- Other OTHER

Annual flow volumes for each of the Brine Generator Categories are presented graphically in **Figure 1** below.

Figure 1 - Historic Brine Line Flow by Brine Generator Category

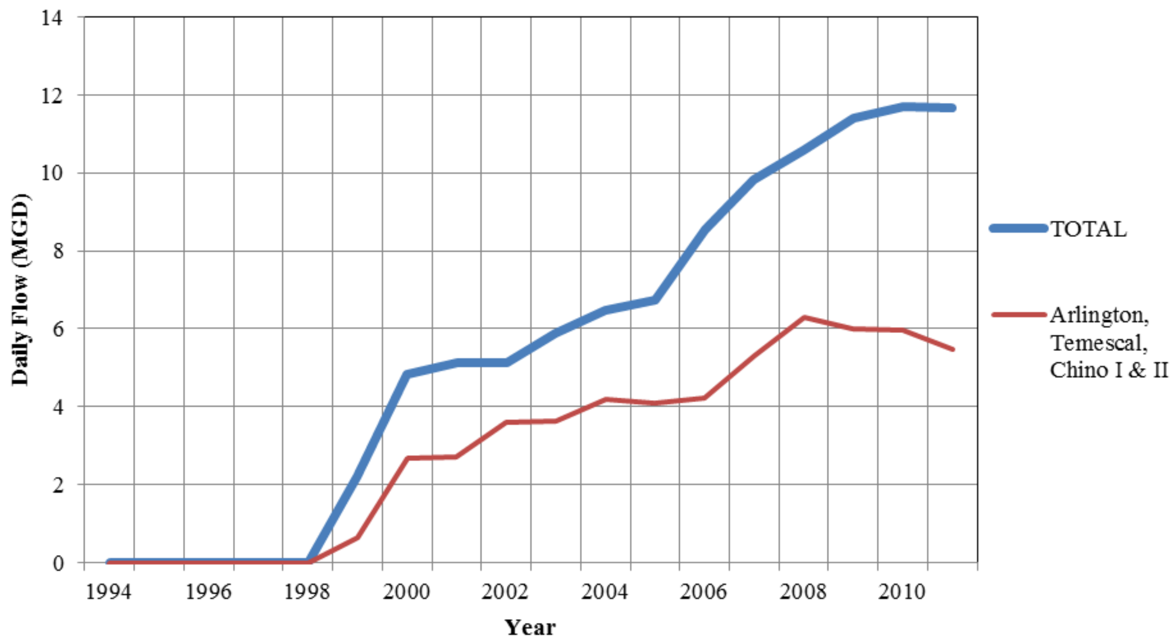


It is apparent from **Figure 1** that Desalter Facilities contribute a significant portion of the Brine Line flows. In recent years, flows from the Desalter Facilities

Brine Generator Category have exceeded the flows from each of the other categories by at least 400 percent.

Historical flows from the Desalter Facilities category have come from only four facilities (Arlington, Temescal, Chino I and Chino II). The significance of these facilities to the Brine Line system is further emphasized by the relationship of the combined average daily flow from the four existing facilities to total Brine Line flows, illustrated in **Figure 2** below.

Figure 2 - Historical Brine Line Flow from Desalter Facilities



Desalter Facilities have accounted for approximately half of the historical total Brine Line flows.

The Industrial Facilities and Domestic Brine Generator Categories have been the next largest in recent years. Flows from the Industrial Facilities category have steadily increased over time. However, flows from the Domestic category have shown only modest increase; and improvements to domestic wastewater collection systems in the area are currently under way that will result in removal of nearly all Domestic flows from the Brine Line by 2015. Therefore, the Domestic category will no longer be a significant contributor to the Brine Line in future years.

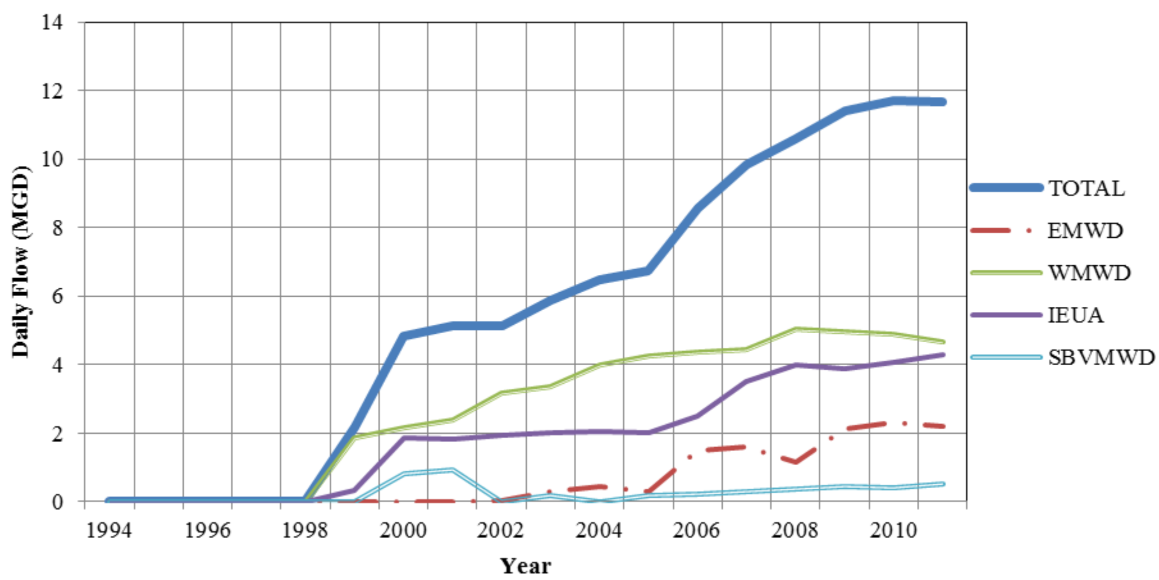
Flows from the Power Plants category have increased steadily and have become an increasingly significant portion of the total Brine Line flows in recent years.

Flows from the Recycled Water Facilities, Offline, Temporary and Other Brine Generator Categories are comparatively minor. The aggregate of historical flows from these categories amounts to approximately one percent of the total Brine Line flows.

Historical Flow Data by SAWPA Member Agency

The historical flow data has also been sorted by SAWPA Member Agency on an average daily flow basis. Because the flows from the Offline, Temporary and Other Brine Generator Categories are small, they have been eliminated from this analysis; the results of which are presented in **Figure 3** below.

Figure 3 - Historical Brine Line Flow by SAWPA Member Agency



The largest flows originate from the WMWD service area, followed closely by IEUA. Combined, these two agencies comprise approximately 75 to 90 percent of the total Brine Line flows on an annual basis. As indicated in the discussion of Brine Generator Categories above, more than half of the total Brine Line flows are generated by four Desalter Facilities. The flows from WMWD and IEUA exceed the flows from EMWD and SBVMWD, primarily because the Desalter Facilities are located in their service areas:

- Arlington Desalter: WMWD
- Temescal Desalter: WMWD
- Chino I Desalter: IEUA
- Chino II Desalter: IEUA

Forecasting of Flows from Existing SAWPA Service Area

Methodology

As discussed above, SAWPA Member Agencies own rights to the Brine Line system capacity. The system capacity is thus allocated and tracked by various parameters, including Member Agency and permit number(s). These allocations and tracking parameters were tabulated by CDM in the Salinity Management Program.

Future service connections in the Santa Ana Watershed were also identified by CDM in the Salinity Management Program with corresponding forecasted flows and sorted into Brine Generator Categories. The timing of the flows for each future service connection was determined using the estimated year the new service connection will become operational and the estimated year that facility operation will reach full capacity. A linear growth rate was applied between those dates.

Existing Brine Line System Capacity

The Salinity Management Program report by CDM addresses the existing capacity constraints of the Brine Line system. These capacity constraints include the OCSD contractual commitments by which SAWPA owns 17 MGD of OCSD capacity and has a right to purchase up to 30 MGD, total, of OCSD capacity. Capacity constraints also include the maximum capacity of the existing pipeline, which is approximately 32.5 MGD. These capacity constraints were contrasted with the total historical and forecasted flows in the Brine Line system. The flows for Years 1994 through 2011 reflect actual system flows measured at the CLMM. The flows for Year 2012 and beyond are the forecasted rates.

The capacity constraints and the total historical and forecasted flows in the Brine Line are shown in **Figure 4** below.

Figure 4 - Existing Brine Line System Capacity

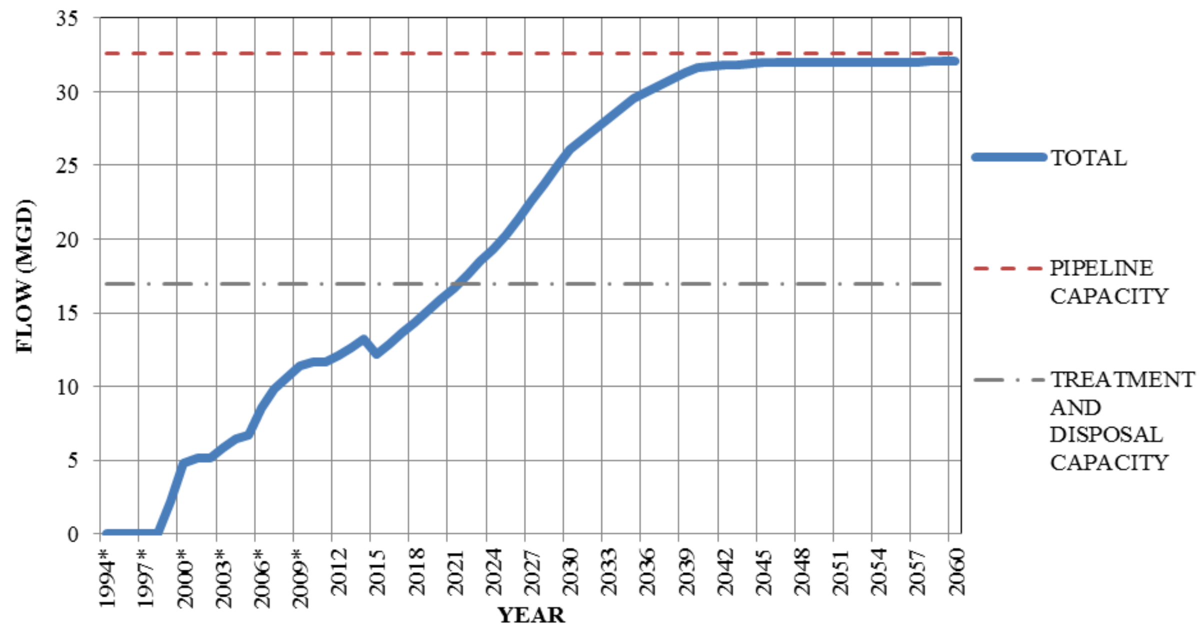
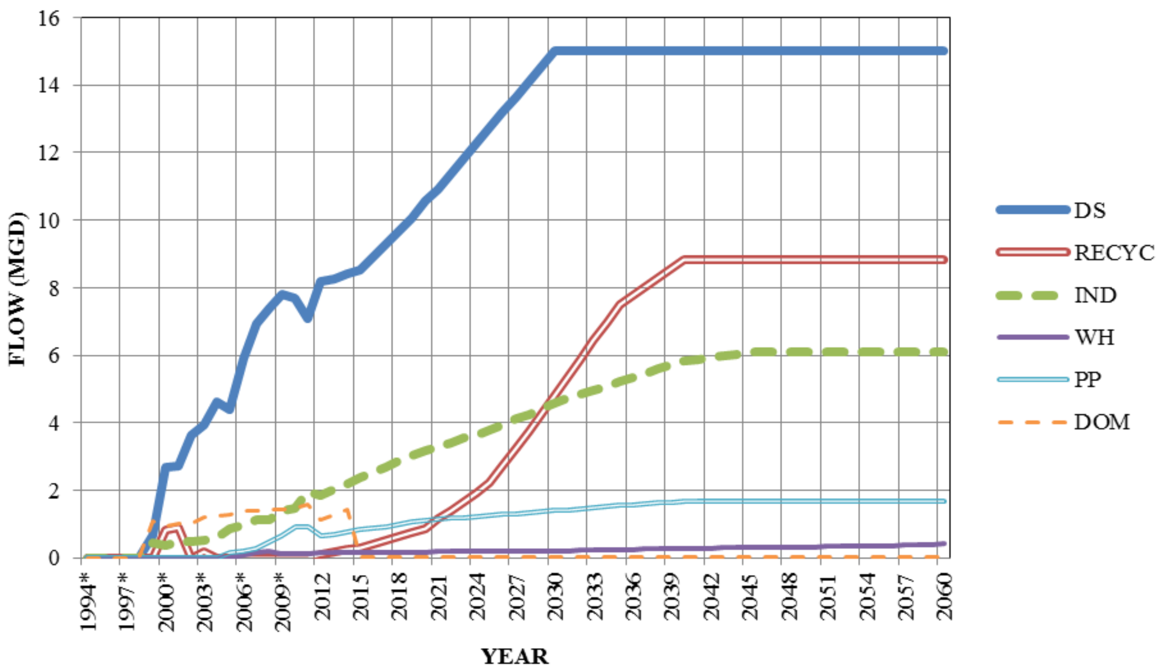


Figure 4 indicates that Brine Line system flows will exceed the maximum rate contracted with OCSD (17 MGD) by Year 2022, and will reach the capacity of the existing pipeline (32.5 MGD) as early as Year 2040. The minor dip in the total flows in the Year 2015 coincides with decreased brine generation from the Arlington Desalter and with planned removal of Domestic flows from the Brine Line system.

Forecasted Flows by Brine Generator Category

Building upon the results shown previously in **Figure 1**, the forecasted Brine Line flows have been sorted by Brine Generation Category. These results are presented in **Figure 5** below.

Figure 5 - Forecasted Flows by Brine Generator Category



As discussed in the “Historical Flow Data by Brine Generator Category” subsection above, the Desalter Facilities category has accounted for approximately half of the historical total Brine Line flows. It is anticipated that flows from Desalter Facilities will continue to account for approximately half of the Brine Line flows. The projected peak flow rate produced from the Desalter Facilities category is 15.0 MGD, occurring in Year 2030.

The flows from the Industrial Facilities category are anticipated to exhibit steady growth, with an average rate of increase of approximately 0.14 MGD per year. The projected peak flow rate produced from the Industrial Facilities category is forecasted to be approximately 6 MGD, reached in Year 2044.

As noted previously, flows from the Domestic category will be eliminated from the system by 2015. The lone exception is the Green River Golf Club, which will continue to contribute domestic wastewater flows to the Brine Line system.

The flows from the Power Plants and Waste Haulers categories are anticipated to remain relatively consistent. Both categories are expected to generate minor flows, with Power Plants contributing approximately five percent and Waste Haulers contributing approximately one percent of the total system flows.

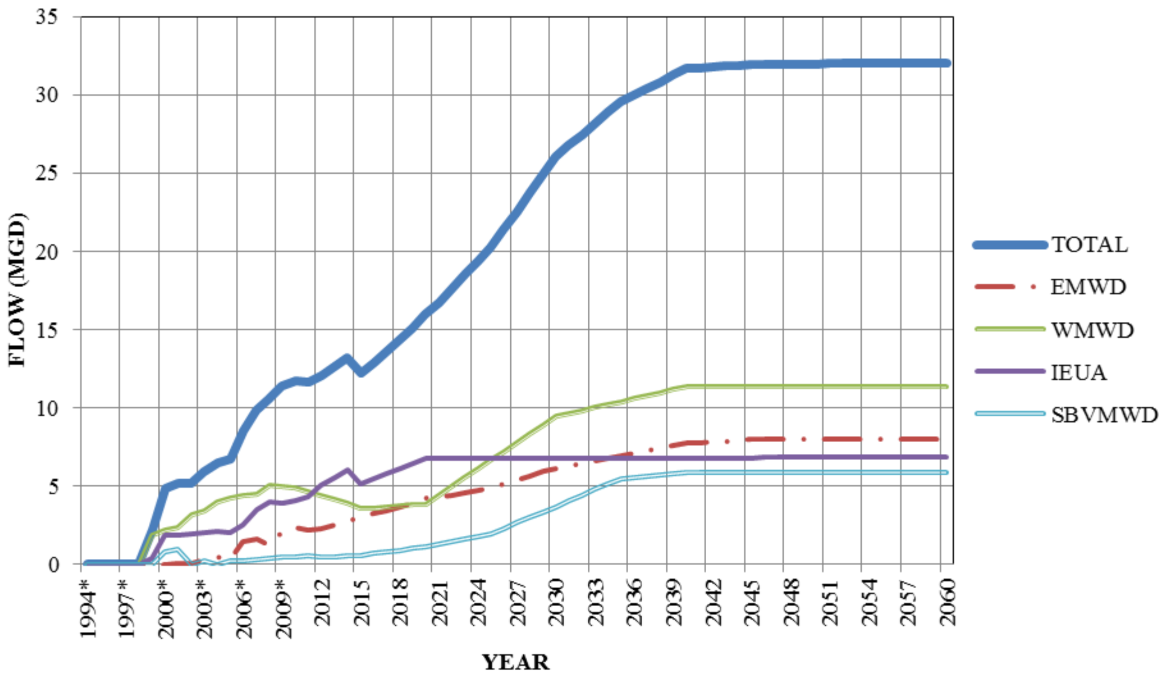
The Recycled Water category has not been a major contributor to historical Brine Line flows. For example, there were no flows in the Brine Line system from Recycled Water connections in 2011. Due to the growing reliance upon recycled water as a portion of the water supply portfolio of water districts throughout the region in their Urban Water Management Plans, the Brine Line flows for this category are expected to significantly increase over the next 25 years. The Recycled Water category is anticipated to overtake the Industrial category as the second largest SAWPA Brine Generator Category by Year 2030. However, it should be noted that the design of Water Reclamation Facilities (WRF) frequently provides for return of the waste flows to the treatment process and direct disposal to the Brine Line may not be the most economical alternative available to those facilities. Therefore, the forecasted Recycled Water category flows may not be realized in the future.

Forecasted Flows by SAWPA Member Agencies

The forecasted flows have also been sorted into four SAWPA Member Agencies. The values for Years 1994 through 2011 represent actual measured rates of flow in the system. Flow rates for Years 2012 and beyond reflect the forecasted values. The forecasted Brine Line flows from each SAWPA Member Agency are expected to continue to increase until their respective share of the capacity has been reached.

The forecasted flows for each SAWPA Member Agency are displayed in **Figure 6** below.

Figure 6 - Forecasted Brine Line Flows by SAWPA Member Agency



Consistent with the historical pattern, flows from WMWD are anticipated to be the largest among the four SAWPA Member Agencies analyzed, increasing to its capacity ownership of 11.33 MGD as early as Year 2040. The flows from WMWD began to dip in 2008. This dip coincides with decreased brine generation from the Arlington Desalter and with removal of domestic wastewater service connections in the WMWD service area. This downturn is anticipated to reverse by 2015 as the impact of these changes is offset by increased flows from other sources. For example, it is anticipated that flows from several WMWD service connections in the Industrial Facilities category will increase, peaking in Year 2030, and that several planned Water Reclamation Facilities in the WMWD service area will begin contributing flows to the Brine Line in Year 2021.

EMWD is anticipated to be the second largest SAWPA Member Agency, with flows reaching its capacity ownership of 8.0 MGD as early as Year 2045. EMWD anticipates modest growth, with the two existing Desalter Facilities in the EMWD service area reaching capacity in Year 2020, followed by two additional planned Desalter Facilities coming online at that time and reaching full capacity as early as Year 2030.

SBVMWD is forecasted to experience steady growth to its capacity ownership of 5.84 MGD by Year 2036.

Flows from IEUA are anticipated to experience a dip in the in Year 2015, which coincides with removal of domestic wastewater connections located in the IEUA service area. Nevertheless, IEUA flows are expected to reach capacity ownership of 6.8 MGD as early as Year 2020, much sooner than the other SAWPA Member Agencies.

Potential SAWPA Service Area Expansion

Communities in the Potential Service Area Expansion

The route of the proposed IEI represents an opportunity for SAWPA to expand the Brine Line service area to include the San Gorgonio Pass and Coachella Valley areas.

The San Gorgonio Pass area includes the communities of Beaumont, Banning and Cabazon and tribal lands of the Morongo Band of Mission Indians. (The City of Beaumont is located within the boundary of the SAWPA service area, but not within those of any of the SAWPA Member Agencies.) The area is dominated by major transportation and utilities corridors. Land use in the Pass is predominantly low density residential, with some commercial and light industrial uses attracted by the highway and railroad transportation corridors. The east end of the Pass is dominated by expansive fields of wind turbine electrical generators, which extend into the westernmost portion of Coachella Valley.

The Coachella Valley is characterized by two distinctly different areas, the West Valley and the East Valley. The West Valley, the upper portion, extends from the Palm Springs area eastward to the communities of La Quinta and Indio. Land use in this area is predominately low-density urban, characterized by numerous resort residential golf course communities. Light industrial land use areas are small, sufficient only to support the needs of the local community. The East Valley, the lower portion, extends from vicinity of the City of Coachella southeastward to the Salton Sea. Land use in this area is predominately agricultural, with little industrial land use.

Implementation of the proposed IEI would likely make San Gorgonio Pass and Coachella Valley more attractive to industry, by making important infrastructure more readily available.

Water Supplies in San Gorgonio Pass and Coachella Valley

The State of California Department of Water Resources requires each supplier of water in the state that serves over 3,000 connections or supplies 3,000 acre-feet of water annually to conduct long term resource planning. This planning is documented by each such supplier in an Urban Water Management Plan

(UWMP), which must be updated at five-year intervals. The purpose of the UWMP is to assess the reliability of water supplies over a 20-year period to ensure that existing and future water demands in the given service area will be met. The UWMP takes into consideration population, changes in land use, conservation measures, climate change, and environmental issues that potentially impact the water supplier's operations.

The most recent UWMPs produced by the water suppliers for the various communities in San Gorgonio Pass and Coachella Valley were reviewed for this Appraisal Analysis as part of the evaluation of the potential for new service connections to the proposed IEI.

The communities in San Gorgonio Pass enjoy high quality groundwater supply, which is recharged by runoff from the mountains on either side. This supply has historically been sufficient to meet the needs of these communities and no augmentation with imported water has been necessary.

Coachella Valley has benefitted from high quality groundwater as its principal source of water supply. However, this local water supply is not sufficient to meet the total water demands of the area. So the local supply is augmented by Colorado River water delivered via the Colorado River Aqueduct and via the Coachella Canal, which receives Colorado River water via the All-American Canal.

The water from the Colorado River Aqueduct is used to recharge the aquifer in the West Valley using the Whitewater River recharge facility in the Palm Springs area. These groundwater supplies primarily serve the urbanized West Valley, and are closely monitored. Coachella Canal water is delivered to the East Valley. The water is primarily used for agricultural irrigation, urban landscape irrigation, and groundwater recharge. The groundwater resource in the East Valley is split into upper and lower zones by an aquitard. The Thomas E. Levy and Martinez Canyon recharge facilities are used to augment natural groundwater recharge of the upper zone of the aquifer.

Water Demands in San Gorgonio Pass and Coachella Valley

Like the upper Santa Ana Watershed, the communities of the San Gorgonio Pass and Coachella Valley area are served by several suppliers of water. The populations and total water demands of the four SAWPA Member Agencies and of the San Gorgonio Pass and Coachella Valley communities are presented in **Table 1** below.

Table 1 – Regional Water Demand and Population Comparison

	2010		2020		2030	
Location	**Population**	**Total Demand (AFY)**	**Population**	**Total Demand (AFY)**	**Population**	**Total Demand (AFY)**
EMWD[3]	*695,932*	154,700	*870,603*	241,400	*1,111,729*	302,200
WMWD[5]	*85,469*	85,634	*112,157*	124,042	*161,016*	156,231
IEUA[9]	*846,469*	222,623	*981,651*	347,739	*1,176,066*	393,746
SBVMWD[4]	*187,690*	55,940	*207,715*	75,850	*221,400*	94,264
Santa Ana Watershed Totals	***1,815,560***	**518,897**	***2,172,126***	**789,031**	***2,670,211***	**946,441**
Beaumont[8]	*27,305*	18,029	*59,898*	24,417	*90,290*	25,577
Banning[7]	*29,603*	7,586	*36,086*	10,183	*48,567*	12,413
Indio Water Authority[6]	*76,036*	20,466	*93,115*	34,141	*105,873*	44,154
DWA/MSWD Totals[1]	*111,400*	50,500	*141,300*	59,100	*177,500*	73,400
CVWD Totals[2]	*435,698*	678,600	*614,938*	719,100	*922,994*	817,100
San Gorgonio Pass and Coachella Valley Totals	***680,042***	**775,181**	***945,337***	**846,941**	***1,345,224***	**972,644**

1- Desert Water Agency/Mission Springs Water District 2010 Urban Water Management Plan, values from Tables 2, 4, & 15

2- Coachella Valley Water District 2010 Urban Water Management Plan, values from Tables 3-1, 3-2,

3- Eastern Municipal Water District 2010 Urban Water Management Plan, values from Tables 1.2, 1.3, 3-2, 3-4

4- 2010 San Bernardino Valley Regional Urban Water Management Plan, values from Tables 10-2, 10-35

5- Western Municipal Water District 2010 Urban Water Management Plan, values from Tables 1-3, 2-1, 2-10,

6- Indio Water Authority 2010 Urban Water Management Plan, values taken from Table 2-8,

7- City of Banning 2010 Urban Water Management Plan, values taken from Table 3-8

8- Beaumont Cherry Valley Water District 2005 Urban Water Management Plan, values taken from Table 3-8

9- Inland Empire Water District 2010 Urban Water Management Plan, values from Table 3-9, 3-12

It is readily apparent from **Table 1** that the upper Santa Ana Watershed has a much larger population than San Gorgonio Pass and Coachella Valley. It is also apparent that the upper Santa Ana Watershed has a smaller total water demand per capita than San Gorgonio Pass and Coachella Valley. This variance is a reflection of non-potable agricultural water demands in those areas, and it is especially large for CVWD due to the large agricultural demands in the East Valley. Urban development is expected to reduce the per capita water needs in Coachella Valley as the increased urban demands (for both potable and non-potable landscape irrigation uses) will be offset by the much larger reduction of agricultural irrigation demands.

Coachella Valley Water Resources Planning

As noted above, Coachella Valley is served by several suppliers of water. These organizations collaborated on the Coachella Valley Integrated Regional Water Management Plan, dated December, 2010, which provides an overview of water-related issues facing the stakeholders. Of the stakeholders Coachella Valley Water District (CVWD) is the largest and the most strategically significant to the proposed IEI. The most recent long-term assessments of future water supplies and demands for the CVWD are the ***Coachella Valley Water Management Plan Update (Draft Report)*** [6] (CVWMPU), dated December 2010, and the ***2010 Urban Water Management Plan*** [7]. The CVWMPU is supplemented by the ***Draft*** and ***Final Subsequent Program Environmental Impact Reports*** [8] & [9] (SPEIR).

The CVWMPU identifies a salt imbalance in Coachella Valley. The primary source of this salt is Colorado River water delivered to the upper valley via the Colorado River Aqueduct and to the lower valley via the Coachella Canal. The State (California) Water Resources Control Board Recycled Water Use Policy requires development of a salt/nutrient management plan by Year 2014, and the CVWMPU proposes development of a Salt Management Program to respond to the existing imbalance. Alternative mechanisms for removal of salt from the Valley are addressed in the CVWMPU, including desalination of Colorado River water and desalination of drain water from the East Valley. Both alternatives would produce brine for which a means of disposal would be needed. There are currently no operational Desalter Facilities in the area.

The costs reported in the CVWMPU for the first alternative (desalination of Colorado River water) range from $460 per AF to $685 per AF for capacity up to 90,000 AFY. The CVWMPU notes that expansion of this alternative by as much as 80,000 AFY has been suggested by stakeholders. At the higher (170,000 AFY) capacity, this alternative would produce up to 40 MGD of brine at an 85% recovery rate. The costs reported in the CVWMPU for the latter alternative (desalination of drain water) range from $480 per AF to $740 per AF. The anticipated capacity range is 55,000 to 85,000 AFY.

The cost information presented in the CVWMPU suggests that the total cost of each alternative will depend on system capacity and the influence of technical aspects on the unit cost (per AF). The first alternative, desalination of Colorado River water, is ruled out in the CVWMPU as economically infeasible (within the 20-year planning horizon). The CVWMPU suggests that the latter alternative, desalination of drain water from the East Valley, is the more promising alternative, and CVWD has investigated this alternative with a pilot and feasibility study by consultant Malcolm-Pirnie, completed in 2008.

Both of these CVWMPU alternatives would utilize reverse osmosis (RO) Desalter Facilities that will produce large quantities of brine. For the purpose of this Appraisal Analysis, it is anticipated that Desalter Facilities will be used in Coachella Valley. Forecasts of Brine Line flows and brine characteristics from Coachella Valley were developed using historical Brine Line data for the upper Santa Ana Watershed as discussed later in this TM 3.2.

As noted above, each alternative addressed in the CVWMPU would produce brine for which a means of disposal would be needed. The proposed IEI could serve that need. The CVWMPU Final SPEIR includes a schematic plan for a network of brine lines in Coachella Valley. This schematic plan was used for this Appraisal Analysis to identify locations of potential future service connection points to the proposed IEI.

Potential Brine Generators in San Gorgonio Pass & Coachella Valley

An investigation of the San Gorgonio Pass and Coachella Valley area was performed for the purpose of identifying potential brine generators. The research included a review of publicly available information about potential Brine Line customers in the area, including Land Use Plans adopted by the various municipalities; UWMPs for the various municipalities and water districts; and information about wastewater treatment facilities, power plants and other potential brine generators.

This investigation led to identification of a set of Brine Generator Categories that could reasonably be expected to benefit from the proposed IEI. This group of Brine Generator Categories for San Gorgonio Pass and Coachella Valley includes Desalter Facilities, Recycled Water Facilities and Waste Haulers.

As discussed above, the large net annual salt import into Coachella Valley suggests that Brine Line flows from Desalter Facilities in the Valley could be quite large.

Regarding the Industrial Facilities and Waste Haulers Brine Generator Categories, few existing industrial facilities were identified in San Gorgonio Pass and Coachella Valley that would be expected to benefit from a Brine Line outfall through the area. As discussed above, land use in the West Valley is predominately low-density residential and the allocations for light industrial in the local land use plans are small. Similarly, land use in the East Valley is predominately agricultural; and the area has not yet attracted industry. Therefore, forecasted flows from both Brine Generator Categories are anticipated to be small and have been grouped in the Waste Haulers category in this Appraisal Analysis. However, as noted previously herein, implementation of the proposed Brine Line outfall to the Salton Sea may make San Gorgonio Pass and Coachella Valley more attractive to industry and the Waste Hauler and Industrial Facilities categories may become more significant over time.

The Recycled Water Facilities Brine Generator Category is among those that could be expected to contribute significant Brine Line flows from San Gorgonio Pass and Coachella Valley. The UWMPs of the water districts and municipalities in the region, including CVWD, predict a growing reliance upon recycled water as a portion of their water supply portfolios. And this resource is currently being used in Coachella Valley for irrigation of golf courses and other landscaped areas. However, it should be noted that WRF design frequently provides for return of brine waste to the treatment process, so the forecasted Brine Line flows from the Recycled Water Facilities category may not be realized.

Methodology for Forecasting of Flows from Potential Service Area Expansion

Introduction

Three distinct methods were employed for this Appraisal Analysis for forecasting flows from the potential service area expansion in San Gorgonio Pass and Coachella Valley. These three approaches are referred to herein as “Historic Average Ratio Method”, “Member Capacity Ratio Method”, and “Mixed Forecast Ratio Method”. This section of this TM 3.2 describes each method.

Each method was applied to each Santa Ana Watershed Brine Generator Category to develop estimated rates of flow specific to that category for that method. These rates were then applied to the appropriate metric for each Brine Generator Category identified in the San Gorgonio Pass and Coachella Valley area. This established a range for each category, each of which was then evaluated to determine the forecasted Brine Line flows from each Brine Generator Category in the potential service area expansion.

As discussed previously in this TM 3.2, the CVWMPU addresses alternatives for a proposed salt management program to protect the water resources of the area. The 2002 ***Coachella Valley Final Water Management Plan*** [5] proposed implementation of a salt management program by Year 2035. A simple mass balance analysis of the rate of salt accumulation in the Valley was performed for this Appraisal Analysis which reinforced this timeframe for implementation. Therefore, the forecasted Brine Line flows from the potential service area expansion are predicted in this TM 3.2 to begin in Year 2035 with a period of transition to the full rates by Year 2040.

Historic Average Ratio Method

The Historic Average Ratio Method is based upon the actual measured flow in the existing Brine Line system. Though it reflects actual operational experience, the accuracy of forecasts based on the Historic Average Ratio is only as good as the operational data upon which it is based. This method utilizes the available historic Brine Line flow data for various service connections and the production capacities of the associated facilities to identify a ratio of brine generation rates and facility design capacity. Brine Line historical flow data has been recorded by service connection. The data has generally been collected on a monthly basis, but much of it is intermittent. For months with multiple data points, the first data point for the month was used as the monthly flow rate (in millions of gallons per month). These twelve monthly flow rates were summed to create an annual total rate, which was identified as the "Annual Sum of Monthly Average". This annual sum was then converted to an annual average daily flow rate, which was designated as "Adjusted Daily Average of Historic Monthly Flow", measured in millions of gallons per day (MGD).

The results of these calculations for the Perris Desalter (for Years 2003 through 2012) are summarized in **Table 2** below as an example.

Table 2 – Calculation of Adjusted Daily Average of Historic Monthly Flow for the Perris Desalter

Month	2006	2007	2008	2009	2010	2011	2012	Monthly Average (MG)
JAN	18.2199	19.0946	18.057	26.5948	22.0703	27.4107	18.612	21.44
FEB	18.1792	17.4284	0.01	20.3065	23.9567	23.8447	22.2943	21
MAR	4.1697	20.0648	0	25.8315	25.2725	25.2883	24.3551	20.83
APR	5.7474	19.6151	0	22.0335	22.9619	24.6631	#N/A	19
MAY	26.57	21.1267	0	21.132	24.268	22.3567	#N/A	23.09
JUN	23.4396	21.0684	9.0277	21.8507	22.789	23.6302	#N/A	20.3
JUL	25.2809	27.1433	21.3829	23.8305	21.4846	23.1773	#N/A	23.72
AUG	21.1893	22.4053	28.0477	25.4459	24.5799	23.6561	#N/A	24.22
SEP	12.8895	19.8229	25.0795	25.0468	21.9273	18.4427	#N/A	20.53
OCT	20.786	23.3983	24.0326	26.4075	26.0558	16.9349	#N/A	22.94
NOV	22.9296	20.5636	15.7815	17.213	23.8393	18.837	#N/A	19.86
DEC	23.0345	15.8419	15.8743	17.5268	23.0747	25.4182	#N/A	20.13
Total (MG)	222.4	247.6	157.3	273.2	282.3	273.7	65.3	257.1

Adjusted Daily Average of Historic Monthly Flow = 257.1 / 365 = 0.70 MGD

The "Historic Average Ratio" for each service connection was then calculated as the ratio of the "Adjusted Daily Average of Historic Monthly Flow" and the rated production capacity of that facility. For example, the metric for the production capacity of Mountain View Power Plant is mega-watts (MW); and the "Historic Average Ratio" was calculated in millions of gallons per day (MGD) per mega-watt (MW). The weighted average of all the facilities in the given Brine Generation Category was then calculated to yield the "Historic Weighted Average Ratio" for that category.

The "Historic Weighted Average Ratio" for each Brine Generator Category is presented in **Table 3** below.

Table 3 – Summary of Historic Average Ratios

BRINE CATEGORY	METRIC	HISTORIC WEIGHTED AVG RATIO DESCRIPTION	HISTORIC WEIGHTED AVG RATIO
DESALTER	RAW WATER CAPACITY	MGD of BRINE / MGD of H2O	0.095
RECYCLED WATER	n/a		
INDUSTRIAL	n/a		
WASTE HAULER	PER CAPITA	MGD of BRINE / PERSON	6.13E-08
POWER PLANT	MEGAWATTS GENERATED	MGD of BRINE / MW	3.94E-04
DOMESTIC	n/a		

The Historic Average Ratio method is best used for forecasting of Brine Generation Categories with ample historical flow data, such as Desalter Facilities, Power Plants and Waste Haulers. Indeed, in the case of the Waste Hauler category, only the Historic Average Ratio method was used. Conversely, The Historic Average Ratio method was not used for the Recycled Water category because there is no available data for Recycled Water service connections to the Brine Line.

Member Capacity Ratio Method

The Member Capacity Ratio method estimates the Brine Line system capacity that would potentially be purchased to accommodate future flows. As discussed above, SAWPA Member Agencies own rights to the Brine Line system capacity and make that capacity available to third-party brine generators. Allocated system capacity is tracked by permit numbers. This method utilizes the permitted Brine Line capacity for a given Brine Generator Category to forecast rates of Brine Line flow. The "Member Capacity Ratio" is calculated by dividing the permitted capacity (in MGD) by the metric specific to that Brine Generator Category. The same metrics used in the Historic Ratio Method were also employed in this method. SAWPA's actual operational experience suggests that this method is more conservative than the other methods, since it relies upon capacity in the existing system that has not yet been fully utilized.

The results of the Member Capacity Ratio calculations for the Desalter Facilities in the EMWD service area are summarized in **Table 4** below as an example.

Table 4 – Member Capacity Ratio for EMWD Desalter Facilities

FACILITY NAME	AGENCY	DESALTER DESIGN FLOW CAPACITY (MGD)	CURRENT PERMITTED BRINE CAPACITY (MGD)	MEMBER CAPACITY RATIO (MGD of BRINE / MGD of DESIGN FLOW)
Menifee	EMWD	4.1	1.07	0.26
Perris	EMWD	7.9	1.86	0.24
Perris II	EMWD	6.2	0.75	0.12
Hemet	EMWD	4	0.5	0.13

The weighted average of the Member Capacity Ratios for all the facilities in the given Brine Generation Category was then calculated to yield the "Member Capacity Weighted Ratio" for that category. The "Member Capacity Weighted Ratio" and corresponding metrics for each Brine Generator Category are presented in **Table 5** below.

Table 5 – Summary of Member Capacity Ratios

BRINE CATEGORY	METRIC	MEMBER CAPACITY WEIGHTED RATIO DESCRIPTION	MEMBER CAPACITY WEIGHTED RATIO
DESALTER	DESIGN FLOW CAPACITY	MGD of BRINE / MGD of DESIGN FLOW	0.137
RECYCLED WATER	TREATMENT CAPACITY	MGD of BRINE / MGD of EFF H2O	0.106
INDUSTRIAL	n/a		
WASTE HAULER	n/a		
POWER PLANT	MEGAWATTS GENERATED	MGD of BRINE / MW	8.91E-04
DOMESTIC	n/a		

The Member Capacity Ratio method was not used for the Domestic, Industrial Facilities or Waste Hauler Brine Generation Categories. As previously discussed, domestic flows are being removed from the system, and flows from Industrial Facilities in San Gorgonio Pass and Coachella Valley are included in the Waste Hauler flows. The Waste Hauler category is not suitable for analysis using the Member Capacity Ratio method because permits are not issued for these stations. Waste hauler stations are managed differently because they are used by Brine

Line customers with small volumes of brine or who lack a direct connection to the system, and the customers and associated flows are more variable.

The Member Capacity Ratio method is best used for forecasting Brine Line capacity that may be purchased by new Member Agencies or customers. The rates calculated by the Member Capacity Ratio method are not estimates of the flows that will be conveyed in the Brine Line, but rather of the potential maximum flows and of the system capacity needs.

Mixed Forecast Ratio Method

The Mixed Forecast Ratio Method was used to produce Brine Line flow forecasts for the Member Agencies based on relationship to water demand forecasts. Therefore, this method is best used for forecasting of Brine Generation Categories directly associated with water supply, specifically Desalter Facilities and Recycled Water. The forecasts of Brine Line flows for the existing SAWPA Member Agencies developed by CDM are discussed above (in the section entitled "Forecasting of Future Flows for Existing SAWPA Service Area"). Forecasts of water demand have been developed by the water districts and municipalities in their respective Urban Water Management Plans, as previously discussed above (in the section entitled "Potential Service Area Expansion"). The "Mixed Forecast Ratio" is simply calculated as the ratio of the forecasts for brine flow and for water demand.

As an example, the results of the Mixed Forecast Ratio calculations for the Desalter Facilities Brine Generator Category are summarized in **Table 6** on the next page.

The Mixed Forecast Ratio and corresponding metrics for each Brine Generator Category are presented in **Table 7**, also on the next page.

Table 6 – Mixed Forecast Ratio for Desalting Facilities Brine Generator Category

	2010 Population	2010 Potable Demand (MGD)	2010 Brine Demand (MGD)	2010 Mixed Forecast Ratio	2020 Population	2020 Potable Demand (MGD)	2020 Brine Demand (MGD)	2020 Mixed Forecast Ratio	2030 Population	2030 Potable Demand (MGD)	2030 Brine Demand (MGD)	2030 Mixed Forecast Ratio
EMWD	695,932	69.37	1.68	0.02	870,603	108	3.06	0.03	1,111,729	134.19	4.18	0.03
WMWD	85,469	22.09	2.7	0.12	112,157	31	2.23	0.07	161,016	38.23	5.55	0.15
IEUA	846,469	188.71	3.32	0.02	981,651	205	5.29	0.03	1,176,066	224.88	5.29	0.02

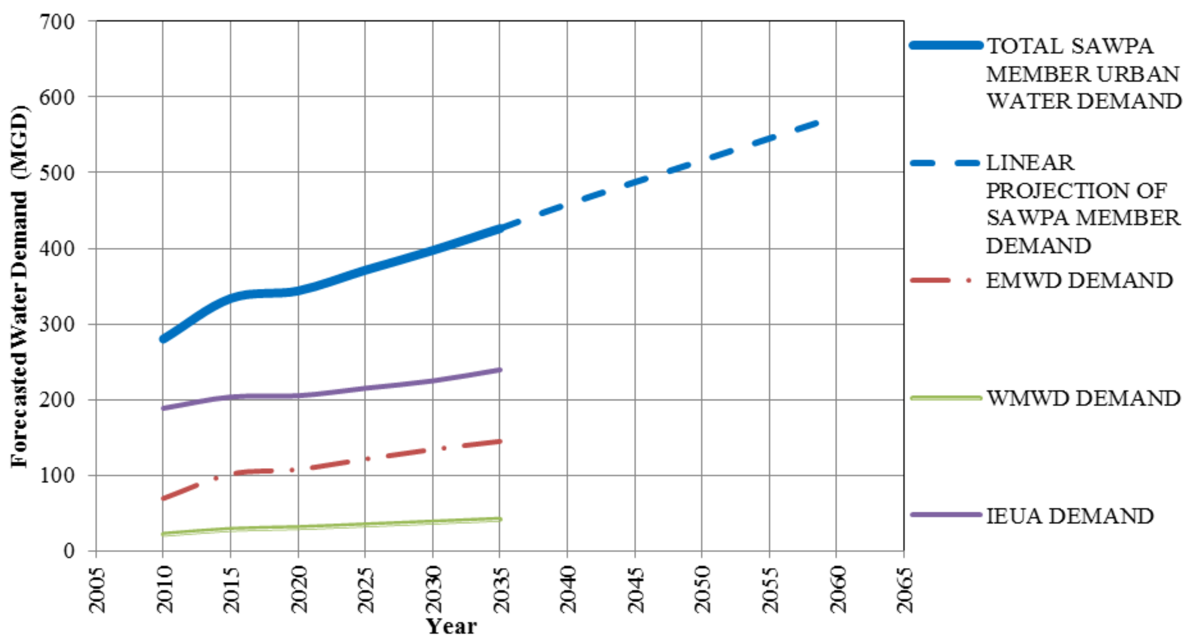
Table 7 – Summary of Mixed Forecast Ratios

BRINE CATEGORY	METRIC	2010 MIXED FORECAST RATIO	2015 MIXED FORECAST RATIO	2020 MIXED FORECAST RATIO	2025 MIXED FORECAST RATIO	2030 MIXED FORECAST RATIO	2035 MIXED FORECAST RATIO
DESALTER	WATER DEMAND	0.028	0.024	0.034	0.032	0.036	0.034
RECYCLED WATER	RECYCLED WATER DEMAND	0.0	0.01	0.01	0.03	0.06	0.08
INDUSTRIAL	n/a						
WASTE HAULER	n/a						
POWER PLANT	n/a						
DOMESTIC	n/a						

As **Table 6** shows, the Mixed Forecast Ratio for a given Brine Generator Category varies from year to year, as do the forecasts for both brine flow and water demand upon which the ratio is based. The Mixed Forecast Ratio is reasonably consistent for each SAWPA Member Agency within each Brine Generator Category. A weighted average was applied to the Mixed Forecast Ratios for the Member Agencies to develop one Mixed Forecast Ratio for each Brine Generator Category for each year considered. The appropriate Ratios were then applied to the proposed facilities within the Service Area Expansion.

The calculated Mixed Forecast Ratios presented in **Table 7** above are limited by the 25-year planning window for water demands in a UWMP, which extends only to Year 2035. The planning window for this Appraisal Analysis extends to Year 2060. To develop a Mixed Forecast Ratio for the period between 2035 and 2060, an estimate of the water and recycled water demands was developed. Linear projections were used to predict the demands beyond 2035. The linear projection of water demands by SAWPA Member Agency is depicted on **Figure 7** below.

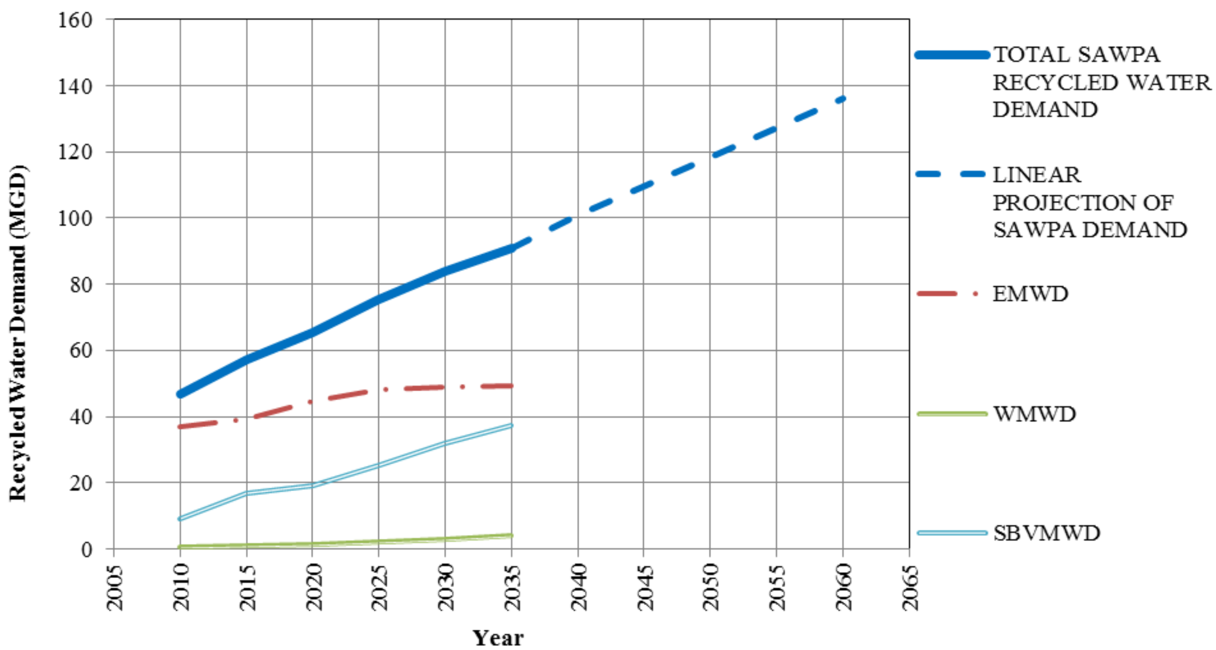
Figure 7 - SAWPA Member Agency Water Demand Forecast



The linear projection shown on **Figure 7** of cumulative water demands for WMWD, IEUA and EMWD translates to a rate of increase for the Santa Ana Watershed of approximately 5.8 MGD annually. Water demand is anticipated to reach 574 MGD in Year 2060. As discussed previously, brine flow from the Desalter Facilities Brine Generator Category is forecasted to plateau by Year 2030 at 15.02 MGD. Therefore, as water demands continue to increase in the Santa Ana Watershed, the Mixed Forecast Ratios (ratio of brine generation to water demand) will decrease after Year 2030.

The linear projection shown on **Figure 8** below of aggregate recycled water demands for WMWD, SBVMWD and EMWD translates to a rate of increase for the Santa Ana Watershed of approximately 1.8 MGD. Recycled water demand is anticipated to reach 136 MGD in Year 2060. As previously discussed, brine flow from the Recycled Water Facilities Brine Generator Category is forecasted to plateau by Year 2040 at 8.8 MGD. As a result, the Mixed Forecast Ratio for the Recycled Water category in the Santa Ana Watershed is expected to decrease after Year 2040.

Figure 8 - SAWPA Member Agencies Recycled Water Demand Forecast



The Mixed Forecast Ratios for Years 2040 through 2060 are presented in **Table 8** below.

Table 8 – Summary of Mixed Forecast Ratios with Approximated Demand

BRINE CATEGORY	METRIC	2040 MIXED FORECAST	2050 MIXED FORECAST	2060 MIXED FORECAST
DESALTER	WATER DEMAND	0.033	0.029	0.026
RECYCLED WATER	RECYCLED WATER DEMAND	0.09	0.07	0.06
INDUSTRIAL	n/a			
WASTE HAULER	n/a			
POWER	n/a			
DOMESTIC	n/a			

Forecasting of Flows from Potential Service Area Expansion

Desalter Facilities

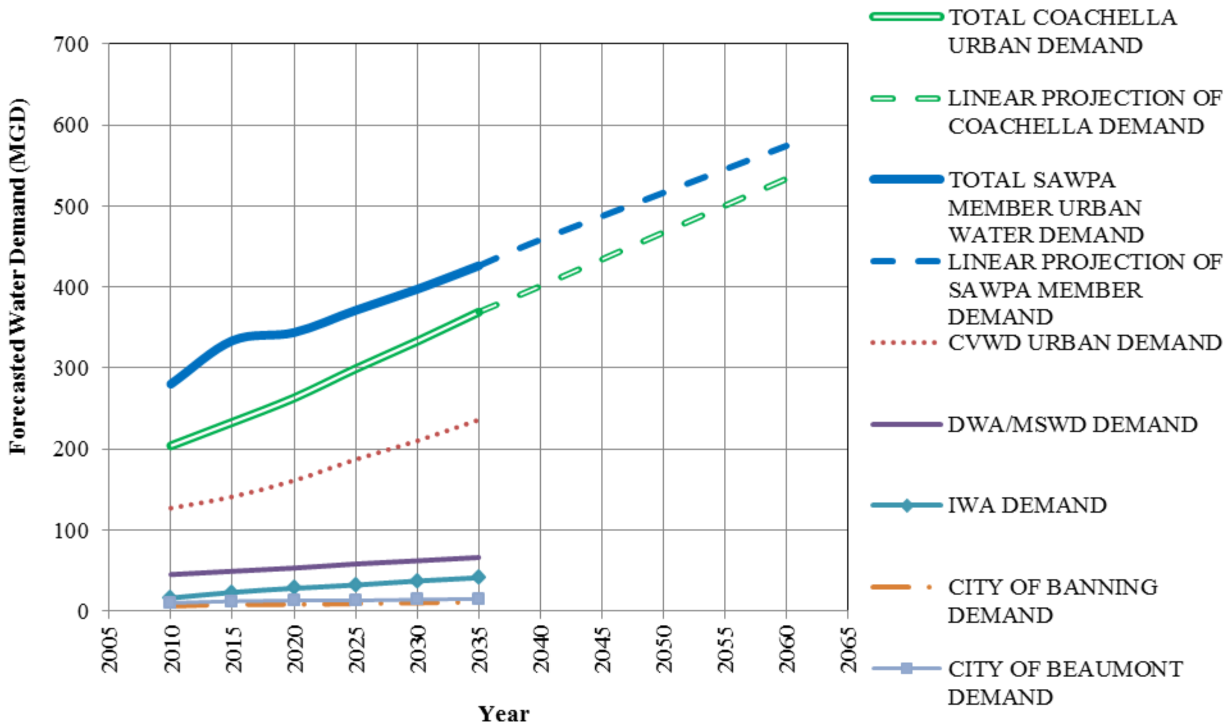
For Desalter Facilities, all three ratio methods described in the Methodology section above (Historic Average Ratio, Member Capacity Ratio and Mixed Forecast Ratio) utilize water demand forecasts to predict rates of Brine Line flow. Therefore, the forecasted future water demands established in the 2010 UWMPs for the municipalities and water districts in San Gorgonio Pass and Coachella Valley were utilized to develop forecasts of Brine Line flows for the potential SAWPA service area expansion.

Due to large agricultural irrigation water demands in Coachella Valley, the cumulative forecasted water demand in the potential SAWPA service area expansion (San Gorgonio Pass and Coachella Valley) is similar to that of Santa Ana Watershed. The forecasted rate of growth of water demand in the area averages 6.6 MGD annually. The estimated demand in Year 2060 for the entire potential service area expansion is 533 MGD. This compares with estimated demand of 574 MGD for the Santa Ana Watershed.

As discussed previously, CVWD is the largest water supplier in the area. The forecasted rate of growth of urban water demand in the CVWD service area alone is approximately 4.0 MGD annually. Using the linear projection to predict urban water demands beyond Year 2035, CVWD alone could require as much as 290 MGD by Year 2060.

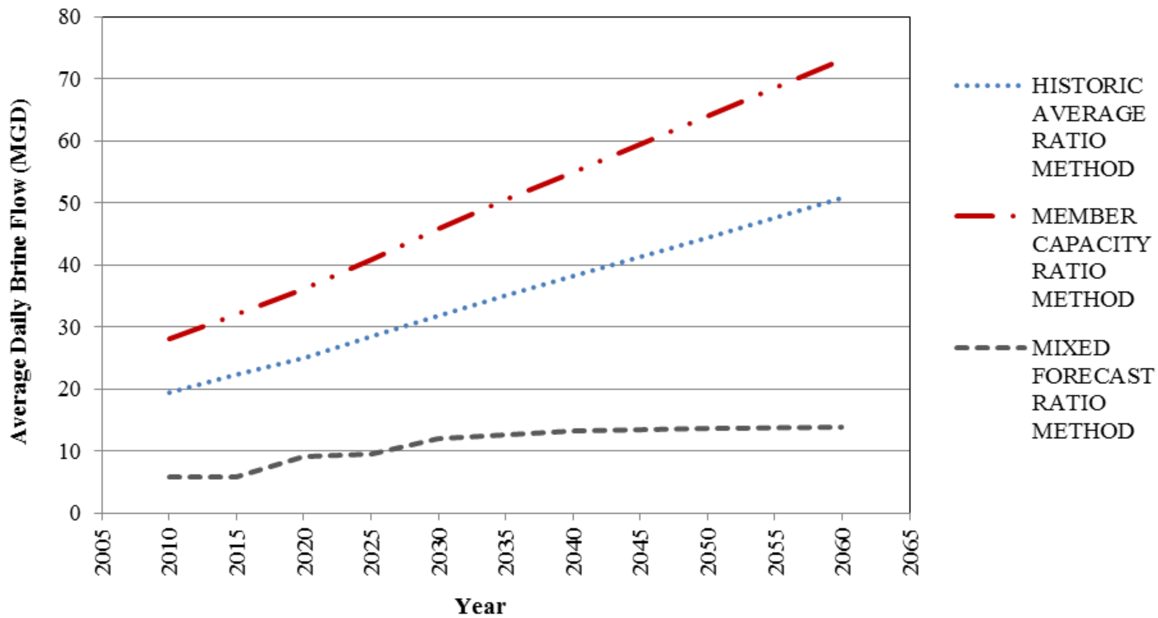
A comparison of forecasted water demands for the Santa Ana Watershed from **Figure 7** with those of the potential service area expansion (referred to here as "Coachella Valley") is shown on **Figure 9** below.

Figure 9 - Water Demand Forecasts



All three ratio methods described in the Methodology section above for predicting rates of Brine Line flow were used for Desalter Facilities. The daily Brine Line flow rates predicted by each method are shown on **Figure 10** below.

Figure 10 - Range of Forecasted Brine Line Flows from Coachella Valley Desalter Facilities



The results from the three ratio methods define the range for forecasting of Brine Line flows from future Desalter Facilities in the San Gorgonio Pass and Coachella Valley area. For this Brine Generator Category, the range is quite large; and it was decided that the Member Capacity Ratio method was overly conservative. Moreover, the large volume of agricultural irrigation in Coachella Valley caused this method to predict flows from Desalter Facilities in Year 2060 to be approximately double the flows from all other categories in the existing SAWPA service area. Therefore, the forecasted Brine Line flows from the Desalter Facilities category were calculated as the average of those calculated by the Historic Average Ratio and Mixed Forecast Ratio methods, initiating by Year 2035 with a period of transition to full flow.

The forecasted Brine Line flows from future Desalter Facilities in the Coachella Valley are presented on **Figure 11** and the values are listed in **Table 9** below.

Figure 11 - Forecasted Brine Line Flows from Coachella Valley Desalter Facilities

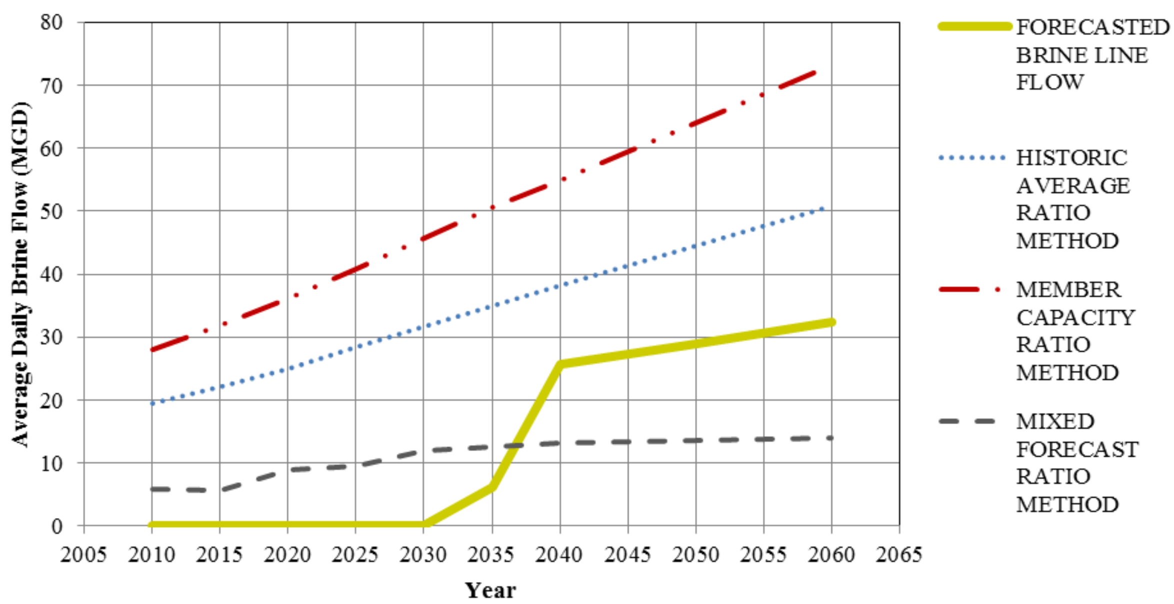


Table 9 – Forecasted Brine Line Flows for Coachella Valley Desalter Facilities

2010	2015	2020	2025	2030	2035	2040	2050	2060
0	0	0	0	0	6.25	25.65	29.0	32.3

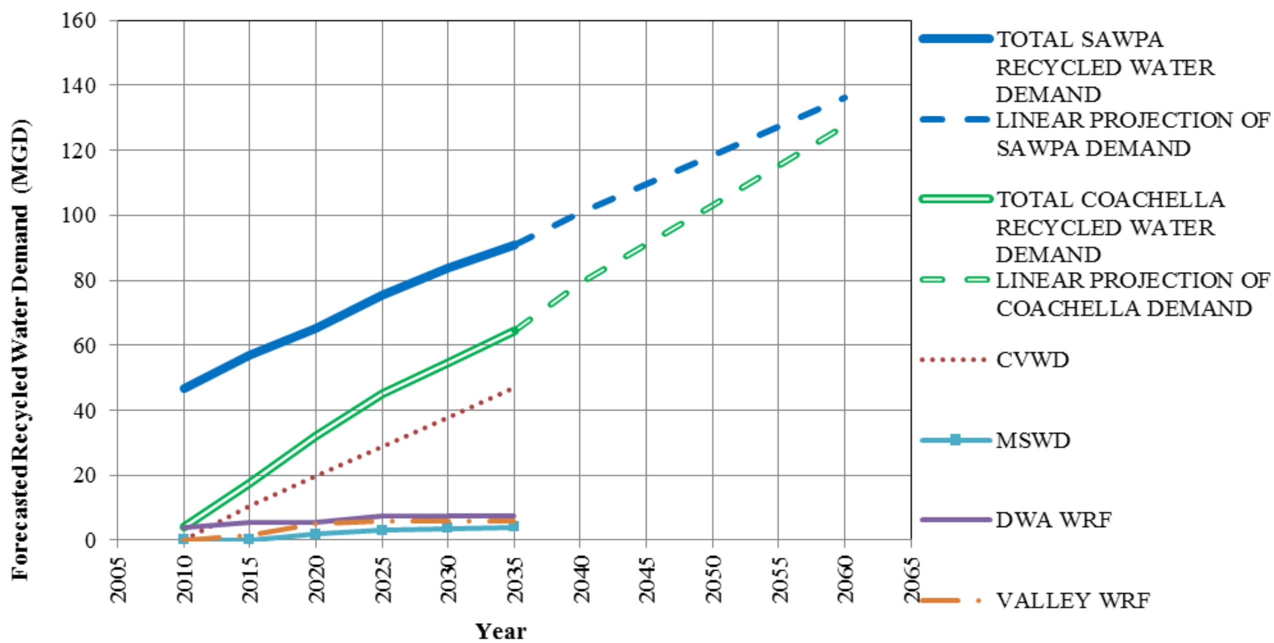
Values in millions of gallons per day.

Recycled Water Facilities

For Recycled Water Facilities, only the Member Capacity Ratio and Mixed Forecast Ratio methods were used to predict rates of Brine Line flow. The absence of available historical data eliminated the Historic Average Ratio method from consideration for this category. As in the Santa Ana Watershed, the Brine Line flows for the Recycled Water category are expected to significantly increase over the next 25 years. Recycled water is already in use for landscape irrigation in the area. However, brine from post-secondary treatment at these facilities is returned to the treatment stream, which suggests that the forecasted Recycled Water category Brine Line flows may not be realized.

As noted previously, 2010 UWMP forecasts of recycled water demands extend only to Year 2035. A linear extrapolation was used to estimate the demand for Years 2040, 2050, and 2060. A comparison of forecasted recycled water demand for the Santa Ana Watershed with that of the potential service area expansion (referred to here as “Coachella Valley) is shown on **Figure 12** below.

Figure 12 - Recycled Water Demand Forecasts

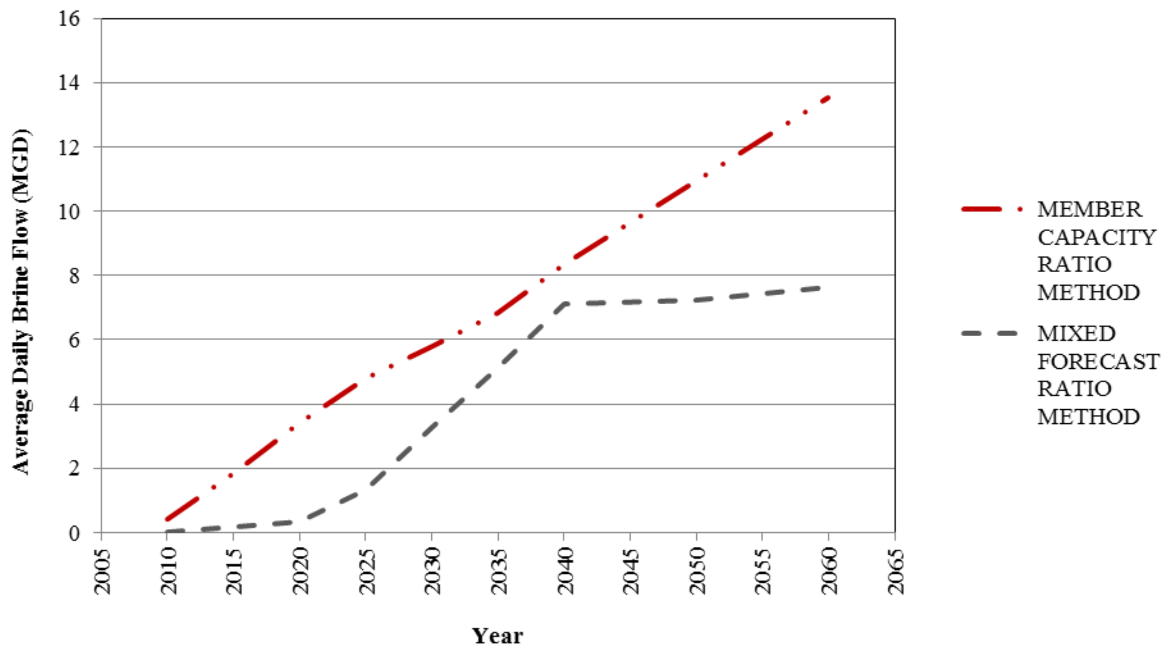


This comparison suggests that the anticipated use of recycled water in the two areas is similar. Water suppliers in both areas already utilize recycled water, approximately 46 MGD in the Santa Ana Watershed in 2010 and a little over 4 MGD in Coachella Valley in 2010. And aggressive growth in the use of recycled water in Coachella Valley is anticipated, as demonstrated by development of new infrastructure such as the Mid-Valley Pipeline by CVWD to deliver recycled water to urban irrigation customers.

The Recycled Water Facilities Brine Generator Category is forecasted to be the second largest category in San Gorgonio Pass and Coachella Valley, and the linear projection shown on **Figure 12** above yields an estimate of 127 MGD of recycled water use in the area in Year 2060.

Only the Member Capacity Ratio and the Mixed Forecast Ratio methods were used to define the predicted range of Brine Line flows from future Recycled Water Facilities in San Gorgonio Pass and Coachella Valley. The flows predicted by these methods are shown on **Figure 13** below.

Figure 13 - Range of Forecasted Brine Line Flows from Coachella Valley Recycled Water Facilities



The Mixed Forecast Ratio method correlates the forecasted recycled water demand with forecasted Brine Line flows. The plateau of forecasted recycled water demand in the potential service area expansion that begins in Year 2040 on **Figure 13** above reflects the similar plateau of Brine Line flows from Santa Ana Watershed due to system capacity limitations.

The forecasted Brine Line flows from the Recycled Water Facilities category were calculated as the average of those calculated by the Member Capacity Ratio and Mixed Forecast Ratio methods. As in the case of Desalter Facilities category, the flows are initiated by Year 2035 with a period of transition to full flow.

The forecasted Brine Line flows from Recycled Water Facilities in San Gorgonio Pass and Coachella Valley are presented graphically on **Figure 14** and the values are listed in **Table 10** below.

Figure 14 - Forecasted Brine Line Flows from Coachella Valley Recycled Water Facilities

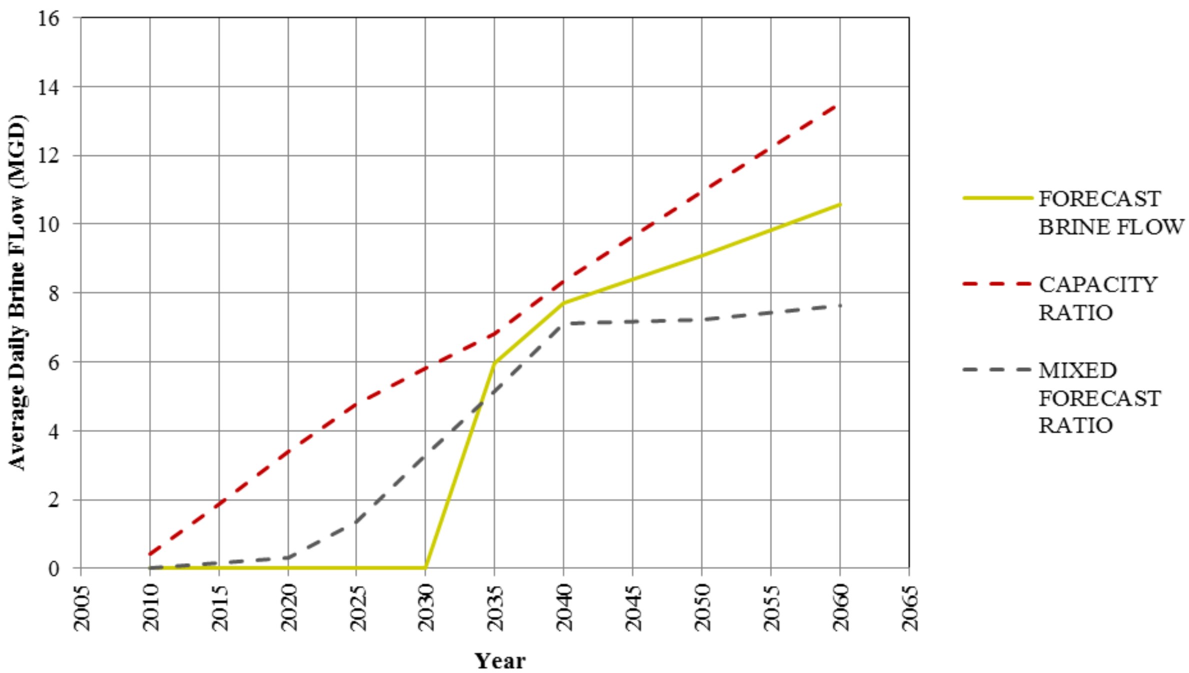


Table 10 – Forecasted Brine Line Flows from Coachella Valley Recycled Water Facilities

2010	2015	2020	2025	2030	2035	2040	2050	2060
0	0	0	0	0	5.98	7.73	9.09	10.59

Values in millions of gallons per day.

Power Plants

Brine Line flows from the Power Plants Brine Generator Category is the waste brine from cooling. Unlike the Desalter and Recycled Water Facilities categories, the Brine Line flows from the Power Plants category do not correlate well with consumer water demand. These flows correlate with plant production capacity in megawatts (MW). All three power plants in the Santa Ana Watershed are powered by natural gas, as are three of the four existing plants in Coachella Valley.

The Power Plants considered in this analysis and the respective generating capacities are listed in **Table 11** below.

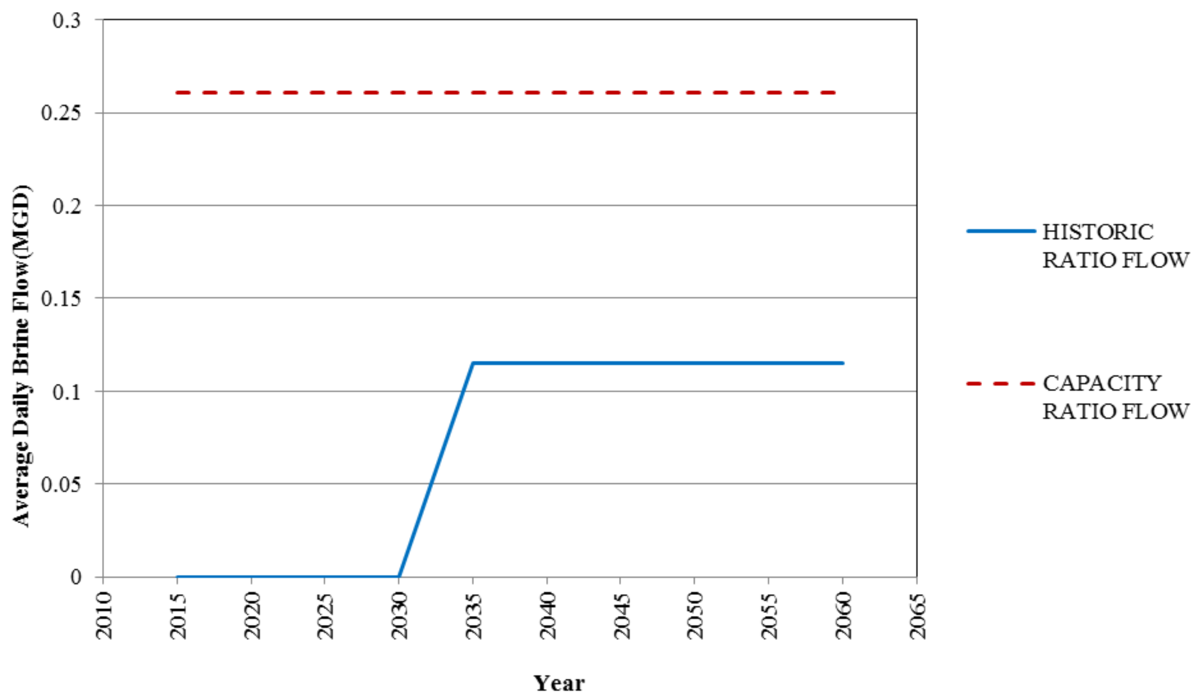
Table 11 – Power Plants in the Santa Ana and Coachella Valleys

FACILITY NAME	AGENCY	GENERATING CAPACITY (MW)	POWER SOURCE
Mountain View	SBVMWD	1054	Natural Gas
E.I. Colton (Agua Mansa Power Plant)	SBVMWD	48	Natural Gas
IEEC	EMWD	800	Natural Gas
Indigo Energy Facility	Diamond Generating Corp., (3) - 50 MW turbines	150	Natural Gas
Municipal Cogeneration Plant	City of Palm Springs, (2) - 1 MW internal combustion generators	2	Natural Gas
Coachella	Imperial Irrigation District, (4) - 23 MW turbines	92	Natural Gas
Colmac Energy Biomass	Colmac Band of Mission Indians, (1) - 48 MW turbine	48	Waste wood

The total rated capacity of the four power plants identified in the Coachella Valley (292 MW) is significantly smaller than that of the three power plants in the Santa Ana Watershed (1,902 MW), so the corresponding forecasted Brine Line flows are small. The Historic Average Ratio and Member Capacity Ratio methods were used to define the range of predicted Brine Line flows from the Power Plants Brine Generator Category. As with the Desalting and Recycled Water Facilities categories, it is anticipated that Brine Line flows for this category will begin in Year 2035.

The range of flows predicted by the Historic Average Ratio and Member Capacity Ratio methods are presented graphically on **Figure 15** below.

Figure 15 - Range of Brine Line Flows from Power Plants



The flows predicted by the Historic Average Ratio method were selected as most representative of the expected Brine Line flows from the Power Plants category in Coachella Valley. Forecasted flow values are listed in **Table 12** below.

Table 12 – Forecasted Brine Line Flows from Coachella Valley Power Plants

2010	2015	2020	2025	2030	2035	2040	2050	2060
0	0	0	0	0	0.115	0.115	0.115	0.115

Values in millions of gallons per day.

Waste Haulers

Brine Line flows from Waste Haulers enter the system at dump stations which serve Brine Line customers that do not have a direct service connection to the Brine Line. The Member Capacity Ratio method cannot be used for this category because these flows are highly variable and there is no permitted capacity assigned to the dump stations. Similarly, the Mixed Forecast Ratio method because there is no measurable base demand with which to associate the forecasted brine flows. Therefore, the Historic Average Ratio method was used to correlate this category with the populations of the service areas. As with the other Brine Generator Categories, it is anticipated that Brine Line flows for this category will begin in 2035.

The forecasted flows from Waste Haulers in San Gorgonio Pass and Coachella Valley are listed in **Table 13** below.

Table 13 – Forecasted Brine Line Flows from Coachella Valley Waste Haulers

2010	2015	2020	2025	2030	2035	2040	2050	2060
0	0	0	0	0	0.039	0.039	0.039	0.039

Values in millions of gallons per day.

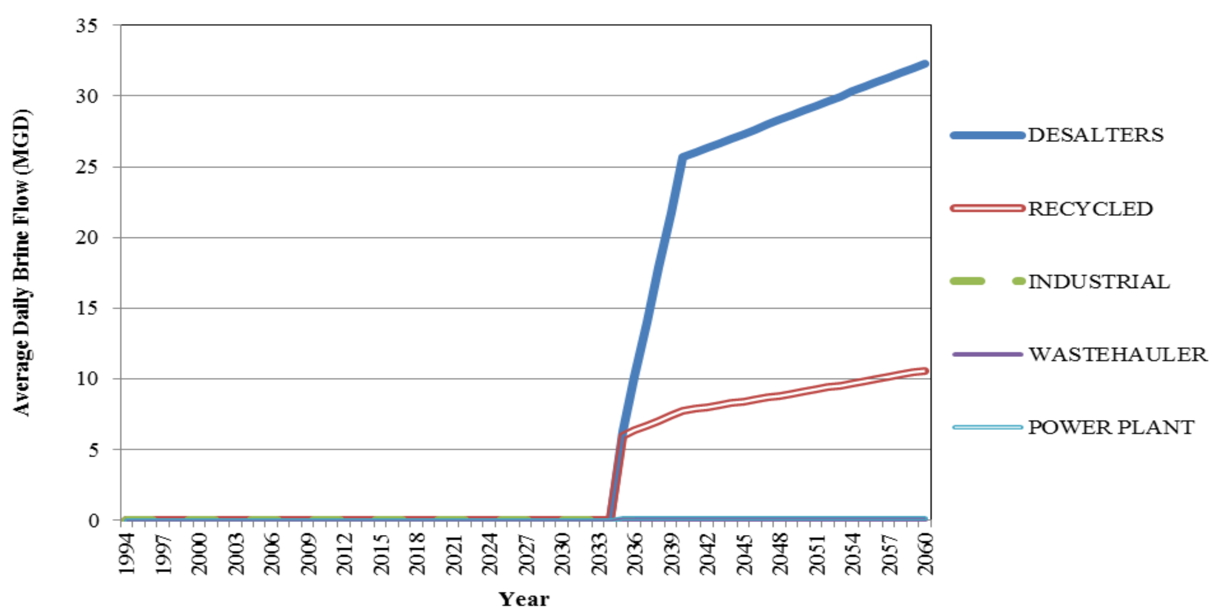
Total Forecasted Brine Line Flows from Expanded Service Area

Flows from Potential Service Area Expansion

Each forecasted Brine Generator Category in San Gorgonio Pass and Coachella Valley is assumed to connect to the proposed Brine Line outfall in the Year 2035. The Desalter Facilities category is anticipated to be the largest, with approximately half of the total flows from the area initially and increasing to approximately 75% of the total by Year 2040. The Recycled Water category follows with approximately half of the total flows initially. Though the forecasted Recycled Water category flows continue to increase, the increases are much smaller than the rate of increase of Desalter Facilities category flows, and the forecasted Recycled Water category flows represent only approximately 25% of the total by Year 2040. The Power Plants and Waste Haulers Brine Generator Categories make up slightly less than half of one percent of the total flows.

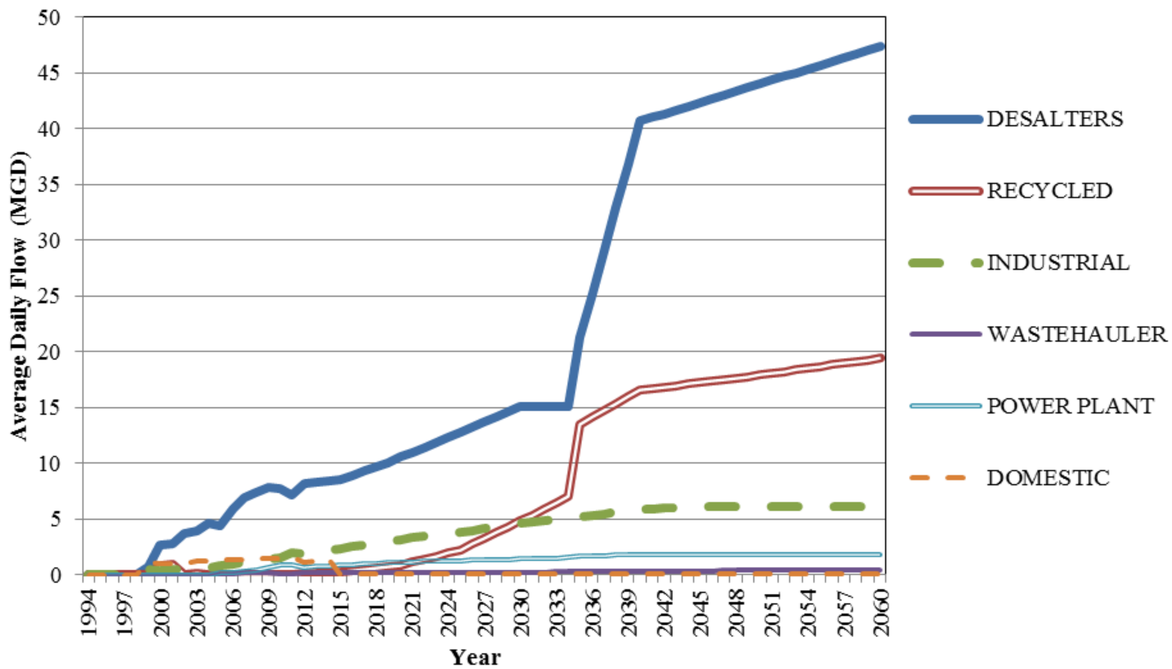
The forecasted flows from each of the major Brine Generator Categories anticipated in San Gorgonio Pass and Coachella Valley are presented on **Figure 16** below.

Figure 16 - Forecasted Brine Line Flows from Coachella Valley by Brine Generator Categories



Flows from Expanded SAWPA Service Area by Brine Generator Categories
The total forecasted flows from each of the major Brine Generator Categories of the entire expanded Brine Line system service area (including Santa Ana watershed, San Gorgonio Pass and Coachella Valley) are presented on **Figure 17** below.

Figure 17 - Total Brine Line Flows by Brine Generator Categories



The total flows from the Desalter Facilities Brine Generator Category are anticipated to continue to account for the majority of the flows in the system. The projected flows from Santa Ana Watershed Desalter Facilities are anticipated to plateau at 15.02 MGD in Year 2030, with the Coachella Desalter Facilities coming online in Year 2035. The total forecasted Brine Line flows from the Desalter Facilities category are 47 MGD in Year 2060.

The forecasted Brine Line flows from the Water Recycling Facilities category are expected to significantly increase in the near future. Recycled water is anticipated to become the second largest brine generation category. The forecasted flows from the potential service area expansion are more than double the flows from the existing SAWPA Member Agencies. The total flows are anticipated to be over 19 MGD in Year 2060.

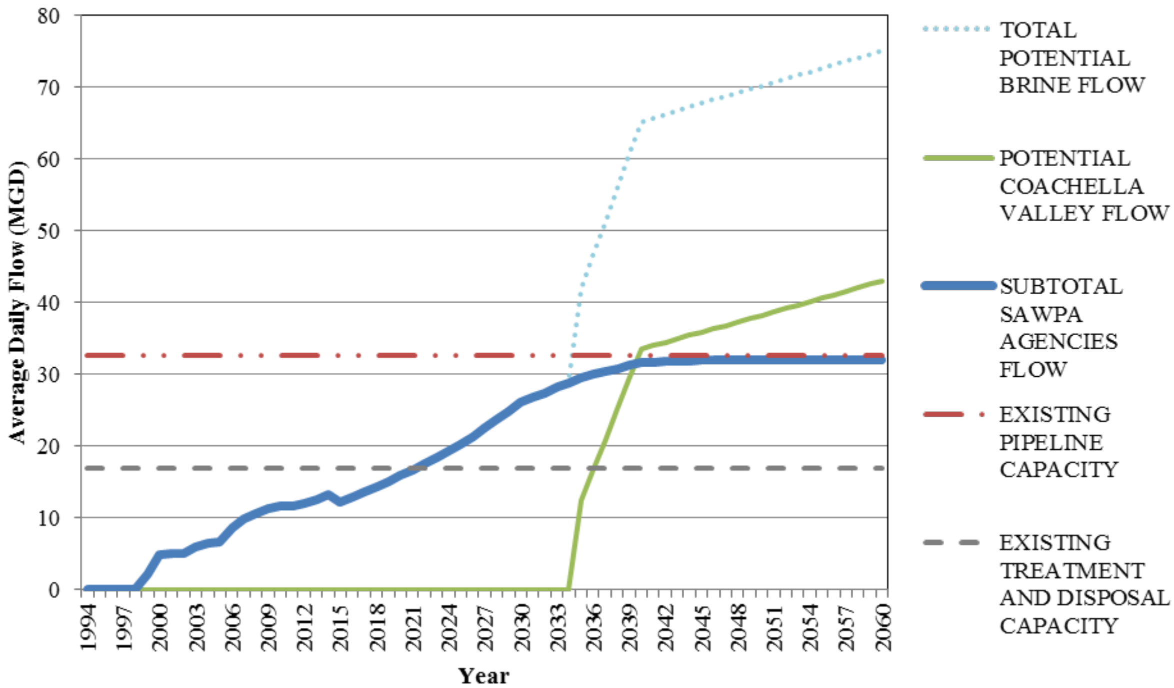
The forecasted Brine Line flows from the Industrial Facilities category are anticipated to continue to increase, but at much lower rates than the Desalter and Water Recycling Facilities categories, accounting for approximately eight percent of the total flows in Year 2060.

The forecasted Brine Line flows from the Power Plants and Waste Haulers categories exhibit relatively slow growth, accounting for approximately three percent of the total flows in Year 2060.

Total Forecasted Brine Line Flows

The total forecasted flows for the entire expanded Brine Line system service area (including Santa Ana watershed, San Gorgonio Pass and Coachella Valley) are presented on **Figure 18** below.

Figure 18 - Total Forecasted Brine Line Flows



The total forecasted flows for the entire expanded Brine Line system service area (including Santa Ana Watershed, San Gorgonio Pass and Coachella Valley) are listed in **Table 14** below.

Table 14 – Total Forecasted Brine Line Flows

	2010	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**	**2050**	**2060**
SAWPA Desalting	7.7	8.52	10.58	12.74	15.02	15.02	15.02	15.02	15.02
Coachella Desalting	0	0	0	0	0	6.25	25.65	29	32.3
Subtotal Desalting	**7.7**	**8.52**	**10.58**	**12.74**	**15.02**	**21.27**	**40.67**	**44.02**	**47.32**
SAWPA Recycled Water	0	0.3	0.87	2.22	4.8	7.52	8.82	8.82	8.82
Coachella Recycled Water	0	0	0	0	0	5.98	7.73	9.085	10.585
Subtotal Recycled Water	**0**	**0.3**	**0.87**	**2.22**	**4.8**	**13.5**	**16.55**	**17.90**	**19.40**
SAWPA Industrial	1.48	2.37	3.17	3.77	4.59	5.22	5.84	6.09	6.09
Coachella Industrial	0	0	0	0	0	0	0	0	0
Subtotal Industrial	**1.48**	**2.37**	**3.17**	**3.77**	**4.59**	**5.22**	**5.84**	**6.09**	**6.09**
SAWPA Waste Hauler	0.12	0.17	0.18	0.2	0.22	0.25	0.27	0.33	0.41
Coachella Waste Hauler	0	0	0	0	0	0.039	0.039	0.039	0.039
Subtotal Waste Hauler	**0.12**	**0.17**	**0.18**	**0.2**	**0.22**	**0.289**	**0.309**	**0.37**	**0.45**
SAWPA Power Plant	0.92	0.83	1.12	1.26	1.4	1.55	1.69	1.69	1.69
Coachella Power Plant	0	0	0	0	0	0.115	0.115	0.115	0.115
Subtotal Power Plant	**0.92**	**0.83**	**1.12**	**1.26**	**1.4**	**1.665**	**1.805**	**1.805**	**1.805**
SAWPA Domestic	**1.48**	**0.02**	**0.03**	**0.03**	**0.03**	**0.03**	**0.03**	**0.03**	**0.03**
Subtotal SAWPA	11.7	12.21	15.95	20.22	26.06	29.59	31.67	31.98	32.06
Subtotal Coachella	0	0	0	0	0	12.38	33.53	38.2	43
Total Brine Flow	**11.7**	**12.21**	**15.95**	**20.22**	**26.06**	**41.974**	**65.204**	**70.22**	**75.10**

Values in millions of gallons per day.

Analysis of Historical Brine Data for Existing SAWPA Service Area

Background

Forecasting of Brine Line flows is an essential aspect of planning for the proposed Inland Empire Interceptor (IEI). Of similar importance is forecasting of the major brine constituents of those Brine Line flows.

The brine constituents under consideration in this Appraisal Analysis are Total Dissolved Solids (TDS), Total Suspended Solids (TSS), and Biochemical Oxygen Demand (BOD). TDS is the measure of solids in solution that pass through a 2 micron filter and is an indicator of hardness and salinity in water. TSS is the measure of solids suspended in water that are trapped by a 2 micron filter, which can reduce transmission of light in water. BOD is the measure of oxygen used by microorganisms in water over a 5 day period at 20°C and is an indirect measure of organic matter in water. High levels of TDS, TSS and BOD in discharges can adversely affect water quality, and forecasts of these constituents are necessary to assess potential impacts on receiving waters.

Standards established for discharges to the Salton Sea from Coachella Valley by the State of California's Colorado River Regional Water Quality Control Board limit TDS to an average concentration of 2,000 mg/L and peak concentration of 2,500 mg/L. The current and projected future concentrations of TDS in the flows entering the Salton Sea from the proposed IEI exceed these values. No specific standards have been established for concentrations of TSS or BOD in discharges to the Salton Sea from Coachella Valley, except for municipal wastewater treatment plants for which the limitations are the typical EPA standards for discharges to surface water bodies (30 mg/L for both TSS and BOD for the 30-day Arithmetic Mean Discharge Rate). The current and projected future concentrations of TSS and BOD in the flows entering the Salton Sea from the proposed IEI exceed these values, also. Therefore, the planning and design of the proposed IEI should address these considerations. These measures will need to include approval by the Colorado River Regional Water Quality Control Board of an amendment to the Basin Plan, which will be addressed further in TM 3.3 of this Appraisal Analysis.

A mass balance approach was used to analyze the historical data and to develop the necessary projections of future brine concentrations. In this approach, the mass of the constituents entering the system must be equal to the mass of the same constituents exiting the system, plus any mass accumulated in the system. The analysis for this Appraisal Analysis assumes a steady-state and non-reactive system. In other words, there is no accumulation of mass in the Brine Line system (steady-state) and there are no chemical reactions taking place in the system that alters the constituents (non-reactive). However, information contained in the Salinity Management Program report prepared by CDM and other available SAWPA documents suggest otherwise. Determination of these dynamics is beyond the scope of this Appraisal Analysis, and mass adjustments have been used in the analysis to address imbalances as described below in the Methodology discussion.

Methodology for Analyses of TSS and BOD

Measurements of TSS and BOD are discussed in this Appraisal Analysis in terms of both mass (in tons) and concentration (in mg/L). Concentration is used because the presence of these constituents in water is measured using this metric. Mass is also used because it provides a measure of the aggregate amount (or "load") of the given constituent at a specific location in the system during a specific time period, and because it is a necessary component of the methodology for calculation of concentrations.

The estimated mass of the TSS and BOD exiting the system was calculated from available historical data for the flows and the concentrations of these constituents recorded at the County Line Master Meter (CLMM), located downstream of the convergence of the existing Brine Line system. The estimated mass of the TSS and BOD entering the Brine Line system was calculated from available historical data for the flows, and the concentrations of these constituents at various service connections to the system.

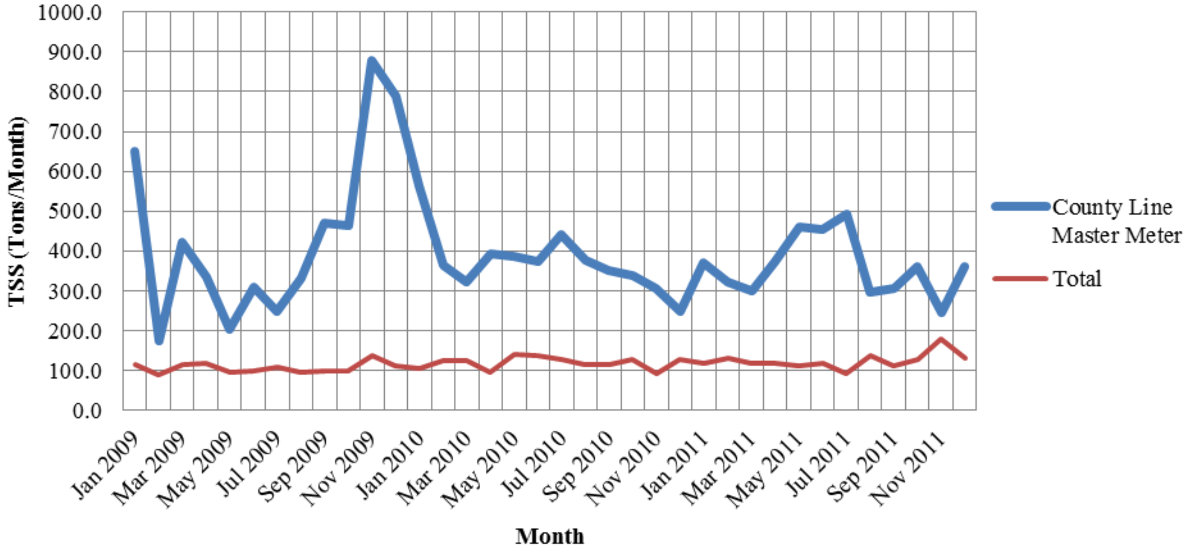
The anticipated mix of Brine Generator Categories for the potential service area expansion differs from that of the existing SAWPA service area. Therefore, it was necessary to develop separate projections of TSS and BOD loads for each applicable Brine Generator Category. The average concentrations of TSS and BOD for each category were calculated from available historical Brine Line system data for the most recent 3-year period, 2009 through 2011, inclusive.

The mass of TSS and BOD entering the Brine Line system (in tons) was estimated for each Brine Generator Category by multiplying the average category concentrations by the forecasted flows for that category. The mass of TSS and BOD exiting the Brine Line system (in tons) was estimated from the historical data recorded at the CLMM. (Note that in the case of the Recycled Water category, historical flow data was used for this brine data analysis that was excluded from the flow data analysis described earlier in this TM 3.2; this was necessary to develop average concentrations for this category.)

Comparison of the mass entering the system with the mass exiting the system revealed imbalances, as mentioned above. In the case of TSS, the 3-year average of mass exiting the system was 3.6 times greater than the average total mass entering the system.

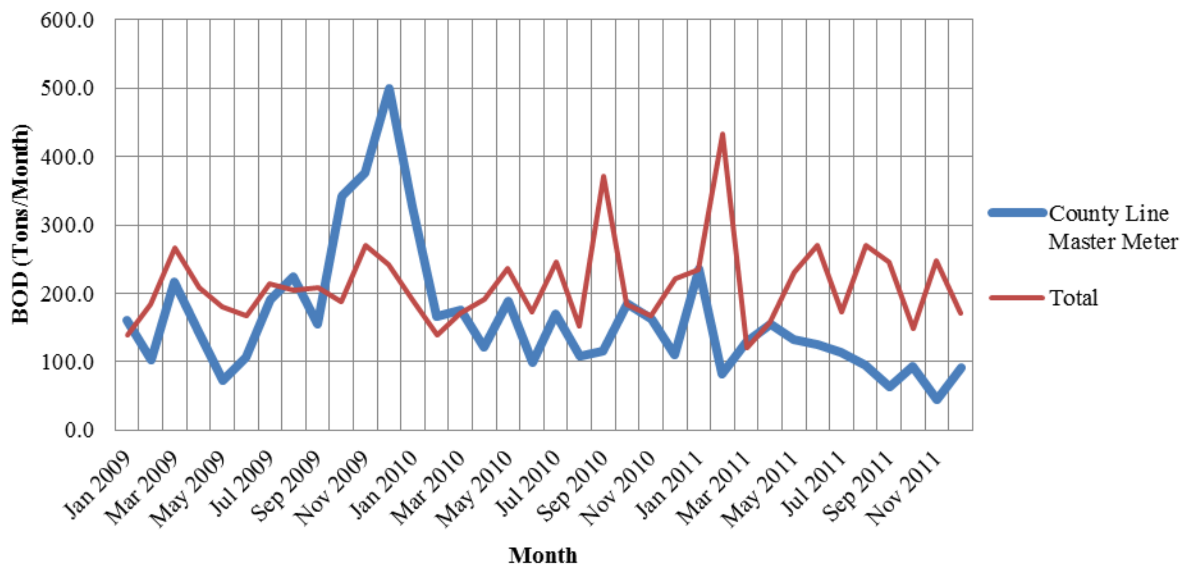
The imbalance between the mass (in tons) of TSS exiting the system at CLMM and the total mass of TSS entering the system is displayed on **Figure 19** below.

Figure 19 - TSS Mass Exiting System (at CLMM) vs. Total TSS Mass Entering System



Conversely, the 3-year average of mass of BOD exiting the system at the CLMM was only 77% of the average total mass of BOD entering the system. The imbalance between the mass (in tons) of BOD exiting the system at CLMM and the total mass of BOD entering the system is displayed on **Figure 20** below.

Figure 20 - BOD Mass Exiting System (at CLMM) vs. Total BOD Mass Entering System



Therefore, mass adjustments were developed to account for the imbalances in the system. The Prorated Mass for each Brine Generator Category for each month was calculated using the ratio of the mass calculated from the CLMM data (exiting the system) and the total mass for all Brine Generator Categories (entering the system) for the corresponding time interval. Using TSS for an example:

$$Prorated\ TSS\ Mass\ (Tons)_{Category} = \frac{TSS\ Mass\ (Tons)_{CLMM}}{TSS\ Mass\ (Tons)_{Total}}\ x\ TSS\ Mass\ (Tons)_{Category}$$

The Prorated Average Mass for each Brine Generator Category was calculated as the average of the Prorated Mass for the respective Brine Generator Category for all months.

The Adjusted Monthly Concentration for each Brine Generator Category was calculated as the Prorated Mass divided by the corresponding rate of flow and adjusting for units. Continuing with the TSS example:

$$Adjusted\ Monthly\ TSS\ Conc. (mg/L)_{Category} = \frac{Prorated\ TSS\ (Tons)_{Category}}{Flow\ \left(\frac{MG}{Month}\right)_{Category}} * \frac{2000\ \left(\frac{lbs}{ton}\right)}{8.34\ \left(\frac{lbs}{MG}\ x\ \frac{L}{mg}\right)}$$

The Adjusted Average Concentration for each Brine Generator Category was calculated as the average of the Adjusted Monthly Concentrations for the respective Brine Generator Category for all months.

Figure 19 and **Figure 20** on the preceding pages depict spikes in the Mass Exiting the System recorded at the CLMM for both TSS and BOD during the period November 2009 through January 2010. No such spike is depicted on **Figure 19** for the Total Mass of TSS Entering the System for the same time interval. This was the case also for BOD on **Figure 20**. It should be noted that, due to the proration methodology described, these spikes are echoed in the Adjusted Monthly Concentration for the various Brine Generator Categories for both TSS and BOD.

Methodology for Analysis of TDS

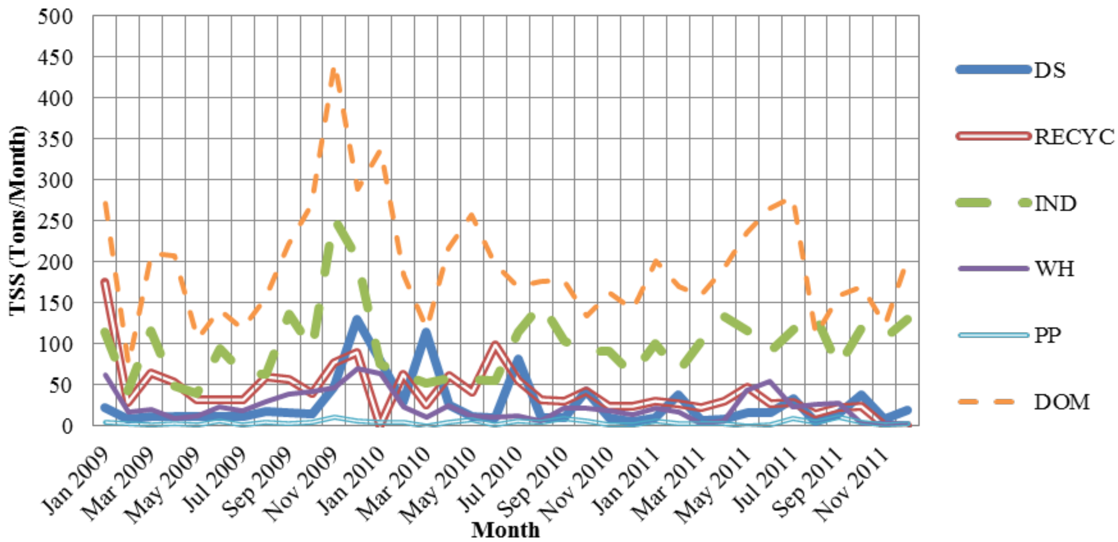
As with TSS and BOD discussed above, measurements of TDS are discussed in this Appraisal Analysis in terms of both mass (in tons) and concentration (in mg/L). Historical data was not available for TDS for Brine Line flows from individual service connections. Historical data was available for TDS only for flows exiting the system as measured at the CLMM, so a mass balance analysis could not be used for this constituent. The estimated mass of the TDS exiting the system was calculated from available historical data for the flows and the concentrations recorded at the CLMM.

The historical TDS data revealed that the average concentration has been trending upward since 1997. It is anticipated that, as demands for water in Southern California continue to grow, optimization and technological improvements will continue to lead to improved system efficiency with increasing TDS concentrations resulting from decreasing rates of flow from individual system connections. A trend analysis was performed and evaluated as described in "Forecasting of Total Dissolved Solids (TDS)" below.

Analysis of Historical TSS Data

The Prorated Mass of TSS for each Brine Generator Category was calculated for each month as described in the methodology discussion above. The results of these calculations are presented on **Figure 21** below.

Figure 21 - Prorated Mass of TSS by Brine Generator Category



The Prorated Average Mass of TSS and the Adjusted Average TSS Concentration was calculated for each Brine Generator Category. The results of these calculations are listed in **Table 15** below.

Table 15 – Prorated Average TSS Mass and Adjusted Average TSS Concentration

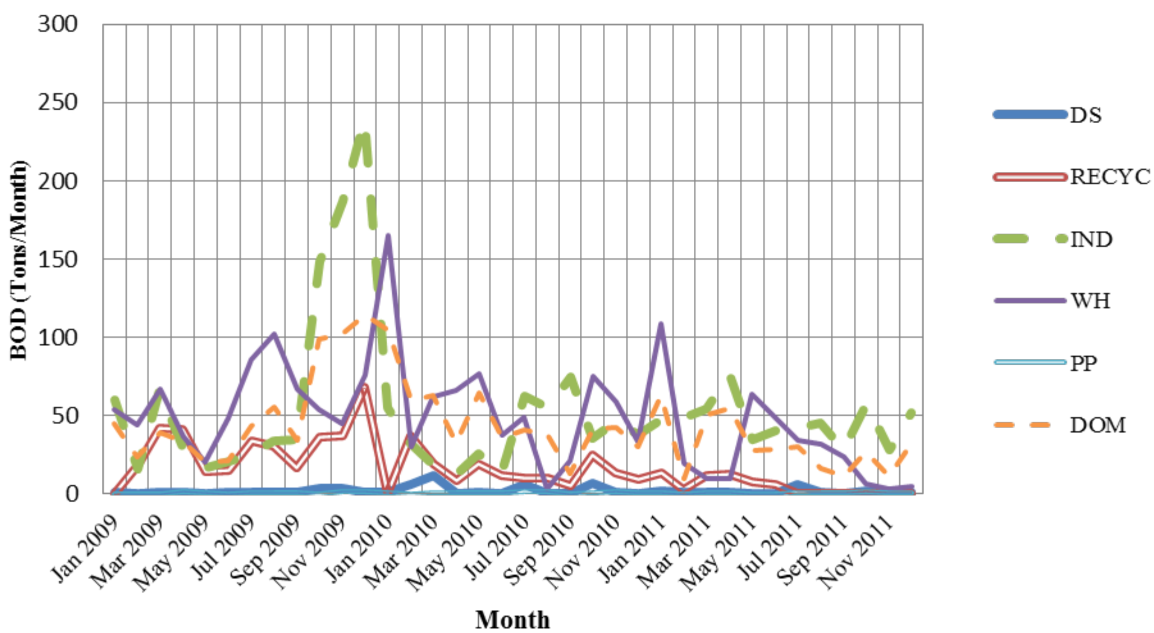
Category	Prorated Average TSS Mass (Tons / Month)	Adjusted Average TSS Concentration (mg/L)
DS	27	27
RECYC	42	1,339
IND	98	487
WH	24	2,660
PP	4	40
DOM	196	1,039
CLMM	**391**	**264**

It is apparent from **Figure 21** and **Table 15** above that the Domestic category is the largest contributor of TSS mass to the Brine Line flows with approximately 50% of the total. The planned removal of the domestic wastewater flows from the system can be expected to significantly reduce TSS in the system. The Industrial category has been the next largest contributor with approximately 25% of the total, which will increase to roughly half after the Domestic category flows have been removed from the system. Though the mass of TSS from the Waste Hauler is not large, the TSS concentration from this category is much higher than the other categories. Pretreatment of flows from service connections in the Industrial and Waste Hauler categories may be effective at further reducing the mass of TSS in the system.

Analysis of Historical BOD Data

As with the TSS data, the Prorated Mass of BOD for each Brine Generator Category was calculated for each month. The results of these calculations are presented on **Figure 22** below.

Figure 22 - Prorated Mass of BOD by Brine Generator Category



The Prorated Average Mass of BOD and the Adjusted Average BOD Concentration was calculated for each Brine Generator Category. The results of these calculations are listed in **Table 16** below.

Table 16 – Prorated Average BOD Mass and Adjusted Average BOD Concentration

Category	Average Prorated BOD Mass (Tons / Month)	Adjusted Average BOD Concentration (mg/L)
DS	2	2
RECYC	16	609
IND	53	268
WH	48	5,127
PP	1	6
DOM	43	229
CLMM	**163**	**110**

It is apparent from **Figure 22** and **Table 16** above that the Domestic category is a significant contributor of BOD mass to the Brine Line flows with approximately 26% of the total. Though system loads from Domestic flows are less significant for BOD mass than for TSS, the planned removal of these flows can be expected to significantly reduce BOD in the system. The Industrial and Waste Hauler categories have been the other large contributors of BOD mass, combining for approximately 62% of the total, increasing to over 80% after the Domestic category flows have been removed from the system. As with TSS, the Waste Hauler category is particularly noteworthy in terms of BOD concentration. Pretreatment of flows from service connections in the Industrial and Waste Hauler categories may be effective at further reducing the mass of BOD in the system.

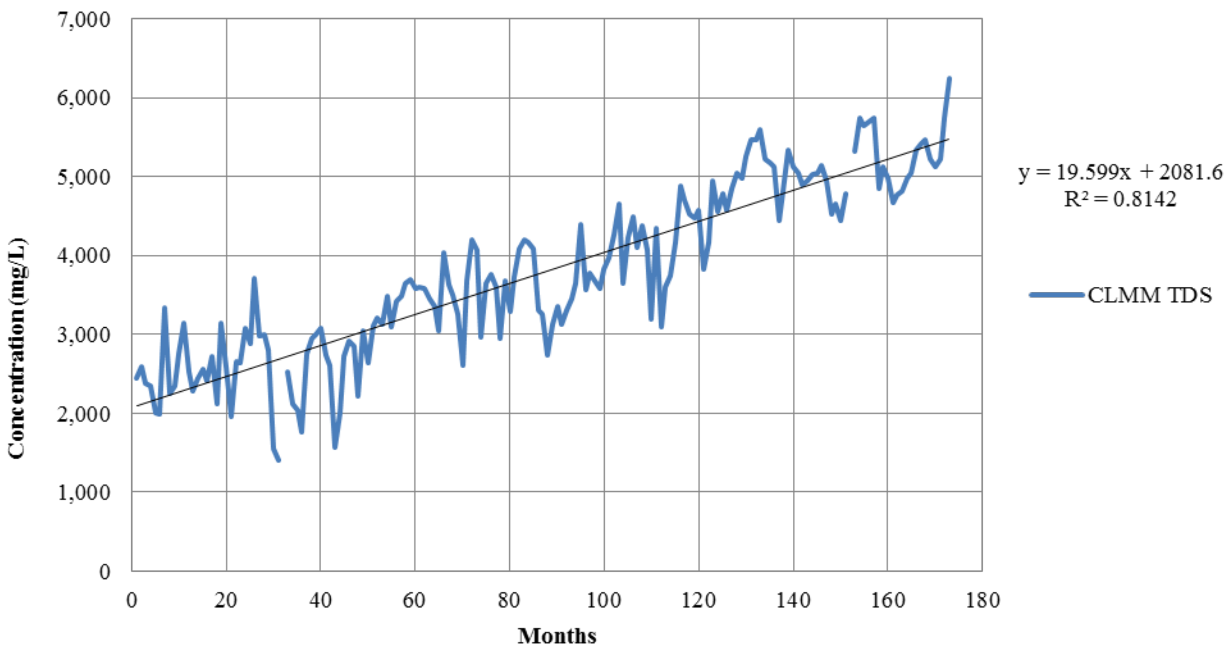
Analysis of Historical TDS Data

As noted above, historical data was available for TDS only for flows measured at the CLMM. Therefore, TDS could not be evaluated for individual Brine Generator Categories and a mass balance analysis could not be performed.

TDS concentrations at the CLMM have been trending upward since 1997. A trend analysis of the historical data for TDS concentrations at CLMM was performed, which revealed a linear trend. The average TDS concentration was approximately 2,082 mg/L in September 1997, and has been increasing since at the rate of approximately 19.6 mg/L per month. It is anticipated that, as demands for water in Southern California continue to grow, optimization and technological improvements will continue to improve system efficiency, resulting in decreasing rates of flow from individual system connections and increasing TDS concentrations.

The historical data for TDS concentrations at the CLMM (with outliers removed) and the results of the trend analysis are depicted on **Figure 23** below.

Figure 23 - TDS Concentration Trend, Starting September 1997



However, TDS concentrations in the system cannot be expected to continue to increase without limit. It is anticipated that TDS concentrations will level off at some time in the future due to economic and/or technological constraints. Therefore, for the purpose of this Appraisal Analysis, TDS concentrations in Brine Line flows were anticipated to level off when the target rate of salt removal from the Santa Ana Watershed has been accomplished.

The target salt removal rate for Santa Ana Watershed is approximately 270,000 tons per year, as reported in Section 2 of ***Phase 2 SARI Planning Technical Memorandum*** of the Salinity Management Program report. This rate was used as the mass of TDS used for calculation of the maximum average TDS concentration. The Desalter Facilities category is the largest contributor of both flows and mass of TDS to the Brine Line; and the target TDS mass removal is expected to occur when all Desalters are operating at planned capacity. This is forecasted to occur in Year 2030. The forecasted Brine Line flow from the existing SAWPA service area in that year (2030) is 26.06 MGD (see **Table 14**).

Therefore, the maximum average TDS concentration was calculated as the ratio of the target salt removal rate and the forecasted Brine Line flow in Year 2030:

$$Max.TDS\ Conc.\left(\frac{mg}{L}\right) = \frac{270{,}000\frac{Tons}{Year}(TDS)}{26.06\left(\frac{MG}{Day}\right)(Flow)} * \frac{2000\ \left(\frac{lbs}{ton}\right)}{365\ \left(\frac{Days}{Year}\right) * 8.34\ \left(\frac{lbs}{MG} x \frac{L}{mg}\right)}$$

$$= 6{,}800\ \left(\frac{mg}{L}\right)$$

The maximum average TDS concentration used in this analysis is 6,800 mg/L. The trend analysis depicted on **Figure 23** above indicates that the maximum average TDS concentration (6,800 mg/L) will be realized as early as Year 2018.

Forecasting of Brine Loads from Existing SAWPA Service Area

Total Suspended Solids

Forecasting of future TSS loads from the existing SAWPA service area was performed using the Adjusted Average Concentration for each applicable Brine Generator Category calculated as described in the section above entitled "Analysis of Historical Brine Data for Existing SAWPA Service Area" and as listed in **Table 15**. These Adjusted Average TSS Concentrations were used in combination with the forecasted flows for the corresponding Brine Generator Category to forecast annual mass of TSS (in tons per year) for each category to Year 2060. Since the average concentration was held constant for each category, the flow forecasts represent the only variable for each category. But, because the rate of change of flow over time is different for each category and the TSS concentrations vary significantly between categories, the overall average concentration also varies over time.

The forecasts of TSS mass from the existing SAWPA service area for each Brine Generator Category and of the average TSS concentration are listed in **Table 17** below.

Table 17 – Forecasted TSS Mass & Average Concentration from Existing SAWPA Service Area

Forecasted TSS Mass (Tons/Year) from Existing SAWPA Service Area								Brine Line Flows (MGD)	Average TSS Concentration (mg/L)
Year	DS	RECYC	IND	WH	PP	DOM	Total		
2010	320.6	0.0	1,097.1	486.2	56.2	2,342.9	4,303.0	11.7	241
2015	354.8	611.7	1,756.8	688.7	50.7	31.7	3,494.4	12.21	188
2020	440.6	1,774.1	2,349.8	729.2	68.4	47.5	5,409.6	15.95	223
2025	530.5	4,526.9	2,794.6	810.3	77.0	47.5	8,786.7	20.22	285
2030	625.5	9,787.9	3,402.4	891.3	85.6	47.5	14,840.1	26.06	373
2035	625.5	15,334.4	3,869.4	1,012.8	94.7	47.5	20,984.3	29.59	465
2040	625.5	17,985.3	4,329.0	1,093.9	103.3	47.5	24,184.4	31.67	501
2050	625.5	17,985.3	4,514.3	1,336.9	103.3	47.5	24,612.8	31.98	505
2060	625.5	17,985.3	4,514.3	1,661.0	103.3	47.5	24,936.9	32.06	510

The Desalter and Domestic categories are illustrative of the variations of TSS mass loads and concentrations over time. Flows from the Domestic category have historically been the source of a significant portion of the TSS mass in the Brine

Line flows (approximately 54% in Year 2010), but are only a small portion of the flows (approximately 13% in Year 2010). Improvements to domestic wastewater collection systems in the existing SAWPA service area are currently under way that will result in removal of nearly all Domestic flows from the Brine Line by Year 2015. This will cause the projected average concentration to decrease for a time. Conversely, the Desalter category contributes a large portion of the flow (approximately 66% in Year 2010), but are only a small portion of the TSS mass (approximately 7% in Year 2010), which tends to moderate the impact of increasing TSS mass loads from other categories on average concentrations over time. The TSS forecasts in **Table 17** above reflect these changes.

Biochemical Oxygen Demand

Similar to the TSS forecasts, forecasting of future BOD loads from the existing SAWPA service area was performed using the Adjusted Average Concentration for each applicable Brine Generator Category calculated as described in the Analysis of Historical BOD Data section above and as listed in **Table 16**. These Adjusted Average BOD Concentrations were used in combination with the forecasted flows for the corresponding Brine Generator Category to forecast annual mass of BOD (in tons per year) for each category to Year 2060. Since the average concentration was held constant for each category, the flow forecasts represent the only variable for each category. But, as with the TSS variations discussed above, because the rate of change of flow over time is different for each category and the BOD concentrations vary significantly between categories, the aggregate average concentration also varies over time.

The forecasts of BOD mass from the existing SAWPA service area for each Brine Generator Category and of the average BOD concentration are listed in **Table 18** below.

Table 18 – Forecasted BOD Mass & Average Concentration from Existing SAWPA Service Area

Forecasted BOD Mass (Tons/Year) from Existing SAWPA Service Area								Brine Line Flows (MGD)	Average BOD Concentration (mg/L)
Year	DS	RECYC	IND	WH	PP	DOM	Total		
2010	26.4	0.0	603.8	937.1	8.0	515.9	2,091.2	11.7	117
2015	29.2	278.2	966.8	1,327.6	7.2	7.0	2,616.0	12.21	141
2020	36.2	806.8	1,293.2	1,405.7	9.8	10.5	3,562.1	15.95	147
2025	43.6	2,058.7	1,537.9	1,561.9	11.0	10.5	5,223.6	20.22	170
2030	51.5	4,451.3	1,872.5	1,718.1	12.2	10.5	8,115.9	26.06	204
2035	51.5	6,973.7	2,129.5	1,952.3	13.5	10.5	11,130.9	29.59	247
2040	51.5	8,179.2	2,382.4	2,108.5	14.8	10.5	12,746.8	31.67	264
2050	51.5	8,179.2	2,484.4	2,577.1	14.8	10.5	13,317.4	31.98	273
2060	51.5	8,179.2	2,484.4	3,201.8	14.8	10.5	13,942.1	32.06	285

As with the TSS variations discussed above, the Desalter and Domestic categories are illustrative of the variations of BOD mass loads and concentrations over time. Flows from the Domestic category have historically been the source of a significant portion of the BOD mass in the Brine Line flows (approximately 25% in 2010), but are only a small portion of the flows (approximately 13% in Year 2010). The improvements to domestic wastewater collection systems in the existing SAWPA service area currently under way will remove nearly all Domestic flows from the Brine Line by Year 2015 and moderate the projected average concentration for a time. The Desalter category, by contrast, contributes a large portion of the flow (approximately 66% in Year 2010), but is only a small portion of the BOD mass (approximately 1% in Year 2010), which moderates the impact of increasing TSS mass loads from other categories on average concentrations over time. The BOD forecasts in **Table 18** above reflect these changes.

Total Dissolved Solids

As discussed above, unlike TSS and BOD forecasts, historical TDS data could not be evaluated for individual Brine Generator Categories. And the forecasted average TDS concentrations used to estimate future TDS loads from the existing SAWPA service area were determined using the trend analysis, increasing at the rate of 19.6 mg/L per month to a maximum rate of 6,800 mg/l in Year 2020, after which the forecasted concentration remains constant.

The forecasted average TDS concentrations were used to forecast mass of BOD (in tons per year) to Year 2060. The forecasted BOD loads from the existing SAWPA service area are listed in **Table 19** below.

Table 19 – Forecasted TDS Mass from Existing SAWPA Service Area

Forecasted TDS Mass(Tons/Year) from Existing SAWPA Service Area			
Year	**TDS Concentration (mg/L)**	**Flow (MGD)**	**TDS Mass (Tons/Year)**
2010	5,198	11.70	92,627
2015	6,374	12.21	118,535
2020	6,800	15.95	165,191
2025	6,800	20.22	209,415
2030	6,800	26.06	269,899
2035	6,800	29.59	306,458
2040	6,800	31.67	328,000
2050	6,800	31.98	331,211
2060	6,800	32.06	332,040

Forecasting of Brine Loads from Potential Service Area Expansion

Methodology

Forecasting of future TSS, BOD and TDS loads and concentrations from the potential SAWPA service area expansion in San Gorgonio Pass and Coachella Valley was performed using the same methodology used to forecast the loads and concentrations from the existing SAWPA service area. The Adjusted Average Concentration for each applicable Brine Generator Category was calculated as described in the section above entitled “Analysis of Historical Brine Data for Existing SAWPA Service Area” and used to forecast annual mass of each brine constituent (in tons per year) to Year 2060.

Total Suspended Solids

The forecasts of TSS mass and average concentration from the potential SAWPA service area expansion in San Gorgonio Pass and Coachella Valley for each Brine Generator Category are listed in **Table 20** below.

Table 20 – Forecasted TSS Mass & Average Concentration from Service Area Expansion

Forecasted TSS Mass (Tons/Year) from Service Area Expansion								Brine Line Flows (MGD)	Average TSS Concentration (mg/L)
Year	DS	RECYC	IND	WH	PP	DOM	Total		
2010	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2015	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2020	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2025	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2030	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2035	260.3	12,194.1	0.0	158.0	7.0	0.0	12,619.4	12.38	669
2040	1,068.1	15,762.6	0.0	158.0	7.0	0.0	16,995.8	33.53	333
2050	1,207.6	18,525.7	0.0	158.0	7.0	0.0	19,898.3	38.2	341
2060	1,345.0	21,584.4	0.0	158.0	7.0	0.0	23,094.5	43.0	352

Biochemical Oxygen Demand

The forecasts of BOD mass and average concentration from the potential SAWPA service area expansion in San Gorgonio Pass and Coachella Valley for each Brine Generator Category are listed in **Table 21** below.

Table 21 – Forecasted BOD Mass & Average Concentration from Service Area Expansion

Forecasted BOD Mass (Tons/Year) from Service Area Expansion								Brine Line Flows (MGD)	Average BOD Concentration (mg/L)
Year	DS	RECYC	IND	WH	PP	DOM	Total		
2010	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2015	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2020	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2025	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2030	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2035	21.4	5,545.6	0.0	304.6	1.0	0.0	5,872.5	12.38	311
2040	87.9	7,168.4	0.0	304.6	1.0	0.0	7,561.9	33.53	148
2050	99.4	8,425.0	0.0	304.6	1.0	0.0	8,829.9	38.2	152
2060	110.7	9,816.0	0.0	304.6	1.0	0.0	10,232.2	43.0	156

Total Dissolved Solids

As for the forecasts of TDS for the existing SAWPA service area above, forecasted average TDS concentrations (from the forecasts for the existing service area) were used to estimate future TDS loads from the potential SAWPA service area expansion. The forecasts of TDS mass from the potential SAWPA service area expansion in San Gorgonio Pass and Coachella Valley are listed in **Table 22** below.

Table 22 – Forecasted TDS Mass from Service Area Expansion

Year	TDS Concentration (mg/L)	Total Flow (MGD)	Total TDS (Tons / Year)
2010	5,198	0.0	0.0
2015	6,374	0.0	0.0
2020	6,800	0.0	0.0
2025	6,800	0.0	0.0
2030	6,800	0.0	0.0
2035	6,800	12.38	128,259
2040	6,800	33.53	347,305
2050	6,800	38.24	396,034
2060	6,800	43.04	445,747

Forecasting of Total Brine Loads from Expanded Service Area

Methodology

Forecasts of total TSS, BOD and TDS loads from the expanded SAWPA service area are simply the sum of the forecasts for the existing service area in upper Santa Ana Watershed and the potential service area expansion in the San Gorgonio Pass and Coachella Valley area. The forecasted total TSS and BOD loads for each Brine Generator Category were used to calculate the total loads and the average concentration for each year.

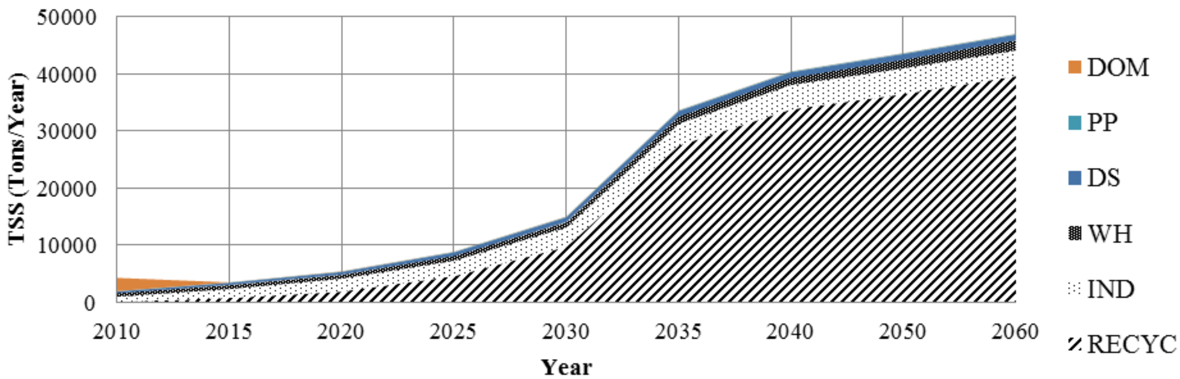
Total Suspended Solids

The total forecasted mass of TSS loads and average concentration from the expanded SAWPA service area for each Brine Generator Category is listed in **Table 23.** The total forecasted mass of TSS loads over time is graphically presented on **Figure 24** on the next page.

Table 23 – Forecasted TSS Mass & Average Concentration from Expanded SAWPA Service Area

Forecasted TSS Mass (Tons/Year)								Brine Line Flows (MGD)	Average TSS Concentration (mg/L)
Year	DS	RECYC	IND	WH	PP	DOM	Total		
2010	320.6	0.0	1,097.1	486.2	56.2	2,342.9	4,303.0	11.7	241
2015	354.8	611.7	1,756.8	688.7	50.7	31.7	3,494.4	12.21	188
2020	440.6	1,774.1	2,349.8	729.2	68.4	47.5	5,409.6	15.95	223
2025	530.5	4,526.9	2,794.6	810.3	77.0	47.5	8,786.7	20.22	285
2030	625.5	9,787.9	3,402.4	891.3	85.6	47.5	14,840.1	26.06	374
2035	885.7	27,528.5	3,869.4	1,170.8	101.8	47.5	33,603.7	41.97	525
2040	1,693.6	33,748.0	4,329.0	1,251.9	110.3	47.5	41,180.1	65.20	414
2050	1,833.1	36,511.0	4,514.3	1,494.9	110.3	47.5	44,511.1	70.22	416
2060	1,970.5	39,569.7	4,514.3	1,819.0	110.3	47.5	48,031.3	75.1	420

Figure 24 - Total Forecasted Annual TSS Mass



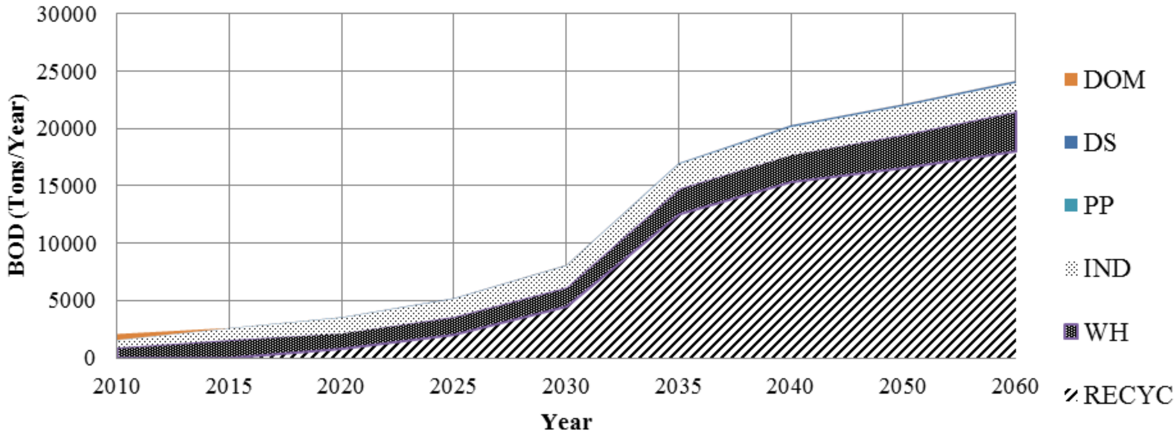
Biochemical Oxygen Demand

The total forecasted BOD loads and average concentration from the expanded SAWPA service area for each Brine Generator Category are listed in **Table 24.** The total forecasted mass of BOD loads over time is graphically presented on **Figure 25** on the next page.

Table 24 - Forecasted BOD Mass & Average Concentration from Expanded SAWPA Service Area

Forecasted BOD Mass (Tons/Year)								Brine Line Flows (MGD)	Average BOD Concentration (mg/L)
Year	DS	RECYC	IND	WH	PP	DOM	Total		
2010	26.4	0.0	603.8	937.1	8.0	515.9	2,091.2	11.7	117
2015	29.2	278.2	966.8	1,327.6	7.2	7.0	2,616.0	12.21	141
2020	36.2	806.8	1,293.2	1,405.7	9.8	10.5	3,562.1	15.95	147
2025	43.6	2,058.7	1,537.9	1,561.9	11.0	10.5	5,223.6	20.22	170
2030	51.5	4,451.3	1,872.5	1,718.1	12.2	10.5	8,115.9	26.06	204
2035	72.9	12,519.2	2,129.5	2,256.9	14.5	10.5	17,003.5	41.97	265
2040	139.3	15,347.7	2,382.4	2,413.1	15.8	10.5	20,308.7	65.20	204
2050	150.8	16,604.2	2,484.4	2,881.7	15.8	10.5	22,147.3	70.22	207
2060	162.1	17,995.2	2,484.4	3,506.4	15.8	10.5	24,174.4	75.1	211

Figure 25 - Total Forecasted Annual BOD Mass



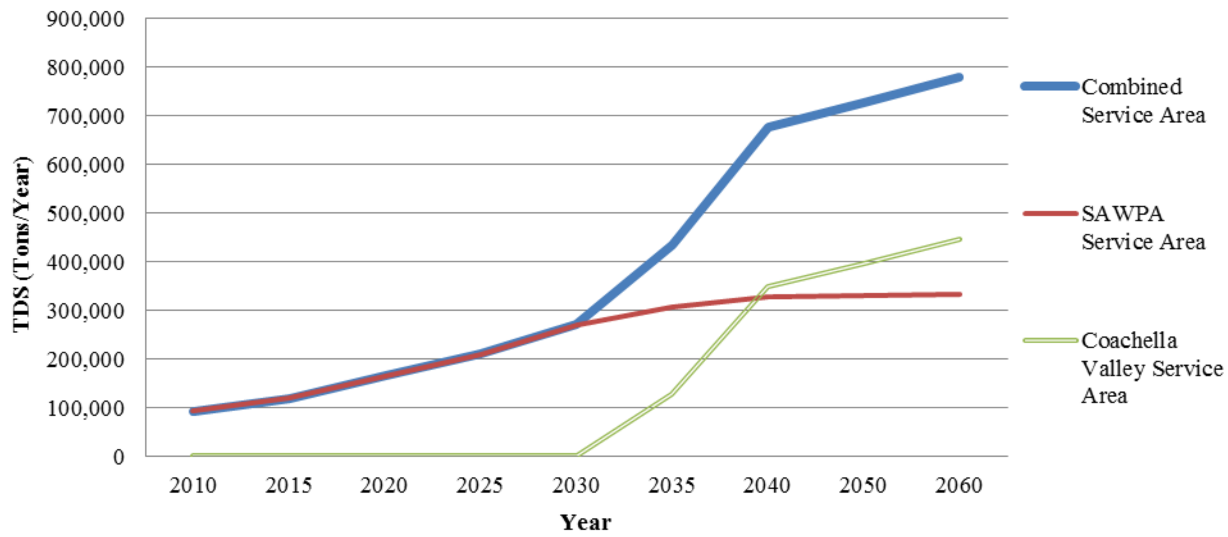
Total Dissolved Solids

The total forecasted TDS loads from the expanded SAWPA service area are listed in **Table 25** and graphically presented on **Figure 25** below. The total forecasted mass of TSS loads over time is graphically presented on **Figure 26** on the next page.

Table 25 - Forecasted TDS Mass from Expanded SAWPA Service Area

Year	TDS Concentration (mg/L)	Flow (MGD)	TDS Mass (Tons/Year)
2010	5,198	11.70	92,627
2015	6,374	12.21	118,535
2020	6,800	15.95	165,191
2025	6,800	20.22	209,415
2030	6,800	26.06	269,899
2035	6,800	41.97	434,717
2040	6,800	65.20	675,306
2050	6,800	70.22	727,245
2060	6,800	75.10	777,787

Figure 26 - Total Forecasted Annual TDS Mass from Expanded Service Area



Summary of Total Forecasted Brine Line System TSS, BOD and TDS Mass

The total forecasted TSS loads (in tons per year) for the entire expanded SAWPA service area (including Santa Ana Watershed, San Gorgonio Pass and Coachella Valley) are listed in **Table 26** below.

Table 26 – Total Forecasted Annual Brine Line TSS Mass

	2010	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**	**2050**	**2060**
SAWPA Desalting	320.6	354.8	440.6	530.5	625.5	625.5	625.5	625.5	625.5
Coachella Desalting	0	0	0	0	0	260.3	1,068.1	1,207.6	1,345.0
Subtotal Desalting	**320.6**	**354.8**	**440.6**	**530.5**	**625.5**	**885.7**	**1,693.6**	**1,833.1**	**1,970.5**
SAWPA Recycled Water	0	611.7	1,774.1	4,526.9	9,787.9	15,334.4	17,985.3	17,985.3	17,985.3
Coachella Recycled Water	0	0	0	0	0	12,194.1	15,762.7	18,525.7	21,584.4
Subtotal Recycled Water	**0**	**611.7**	**1,774.1**	**4,526.9**	**9,787.9**	**27,528.5**	**33,748.0**	**36,511.0**	**39,569.7**
SAWPA Industrial	1,097.1	1,756.8	2,349.8	2,794.6	3,402.4	3,869.4	4,329.0	4,514.3	4,514.3
SAWPA Waste Hauler	486.2	688.7	729.2	810.3	891.3	1,012.8	1,093.9	1,336.9	1,661.0
Coachella Waste Hauler	0	0	0	0	0	158.0	158.0	158.0	158.0
Subtotal Waste Hauler	**486.2**	**688.7**	**729.2**	**810.3**	**891.3**	**1,170.8**	**1,251.9**	**1,494.9**	**1,819.0**
SAWPA Power Plant	56.2	50.7	68.4	77.0	85.6	94.7	103.3	103.3	103.3
Coachella Power Plant	0	0	0	0	0	7.1	7.0	7.0	7.0
Subtotal |Power Plant	**56.2**	**50.7**	**68.4**	**77.0**	**85.6**	**101.8**	**110.3**	**110.3**	**110.3**
SAWPA Domestic	2,342.9	31.7	47.5	47.5	47.5	47.5	47.5	47.5	47.5
Subtotal SAWPA	4,303.0	3,494.4	5,409.6	8,786.8	14,840.2	20,984.3	24,184.5	24,612.8	24,936.9
Subtotal Coachella	0	0	0	0	0	12,619.4	16,995.8	19,898.3	23,094.5
Total Brine Flow	**4,303.0**	**3,494.4**	**5,409.6**	**8,786.7**	**14,840.1**	**33,603.7**	**41,180.1**	**44,511.1**	**48,031.3**

The total forecasted BOD loads (in tons per year) for the entire expanded SAWPA service area (including Santa Ana Watershed, San Gorgonio Pass and Coachella Valley) are listed in **Table 27** below.

Table 27 – Total Forecasted Annual Brine Line BOD Mass

	2010	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**	**2050**	**2060**
SAWPA Desalting	26.4	29.2	36.2	43.6	51.5	51.5	51.5	51.5	51.5
Coachella Desalting	0	0	0	0	0	21.4	87.8	99.3	110.6
Subtotal Desalting	**26.4**	**29.2**	**36.2**	**43.6**	**51.5**	**72.9**	**139.3**	**150.8**	**162.1**
SAWPA Recycled Water	0	278.2	806.8	2,058.7	4,451.3	6,973.7	8,179.2	8,179.2	8,179.2
Coachella Recycled Water	0	0	0	0	0	5,545.5	7,168.5	8,425.0	9,816.0
Subtotal Recycled Water	**0**	**278.2**	**806.8**	**2,058.7**	**4,451.3**	**12,519.2**	**15,347.7**	**16,604.2**	**17,995.2**
SAWPA Industrial	603.8	966.8	1,293.2	1,537.9	1,872.5	2,129.5	2,382.4	2,484.4	2,484.4
SAWPA Waste Hauler	937.1	1,327.6	1,405.7	1,561.9	1,718.1	1,952.3	2,108.5	2,577.1	3,201.8
Coachella Waste Hauler	0	0	0	0	0	304.6	304.6	304.6	304.6
Subtotal Waste Hauler	**937.1**	**1,327.6**	**1,405.7**	**1,561.9**	**1,718.1**	**2,256.9**	**2,413.1**	**2,881.7**	**3,506.4**
SAWPA Power Plant	8.0	7.2	9.8	11.0	12.2	13.5	14.8	14.8	14.8
Coachella Power Plant	0	0	0	0	0	1.0	1.0	1.0	1.0
Subtotal Power Plant	**8.0**	**7.2**	**9.8**	**11.0**	**12.2**	**14.5**	**15.8**	**15.8**	**15.8**
SAWPA Domestic	515.9	7.0	10.5	10.5	10.5	10.5	10.5	10.5	10.5
Subtotal SAWPA	2,091.2	2,616.0	3,562.1	5,223.6	8,115.9	11,131.0	12,746.9	13,317.5	13,942.2
Subtotal Coachella	0	0	0	0	0	5,872.5	7,561.9	8,829.9	10,232.2
Total Brine Flow	**2,091.2**	**2,616.0**	**3,562.1**	**5,223.6**	**8,115.9**	**17,003.5**	**20,308.7**	**22,147.3**	**24,174.4**

The total forecasted TDS loads (in tons per year) for the entire expanded SAWPA service area (including Santa Ana Watershed, San Gorgonio Pass and Coachella Valley) are listed in **Table 28** below.

Table 28 – Total Forecasted Annual Brine Line TDS Mass

	2010	2015	2020	2025	2030	2035	2040	2050	2060
Subtotal SAWPA	92,627	118,535	165,191	209,415	269,899	306,458	328,000	331,211	332,040
Subtotal Coachella	0	0	0	0	0	128,259	347,306	396,034	445,747
Total Brine Flow	**92,627**	**118,535**	**165,191**	**209,415**	**269,899**	**434,717**	**675,306**	**727,245**	**777,787**

Summary of Total Forecasted Brine Line System TSS, BOD and TDS Concentration

The total forecasted TSS concentrations (in mg/L) for the entire expanded SAWPA service area (including Santa Ana Watershed, San Gorgonio Pass and Coachella Valley) are listed in **Table 29** below.

Table 29 – Total Forecasted Annual Brine Line TSS Concentration

	2010	2015	2020	2025	2030	2035	2040	2050	2060
Subtotal SAWPA	241	188	223	285	374	465	501	505	510
Subtotal Coachella	0	0	0	0	0	669	333	341	352
Total Brine Flow	**241**	**188**	**223**	**285**	**374**	**525**	**414**	**416**	**420**

The total forecasted BOD concentrations (in mg/L) for the entire expanded SAWPA service area (including Santa Ana Watershed, San Gorgonio Pass and Coachella Valley) are listed in **Table 30** below.

Table 30 – Total Forecasted Annual Brine Line BOD Concentration

	2010	2015	2020	2025	2030	2035	2040	2050	2060
Subtotal SAWPA	117	141	147	170	204	247	264	273	285
Subtotal Coachella	0	0	0	0	0	311	148	152	156
Total Brine Flow	**117**	**141**	**147**	**170**	**204**	**266**	**204**	**207**	**211**

The total forecasted TDS concentrations (in mg/L) for the entire expanded SAWPA service area (including Santa Ana Watershed, San Gorgonio Pass and Coachella Valley) are listed in **Table 31** below.

Table 31 – Total Forecasted Annual Brine Line TDS Concentration

	2010	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**	**2050**	**2060**
Subtotal SAWPA	5,198	6,374	6,800	6,800	6,800	6,800	6,800	6,800	6,800
Subtotal Coachella	0	0	0	0	0	6,800	6,800	6,800	6,800
Total Brine Flow	**5,198**	**6,374**	**6,800**	**6,800**	**6,800**	**6,800**	**6,800**	**6,800**	**6,800**

References

[1] ***Santa Ana Watershed Salinity Management Program, Phase 2 SARI Planning Technical Memorandum***, Camp, Dresser & McKee (CDM), et al for Santa Ana Watershed Project Authority, May 2010.

[2] ***Santa Ana Watershed Salinity Management Program, Summary Report***, CDM, et al for Santa Ana Watershed Project Authority, July 2010.

[3] ***Inland Empire Brine Line Disposal Option Concept Investigation*** (Draft), Santa Ana Watershed Project Authority, October 2011.

[4] ***Reclamation Manual, Directives and Standards, FAC 09-01: Cost Estimating & 09-02: Construction Cost Estimates and Project Cost Estimates***, Bureau of Reclamation, October 2007.

[5] ***Coachella Valley Final Water Management Plan***, Coachella Valley Water District in association with MWH Americas, Inc. and Water Consult, Inc., et al, September 2002.

[6] ***Coachella Valley Water Management Plan Update (Draft Report)***, MWH Americas, Inc. and Water Consult, Inc., et al for Coachella Valley Water District, December 2010.

[7] ***2010 Urban Water Management Plan (Final Report)***, Coachella Valley Water District in association with MWH Americas, Inc., July 2011.

[8] ***Coachella Valley Water Management Plan Draft Subsequent Program Environmental Impact Report (Administrative Draft)***, Coachella Valley Water District, July 2011.

[9] ***Coachella Valley Water Management Plan Final Subsequent Program Environmental Impact Report***, Coachella Valley Water District with assistance from MWH Americas, Inc. and Water Consult, Inc., January 2012.

Note: Various Urban Water Management Plans also referenced, as cited.

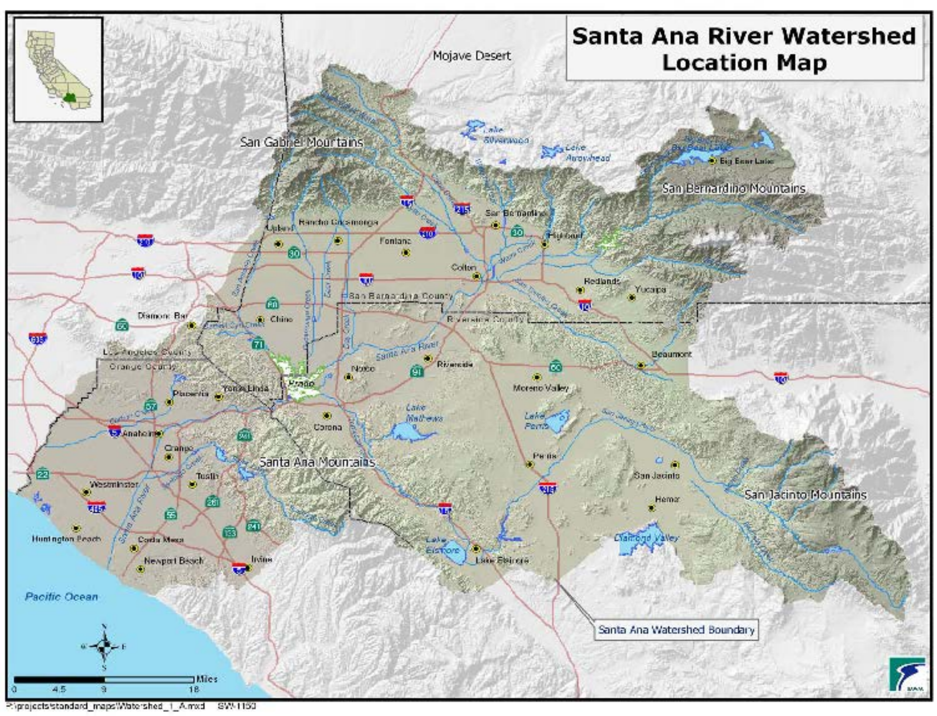
RECLAMATION

Managing Water in the West

Technical Memorandum No. 3.3
Summary of Options and Strategies

Inland Empire Interceptor Appraisal Analysis

Santa Ana Watershed Basin Study, California
Lower Colorado Region



U.S. Department of the Interior
Bureau of Reclamation
Southern California Area Office

Santa Ana Watershed
Project Authority

May 2013

Mission Statements

The mission of the Department of the Interior is to protect and provide access to our Nation's natural and cultural heritage and honor our trust responsibilities to Indian Tribes and our commitments to island communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

BUREAU OF RECLAMATION
Engineering Services Office
Lower Colorado Regional Office, LC-6000

Technical Memorandum No. 3.3
Summary of Options and Strategies

Inland Empire Interceptor Appraisal Analysis

Santa Ana Watershed Basin Study, California
Lower Colorado Region

Prepared by:	**Thomas Nichols, P.E.** **Civil Engineer (Hydrologic)** **Engineering Services Office, LC-6233** **Lower Colorado Region**
Reviewed by:	**Richard Eastland, P.E.** **Kevin Margetts, P.E.**

This page intentionally left blank.

Contents

Tables

Acronyms and Abbreviations

Organizations:

Caltrans	California Department of Transportation
CDM	Camp, Dresser & McKee
CRWQCB	Colorado River Basin Regional Water Quality Control Board, State of California
CVWD	Coachella Valley Water District
EMWD	Eastern Municipal Water District
EPA	U.S. Environmental Protection Agency
ESO	Bureau of Reclamation's Engineering Services Office, Boulder City, Nevada
IEUA	Inland Empire Utilities Agency
MSWD	Mission Springs Water District
OCSD	Orange County Sanitation District
OCWD	Orange County Water District
Reclamation	Bureau of Reclamation
SAWPA	Santa Ana Watershed Project Authority
SBVMWD	San Bernardino Valley Municipal Water District
SCAO	Bureau of Reclamation's Southern California Area Office, Temecula, California
WMWD	Western Municipal Water District

Documents:

Appraisal Analysis	Inland Empire Interceptor Appraisal Analysis
Basin Plan	Water Quality Control Plan: Colorado River Basin Regional Water Quality Control Board
Basin Study	Santa Ana Watershed Basin Study
CWA	U.S. Clean Water Act
OWOW	One Water One Watershed
Porter-Cologne	California's Porter-Cologne Water Quality Control Act
SAWPA Investigation	Inland Empire Brine Line Disposal Option Concept Investigation
TM	Technical Memorandum

Facilities and Processes:

ALR	Area Loading Rate
Brine Line	Inland Empire Brine Line
CLMM	County Line Master Meter
CVSC	Coachella Valley Stormwater Channel
CW	Constructed Wetland
EPF	Evaporation Pond Facility
FTP	Facultative Treatment Pond

FWS	Free Water Surface
IEBL	Inland Empire Brine Line
IEI	Inland Empire Interceptor
NPDES	National Pollutant Discharge Elimination System
SARI	Santa Ana Regional Interceptor (aka "Brine Line")
TF	Treatment Facilities

Parameters and Units of Measure:

AFY	Acre-Feet per Year
ALR	Area Loading Rate
BOD	Biochemical Oxygen Demand (or Biological Oxygen Demand)
cfs	Cubic feet per Second
ft	Feet
gpm	Gallons per Minute
ha	Hectares
HGL	Hydraulic Grade Line
HRT	Hydraulic Residence Time
in	Inches
kg/ha	Kilograms per Hectare
lbs/acre	Pounds per Acre
MGD	Million Gallons per Day
mg/L	Milligrams per Liter
MW	Megawatt
PRF	Peak Rate Factor
psi	Pounds per Square Inch
TDS	Total Dissolved Solids
TSS	Total Suspended Solids

This page intentionally left blank.

Introduction

Santa Ana Watershed Project Authority

SAWPA is a joint powers authority comprised of five member water districts that serve the vast majority of the Santa Ana Watershed. The area served by SAWPA is located within Orange, Riverside and San Bernardino Counties of California, bounded by the Pacific Ocean on the west, the San Bernardino Mountains to the north, and the San Jacinto Mountains to the east.

The five SAWPA Member Agencies are:

- Eastern Municipal Water District (EMWD),
- Western Municipal Water District (WMWD),
- Inland Empire Utilities Agency (IEUA),
- San Bernardino Valley Municipal Water District (SBVMWD), and
- Orange County Water District (OCWD).

Inland Empire Brine Line

SAWPA's mission is to protect water quality and enhance the water supply within the Santa Ana River Watershed. For these purposes, SAWPA developed the Inland Empire Brine Line (Brine Line), which is also known as the Santa Ana Regional Interceptor (SARI), for the purpose of exporting salt from the Santa Ana Watershed. The Brine Line includes approximately 72 miles of pipeline in multiple branches which converge in the vicinity of Prado Dam near the City of Corona. It has a planned capacity of approximately 32.5 million gallons per day (MGD) and was planned for collection and exportation of approximately 271,000 tons of salt per year from the upper Santa Ana Watershed, east of the Santa Ana Mountains. Currently (2010 & 2011), average system flows are approximately 11.7 MGD and over 75,000 tons of salt are exported per year.

Another 21 miles of pipeline convey the combined flows to Orange County Sanitation District (OCSD) facilities for treatment and disposal by discharge to the Pacific Ocean. This pipeline has a nominal capacity of 30 MGD. The planned capacity of the Brine Line system (32.5 MGD) exceeds the hydraulic capacity of the pipeline from the Brine Line convergence near Prado Dam to the OCSD facilities. Furthermore, the agreement between SAWPA and OCSD allows Brine Line flows to the OCSD system up to only 17.0 MGD, with a contractual right to purchase up to 30.0 MGD capacity.

Project Background

The One Water One Watershed (OWOW) Plan is the integrated water management plan for the Santa Ana Watershed. The OWOW Plan is administered by SAWPA. The Bureau of Reclamation's Southern California Area Office (SCAO) and SAWPA submitted a proposal in June 2010 for funding of a Santa Ana Watershed Basin Study (Basin Study) in support of the OWOW Plan update, known as One Water One Watershed 2.0. In August 2010, this Basin Study was selected by Reclamation for funding. This Inland Empire Interceptor Appraisal Analysis (Appraisal Analysis) is one component of the Basin Study.

A study entitled ***Santa Ana Watershed Salinity Management Program*** [1] [2] (Salinity Management Program) was completed in 2010 by a team of consultants led by Camp, Dresser & McKee (CDM), which addressed the Brine Line capacity limitations. The Salinity Management Program identified and evaluated several potential system configuration changes to address the capacity limitations. One of the alternatives considered is a proposed new Brine Line outfall to the Salton Sea, which was identified as Option 4 in the Salinity Management Program. The Salinity Management Program did not include a comprehensive review of Option 4, which would replace the existing outfall from the Brine Line system convergence near Prado Dam in western Riverside County to the OCSD system. This Option 4 is the subject of this Appraisal Analysis and is identified herein as the Inland Empire Interceptor (IEI).

Appraisal Analysis Objectives

Under Reclamation criteria (Reclamation Manual FAC 09-01), appraisal analyses "are intended to be used as an aid in selecting the most economical plan by comparing alternative features". Several alternative conceptual designs for the proposed Inland Empire Interceptor (IEI) have been developed and evaluated for this Appraisal Analysis for the purpose of comparison.

Reclamation Manual FAC 09-01 also states that appraisal analyses are to be prepared "using the available site-specific data." A literature review of previous studies and other available site-specific data was addressed in Technical Memorandum No. 3.1 (TM 3.1).

The system flows and brine characteristics were addressed in TM 3.2. The route of the proposed IEI represents an opportunity for SAWPA to expand the Brine Line service area to include the San Gorgonio Pass and Coachella Valley areas, and TM 3.2 also addressed this opportunity and the associated additional flows.

This TM 3.3 presents a conceptual design for each of several alternatives under consideration for the proposed IEI. These alternatives begin at a common point in western Riverside County near Prado Dam in upper Santa Ana Watershed, running generally eastward to a common point in San Gorgonio Pass. Two alternatives continue eastward from the common point in San Gorgonio Pass and through Coachella Valley to a common end point near the north edge of the Salton Sea in eastern Riverside County.

Estimated costs associated with the alternative conceptual designs developed for the proposed IEI will be addressed in TM 3.4. Opportunities associated with the proposed IEI and suggested Optimization Strategies for further investigation of the project will also be addressed in TM 3.4.

These Technical Memoranda will be summarized in a final report.

Technical Memorandum No. 3.3 – Options and Strategies

This TM 3.3 presents conceptual designs and results of hydraulic analyses for the various alternatives under consideration in this IEI Appraisal Analysis and addresses various options and strategies, including:

- Proposed modification to the existing Brine Line system.
- Existing easements and rights-of-way.
- Salton Sea considerations, including:
    - Salton Sea restoration plans.
    - Increased water supply to the Salton Sea.
    - Water quality (Total Suspended Solids and Biochemical Oxygen Demand concentrations).
    - Salt load (Total Dissolved Solids concentration).
- Brine pre-treatment strategies.
- Alternative alignments considered.
- Alternative designs considered.
- Pumping requirements.
- Energy recovery strategies.
- Permit requirements.

Proposed Brine Line System Modifications and Inland Empire Interceptor

Background

As noted above, appraisal analyses "are intended to be used as an aid in selecting the most economical and viable plan by comparing alternative features". Various alternatives were developed for the purpose of this comparative analysis, and the purpose of this TM 3.3 is to present the conceptual designs for the alternatives under consideration for this Appraisal Analysis.

After delivery of the Santa Ana Watershed Salinity Management Program report by CDM described above, SAWPA staff prepared a report entitled ***Inland Empire Brine Line Disposal Option Concept Investigation*** [3] (SAWPA Investigation) in which four alternative conceptual designs for the proposed IEI were developed and evaluated. The alternatives considered in this Appraisal Analysis for the portion in the upper Santa Ana Watershed (west of San Gorgonio Pass) were based upon those investigated by SAWPA staff and were refined using available satellite imagery and mapping of the area.

The SAWPA Investigation did not include a comprehensive review of the portion of the proposed IEI through the San Gorgonio Pass and Coachella Valley areas. Two alignments were developed for this portion for consideration in this Appraisal Analysis.

Modifications to the Existing Brine Line Gravity Collection System

The proposed IEI would alter the design and operation of the existing Brine Line system. The existing Brine Line system operates by gravity-flow, including the existing outfall to the Orange County Sanitation District (OCSD) system. Each of the alternatives developed by SAWPA for the portion in upper Santa Ana Watershed (west of San Gorgonio Pass) would replace the existing outfall. All the brine that currently flows to OCSD facilities for treatment and disposal would be intercepted and re-routed toward San Gorgonio Pass.

For each alternative under consideration, the proposed IEI begins near the convergence of the existing system gravity mains at Prado Dam in western Riverside County. The portion of the existing outfall from the convergence to the point of beginning of the proposed IEI would need to be replaced, or supplemented by a new parallel main. This length of this portion is approximately 13,000 feet. The rest of the existing outfall to OCSD would need to be removed or abandoned in-place. If this portion of the system could be converted to some other beneficial use, the cost of abandonment could be reduced or eliminated.

Other modifications to the existing Brine Line system would be somewhat different for each alternative under consideration. These are described later in this report in the section entitled “Inland Empire Interceptor Alternatives in Santa Ana Watershed”.

From the eastern edge of the upper Santa Ana Watershed at San Gorgonio Pass, the proposed IEI would continue eastward through San Gorgonio Pass and Coachella Valley to the Salton Sea. Two alternatives were developed for this portion for consideration in this Appraisal Analysis. These are described later in this report in the section entitled “Inland Empire Interceptor Alternatives in San Gorgonio Pass and Coachella Valley”.

Easements and Rights-of-Way

The alignment alternatives considered in this Appraisal Analysis are generally proposed to be located in or adjoining existing transportation, drainage and/or utility corridors (public or private) wherever possible to minimize acquisition costs for easements or right-of-way necessary for the proposed IEI.

In the case of facilities that may be reasonably compatible and where sufficient room may be available, the proposed IEI alignments are located within the existing easements or right-of-way. These facilities include streets, drainage channels, drainage facility access roads, aqueduct access roads, etc.

In the case of facilities that are less likely to be compatible or where sufficient space would likely not be available, the proposed IEI alignments are located adjoining (but outside of) the existing rights-of-way or easements. These facilities include freeways, railroads, gas mains (except as otherwise identified), etc.

Rights-of-way and easements for facilities that would likely be incompatible were avoided altogether, except where crossings would be necessary. These facilities include riparian areas, electrical power transmission lines, windmill power generator facilities, etc. Such crossings would be unavoidable for a project of this type and appropriate consideration for these crossings will be a necessary part of planning and design for the project.

Brine Pre-treatment Strategies

Six strategies for managing flows in the Brine Line system were addressed by CDM in the Salinity Management Program [1] [2]. These six strategies were identified as follows:

- Option 1: Baseline Condition – continued discharge to OCSD.
- Option 2a: SARI (Inland Empire Brine Line (IEBL)) flow reduction via a centralized treatment, concentration, and reclamation plant.
- Option 2b: SARI (IEBL) flow reduction via a decentralized brine minimization project installed at each groundwater desalter.
- Option 3a: Direct ocean discharge of SARI (IEBL) brine without brine minimization.
- Option 3b: Direct ocean discharge of SARI (IEBL) brine with brine minimization projects as described under Option 2b.
- Option 4: Rerouting all SARI (IEBL) system flows for discharge to Salton Sea.

The Salinity Management Program technical memoranda, which were reviewed for this Appraisal Analysis, included discussions of each of these strategies and estimated costs for each. Four of these Options (2a, 2b, 3a and 3b) involve changes to the method and/or degree of treatment of Brine Line flows. Two of these Options (3a and 3b) involve pre-treatment of brine prior to discharge to the Brine Line system to reduce BOD loads.

The brine minimization strategies discussed in the Salinity Management Program would be ineffective at reducing impacts associated with accumulation of salts in the Salton Sea due to TDS concentrations in IEI flows. Brine minimization would reduce the rate of flows in the IEI, allowing for reduced pipe sizes and pumping costs. However, the smaller flows would convey the same TDS mass loads at higher concentrations.

Option 4 is the subject of this Appraisal Analysis. The discussion of Option 4 in the Salinity Management Program identified a need for treatment of Brine Line flows prior to discharge to the Salton Sea, but the estimated costs presented for Option 4 include only those associated with the pipeline itself. Estimated costs for treatment of Brine Line flows for Option 4 were not included.

Potential strategies for treatment of the Brine Line (IEI) flows are presented in this TM 3.3 as alternatives to the brine pre-treatment strategies discussed in the Salinity Management Program. The use of wastewater treatment ponds and/or constructed wetlands is considered as a centralized treatment mechanism to reduce TSS and BOD concentrations in the flows prior to discharge to the Salton Sea. Potential salt management strategies for addressing increased accumulation of salts in the Salton Sea due to TDS concentrations in the IEI flows are also presented in this TM 3.3.

Various other alternative strategies for treatment of the Brine Line (IEI) flows may warrant consideration as part of future planning and design efforts for the proposed IEI. Alternative strategies may include hybrids of the brine pre-treatment strategies with various configurations of constructed wetlands, wastewater treatment ponds, and/or salt management strategies.

Salton Sea Restoration

Issues associated with existing and projected water quality in the Salton Sea have been the subject of much scientific study and public discussion. The water quality issues in the Salton Sea and the associated environmental impacts result primarily from the existing water mass imbalance and accumulation of salts, nutrients and other contaminants. The Salton Sea is a terminal water body and, as such, no outlet is available for the salts and other contaminants conveyed by water flowing into the Sea. It is typical of such terminal water bodies that salts and other contaminants accumulate, causing water quality to change over time. Several plans have been proposed in recent years for restoration of the Sea [6] [7] [8] [9] in response to the deteriorating water budget imbalance and associated deteriorating water quality. Implementation of any of these restoration plans has been impeded by the estimated costs.

The alternatives presented in the Salton Sea restoration plans typically segregate the Sea into multiple segments separated by embankments. These segments are planned to serve different water quality and wildlife habitat functions and vary in areal size and depth. Under most alternatives, surface water flows from Coachella Valley would first enter a "habitat complex", a network of shallow wetland areas that would provide habitat for fish and wildlife. This habitat complex would also provide water treatment to reduce concentrations of Total Suspended Solids (TSS) and Biochemical Oxygen Demand (BOD) in the flows and trap silt, nitrogen, heavy metals, and other undesirable constituents. The habitat complex would not significantly reduce concentrations of Total Dissolved Solids (TDS) in the flows, which is a measure of salinity in water.

Under the various Salton Sea restoration plan alternatives, after release from the habitat complex, the flows would typically travel through two (or more) progressively deeper segments. The last segment in this train is typically a brine pool where the salts could accumulate to super-saturated concentrations. The salts would precipitate from the water column under those super-saturated conditions and accumulate in the bottom sediments.

It is not within the scope of this Appraisal Analysis to thoroughly address either Salton Sea water quality issues or other aspects of the various proposed Salton Sea restoration plans. But it is necessary to address the influence of the proposed IEI flows on Salton Sea water quality and the regulatory considerations of the proposed IEI in this Appraisal Analysis. Therefore, selected aspects of the Salton

Sea restoration plans and of water quality in the Sea are discussed in general terms in this TM 3.3.

Colorado River Basin Regional Water Quality Control Board Basin Plan

The U.S. Clean Water Act (CWA) protects the Nation's surface water bodies by regulating the water quality of discharges. In addition to the CWA, surface waters in California are also protected by the Porter-Cologne Water Quality Control Act (Porter-Cologne). Under the provisions of Porter-Cologne, the state's Colorado River Basin Regional Water Quality Control Board (CRWQCB) has a lead role in the regulatory framework established to protect water quality in the Colorado River Basin Region of California, which includes the Salton Sea. The CRWQCB adopted the ***Water Quality Control Plan: Colorado River Basin - Region 7*** [11] (Basin Plan), with the intent "to provide definitive guidelines" and to "optimize the beneficial uses of state waters within the Colorado River Basin Region of California by preserving and protecting the quality of these waters."

The Basin Plan has three major components: "Beneficial Uses", "Water Quality Objectives" and "Implementation Program". The second of these establishes "General Surface Water Objectives" regarding controllable sources of discharge to the Salton Sea, which state that "discharges of wastes or wastewater shall not increase the Total Dissolved Solids content of receiving waters, unless it can be demonstrated to the satisfaction of the Regional Board [CRWQCB] that such an increase in Total Dissolved Solids does not adversely affect beneficial uses of receiving waters." The "General Surface Water Objectives" also stipulate that for "Coachella Valley Drains" discharges "shall not cause concentration of Total Dissolved Solids (TDS) in surface water to exceed" 2,000 mg/L on an annual average, or 2,500 mg/L at a maximum.

The "Water Quality Objectives" in the Basin Plan also identify "Specific Surface Water Objectives" for the Salton Sea, which identifies the "present level of salinity" (TDS concentration) as approximately 44,000 mg/L (1992) and includes a goal of stabilizing the TDS concentration at 35,000 mg/L. However, salinity in the Salton Sea has continued to increase. The ***Salton Sea Ecosystem Restoration Program Draft Programmatic Environmental Impact Report*** [8] reported that the average TDS concentration in the Salton Sea was approximately 48,000 mg/L in 2006; and the ***Salton Sea Species Conservation Habitat Project Draft Environmental Impact Report*** [7] reported that the average TDS concentration was nearly 52,000 mg/L in 2010.

The "Specific Surface Water Objectives" section of the Basin Plan also states that "because of economic considerations, 35,000 mg/L may not be achievable" and "in such case, any reduction in salinity which still allows for survival of the Sea's aquatic life shall be deemed an acceptable alternative or interim objective."

The "General Surface Water Objectives" in the Basin Plan are less specific about limitations on concentrations of TSS and BOD. However, these constituents would be expected to influence concentrations of turbidity, dissolved oxygen, bacteria, and other water quality parameters in the Sea for which "General Surface Water Objectives" are identified in the Basin Plan. In reference to municipal wastewater treatment plants, the "Implementation Program" in the Basin Plan states that "the discharge of wastewater effluent to surface water will meet the effluent limitations prescribed by the US Environmental Protection Agency (EPA)." The EPA effluent standard for both TSS and BOD (30-day arithmetic mean) is currently 30 mg/L.

If implemented, the proposed IEI would impact the Salton Sea in various ways, some of which may be considered beneficial and others negative. The projected flows in the proposed IEI present an opportunity to provide a reliable new source of water for the Salton Sea. Though small in comparison to the loss of water from the Sea to evaporation, the IEI flows could offset a portion of the imbalance in the Salton Sea water budget. However, the projected TDS, TSS and BOD concentrations in the IEI flows would not comply with the adopted Basin Plan standards for those parameters. The Basin Plan would be the basis for evaluation by the CRWQCB of the impacts of the project on the Salton Sea and other affected surface water bodies within the Colorado River Basin Region.

Basin Plan Amendment Process

The Basin Plan [11] describes a process for preparation and approval of amendments to the Plan, and amendments to the Basin Plan have previously been approved for specific circumstances in which discharges to the Sea have not met adopted water quality standards. It is anticipated that approval of a Basin Plan Amendment would be necessary for implementation of the proposed IEI.

It is clear from the discussion above of the "Specific Surface Water Objectives" in the Basin Plan for the Salton Sea that the water quality standards established for flows entering the Sea are much higher than the existing and projected conditions in the Sea. The intent of these higher water quality standards is to improve the quality of the receiving water body. The existing imbalance in the Salton Sea water budget is central to the water quality issues in the Sea, and new sources of water supply could be beneficial to efforts to improve Salton Sea water quality.

However, in an arid climate like that of the area adjacent to the Salton Sea, water treated to EPA effluent standards is typically a highly valued resource with many potential uses. The cost of treating water to those standards is significant. It is difficult to justify that cost for water intended for discharge to a surface water body with much lower quality from which that water cannot be recovered. Any water supplies that comply with the requirements of the Basin Plan would certainly have greater value for potential uses other than discharge to the Sea.

Therefore, the high water quality standards in the Basin Plan are a deterrent to any potential new sources of water to the Salton Sea.

If new sources of water to the Sea are to be encouraged in support of restoration efforts, then a change to the regulatory approach to water quality standards warrants serious consideration.

Water Quality (TSS and BOD) Impacts

Beneficial impacts from the proposed IEI would include delivery of a new reliable source of water to the Salton Sea. Of course, those flows would convey significant concentrations of TSS and BOD. These constituents would influence concentrations of dissolved oxygen, bacteria, and other water quality parameters in the Sea for which specific standards are addressed in the Basin Plan [11]. Therefore, management of these brine constituents would be an important consideration in planning and design of the proposed IEI.

Treatment of the flows to reduce TSS and BOD concentrations could be most effectively accomplished prior to release to the Sea, using any of several approaches involving various levels of technological complexity. The use of wastewater treatment ponds and/or constructed wetlands to treat flows for TSS and BOD is offered for consideration as a centralized treatment mechanism as an alternative to pre-treatment of the brine, which was considered in the Salinity Management Plan discussed above. This approach is identified in this TM 3.3 as the Inland Empire Interceptor Water Quality Treatment Facility (TF) and is discussed in the section entitled “Water Quality Treatment”.

A Treatment Facility (TF) utilizing wastewater treatment ponds and/or constructed wetlands would be a “green” approach to treatment of the brine well suited to the Salton Sea area. It is envisioned to be located at the downstream end of the IEI near the shore of the Salton Sea, a rural area with relatively low land costs. And it would use a treatment process with relatively low energy requirements and overall operational costs.

The TF could be developed as a separate facility from the “habitat complex” included in the various Salton Sea restoration plan alternatives described above, or it could be part of a combined habitat complex facility. In the latter case, the IEI flows could provide a reliable water supply to the habitat complex, and the wetland plant and aquatic life communities of the habitat complex could be designed for the combined TSS and BOD mass loads associated with the Coachella Valley flows and the IEI flows.

It should be noted that the TF, if needed, would represent a substantial portion of the cost of implementation of the proposed IEI. If further study or design development for the proposed IEI is performed, those efforts should include more detailed investigation and analysis of the specific water quality characteristics of the projected IEI flows, of the water quality standards established in the Basin Plan, of water quality projections for the Salton Sea, of the influence of Salton Sea restoration planning on the design of the proposed IEI and associated treatment facility.

Salinity (TDS) Impacts

Though the projected concentrations of TDS in the IEI flows (up to 6,800 mg/L) are much lower than existing TDS concentrations in the Sea (approximately 48,000 mg/L), the salts in the IEI flows would add to the existing rate of accumulation of salts in the Sea. Whether the salts in the IEI flows would cause the TDS concentrations in the Sea to increase will depend on factors beyond the scope of the project, such as the magnitude of the Salton Sea water budget imbalance over time and progress (if any) toward implementation of a Salton Sea restoration plan.

As discussed above in this TM 3.3, a brine pool has been proposed as part of the various Salton Sea restoration plan alternatives. If implemented, this brine pool would offer a reasonable solution to the increased salt loads in the Salton Sea resulting from the proposed IEI flows. Salts from the IEI flows could accumulate in the brine pool along with the other salts entering the Sea reaching super-saturated levels. The salts would precipitate from the water column under those super-saturated conditions and accumulate in the bottom sediments. However, as noted previously, implementation of a Salton Sea restoration plan and the associated brine pool has been impeded by the estimated costs.

Treatment processes used to reduce TSS and BOD concentrations in water are not effective at significantly reducing TDS concentrations (removal of salt). If removal of salt from IEI flows (separate from the brine pool) were deemed necessary to reduce or mitigate for accumulation in the Salton Sea of that salt, then this treatment could best be accomplished using a separate process.

An evaporation pond facility (EPF) is discussed in Appendix C of this TM 3.3 as an alternative approach to remove salt. This EPF could serve in lieu of the brine pool as a treatment mechanism to remove salts attributable to the IEI flows from the Salton Sea.

It should be noted that (like the TF discussed above) the EPF, if needed, would represent a substantial portion of the implementation cost of the proposed IEI. If further study or design development for the proposed IEI is performed, those efforts should include more detailed investigation and analysis of the brine characteristics of the projected IEI flows, of the TDS standards in the Basin Plan, of Salton Sea water budget projections, and of the influence of Salton Sea restoration planning on the design of the proposed IEI and associated treatment technologies under consideration.

Economic Development Considerations

The history of economic development in the Santa Ana Watershed demonstrates that brine management infrastructure is a valuable tool for economic development. That history suggests that the proposed IEI also has great potential as a tool for economic development in the San Gorgonio Pass and Coachella Valley areas along the route. Industrial facilities in the upper Santa Ana Watershed are major contributors of flow to the existing Brine Line. If implemented, the proposed IEI would make similar brine management infrastructure available to prospective employers located in the San Gorgonio Pass and Coachella Valley areas.

Implementation of one of the various Salton Sea restoration plan alternatives (or a hybrid of two or more alternatives) could facilitate implementation of the proposed IEI. Conversely, economic development in the San Gorgonio Pass and Coachella Valley areas encouraged by availability of brine disposal infrastructure may facilitate Salton Sea restoration.

Inland Empire Interceptor Alternatives in the Santa Ana Watershed

General Description

As noted above, the proposed IEI would alter the design and operation of the existing Brine Line system in Santa Ana Watershed. The purpose of this section of this report is to describe those modifications to the existing system.

The SAWPA Investigation described four alternative conceptual designs for the portion of the IEI in the upper Santa Ana Watershed, identified herein as SAW Alternatives 1 through 4. Three of these (also identified herein as SAW Alternatives 1, 2 and 4) were selected for consideration in this Appraisal Analysis. The specific alignments are generally the same as those developed for the SAWPA Investigation, with only minor differences. If further study or design development for the proposed IEI is performed, those efforts should include resolution of any such differences as a part of selection and refinement of the preferred alignments.

All three SAW Alternatives selected for consideration terminate at a common point in the City of Beaumont at the west end of San Gorgonio Pass. This common point is located near the highest point along the proposed IEI route. The ground elevation at this location is approximately 2,600 feet above mean sea level and more than 2,100 feet above the lowest ground elevation on the route in Santa Ana Watershed, located near Prado Dam (approximately 440 feet above mean sea level). Therefore, pumping of the system flows to the Pass would be necessary and this portion of the proposed IEI would operate under pressure. A pump station, identified herein as PS 1-BL, would be necessary at the beginning point near Prado Dam and the County Line Master Meter. Additional pump stations would be needed for each SAW Alternative. A discussion of each SAW Alternative is presented in the section below entitled “Alignments”.

If further planning and design development for the proposed IEI is performed, a major consideration should be maintenance of service to existing Brine Line customers, including avoiding unnecessary disruptions of service during construction of the project, and minimizing the impact of any unavoidable disruptions of service on the operations of customers. It is likely that maintenance of service considerations would dictate the sequencing of construction of IEI facilities, of connections of those new facilities to the Brine Line, and of any associated modifications to existing Brine Line facilities. The major existing Brine Line facilities would remain largely intact and continue to operate as gravity mains under all three SAW Alternatives under consideration, delivering flows to the proposed pump station PS 1-BL near Prado Dam and near the County Line Master Meter.

If future study or design development for the proposed IEI indicates that economies could be realized by converting existing gravity mains to some alternative use as part of the proposed IEI, then any such conversions should be planned and implemented with appropriate consideration for maintenance of service. Of course, abandonment of the existing Brine Line outfall to OCSD below the proposed pump station PS 1-BL cannot occur until the proposed IEI has been constructed and is fully functional.

Alternative 3 from the SAWPA Investigation was not selected for further consideration in this Appraisal Analysis. This alternative was used to evaluate a conceptual design developed to minimize system pumping costs. Under this alternative, flows would be intercepted at multiple locations as far upstream in the existing gravity system as possible using several pressure mains in a manifold configuration. Compared to the other three alternatives considered, this approach reduced the sizes of pipes and pump stations, but the total length of pipes and the number of pump stations were increased. As a result, the estimated construction costs for Alternative 3 were significantly higher than those of the other alternatives in amounts too great to be offset by the estimated operating cost savings within an acceptable period of time.

Another alternative route via the Borrego Springs area was also briefly considered for this Appraisal Analysis. This alternative was ruled out after only minimal investigation due to substantially greater length and pumping requirements. The Borrego Springs route would be at least 20 miles longer than the proposed IEI alternatives under consideration. The increased pumping requirements result from greater variation of grades along the route and a much larger grade change from the starting point to the high point on the route (approximately 3,800 feet, versus approximately 2,100 feet for the proposed IEI alternatives). These factors would have resulted in significantly larger estimated costs.

Alignments

The three SAW Alternatives considered in this Appraisal Analysis are based upon two Primary Alignments, which are identified as the Gas Main Alignment and the North Alignment. These two Primary Alignments were identified in the SAWPA Investigation by the same designations. They are complemented by various combinations of Secondary Alignments to form the three SAW Alternatives.

The Secondary Alignments are identified as the IEBL Alignment, the EMWD North Alignment, and the IEUA Alignment. The IEBL Alignment corresponds with the segment identified in the SAWPA Investigation as Reach IV-B to Reach IV-D. Because this IEBL Alignment connects to the Primary Alignments at different locations, the portion in the Prado Dam area is split into two segments identified as BL-1a (or IEBL-1a) and BL-1b (or IEBL-1b). The EMWD North Alignment and the IEUA Alignment were identified in the SAWPA Investigation by the same designations.

Exhibits depicting the routes of the two Primary Alignments in plan-view with matching profile of the existing ground elevations along the route are provided in **Appendix A**. The routes of the Primary Alignments are generally described as follows, with associated Exhibits identified:

Gas Main Alignment

This Primary Alignment is used in two of the alternatives considered (SAW Alternatives 1 and 2). It begins at PS 1-BL in the vicinity of the Green River Golf Club maintenance facility near Prado Dam in the Corona area. It runs generally northeast to the west end of Prado Dam, then generally east through Corona, Riverside, Moreno Valley and the hills east of Moreno Valley to the point of termination common with the North Alignment in Beaumont at the west end of San Gorgonio Pass. The Gas Main Alignment considered in this Appraisal Analysis is depicted on **Exhibit 1** in **Appendix A**.

North Alignment

This Primary Alignment is used in only one of the SAW alternatives considered (SAW Alternative 4). It begins at the Chino 1 Desalter north of Prado Dam in the Chino area. It runs generally east through Colton, Redlands and Yucaipa to the point of termination common with the Gas Main Alignment in Beaumont at the west end of San Gorgonio Pass. The North Alignment is depicted on **Exhibit 2** in **Appendix A**.

The three Secondary Alignments are generally described as follows:

IEBL Alignment

This Secondary Alignment is used in all three of the SAW alternatives considered. This alignment was identified in the SAWPA Investigation as the segment from Reach IV-B to Reach IV-D. Because it connects to the Primary Alignments at different locations, it is split into two segments, BL-1a and BL-1b. Segment BL-1a begins at Pump Station PS 1-BL at the proposed point of connection to the existing Brine Line gravity system near the Green River Golf Club maintenance facility near Prado Dam. It runs generally northeast to the west end of Prado Dam, where it either connects to the Gas Main Alignment (SAW Alternative 1 & 2) or continues north as segment BL-1b (SAW Alternative 4). For SAW Alternative 4, segment BL-1b continues north along the west side of the Prado Flood Control Basin to Chino, where it connects with the North Alignment. The IEBL Alignment is depicted on **Exhibit 3** in **Appendix A**.

EMWD North Alignment

This Secondary Alignment is used in only one of the alternatives considered (SAW Alternative 1). This alignment begins at the Menifee and Perris Desalters in the Menifee area. It generally runs north through Sun City and Perris to the Moreno Valley area, where it connects to the Gas Main Alignment. The EMWD North Alignment is depicted on **Exhibit 4** in **Appendix A**.

IEUA Alignment

This Secondary Alignment is used in only one of the alternatives considered (SAW Alternative 4). The IEUA Alignment is a short segment that conveys flows from the Inland Empire Utilities Agency (IEUA) service area east along Kimball Avenue in Chino and connects to a point at the beginning of the North Alignment. The IEUA Alignment is depicted on **Exhibit 5** in **Appendix A**.

As noted previously, if further study or design development for the proposed IEI is performed, those efforts should include a route study to verify the preferred alternative(s) and refine the preferred alignment(s). For example, a portion of the Gas Main Alignment (SAW Alternatives 1 and 2) considered in this Appraisal Analysis is located in the impoundment above Prado Dam. This route may introduce environmental and construction constraints that might be avoided by relocating that portion to the area between the Prado Dam impoundment and the Riverside Freeway (CA 91).

Alternatives Considered

These three SAW Alternatives under consideration in this Appraisal Analysis (SAW Alternatives 1, 2 and 4) are summarized in tabular form, with the plan & profile Exhibit and the length of each associated Primary and Secondary Alignment, in **Table 1** below.

Table 1 – Proposed Santa Ana Watershed Alternatives

Alignment	Plan & Profile Exhibit	SAW Alternative No. with Alignment Length (Feet)		
		1	2	4
Primary Alignments:				
Gas Main	1	228,700	228,700	0
North	2	0	0	278,900
Secondary Alignments:				
IEBL:	3			
BL-1a		12,500	12,500	12,500
BL-1b		0	0	24,000
EMWD North	4	94,100	0	0
IEUA	5	0	0	9,000
Total Length (Ft)		**335,300**	**241,200**	**324,400**

Note: SAW Alternative 3 was not selected for further consideration due to large estimated construction costs.

All three of these SAW Alternatives begin with the IEBL Alignment at proposed pump station PS 1-BL near Prado Dam. Similarly, all three of these SAW Alternatives have a common point of termination in the vicinity of the intersection of S. California Avenue and W. 4th Street in the City of Beaumont in San Gorgonio Pass. This location is common with the point of beginning of both Coachella Valley Alignments discussed in this TM 3.3.

SAW Alternative 1

The combined length of the alignments that comprise SAW Alternative 1 is the greatest of the three alternatives considered. Space within the existing rights-of-way to accommodate major new infrastructure may be limited, especially in the more densely urbanized portions. SAW Alternative 1 has a reasonably continuous grade change from beginning to end. The portion of the Gas Main Alignment in Moreno Valley does "sag" (approximately 150 feet) from the vicinity of I-215 to the hills west of Beaumont, which influenced the designs for the nearest pump stations. The EMWD North Alignment would intercept brine flows from the EMWD service area, reducing flows in that portion of the gravity Brine Line system.

SAW Alternative 2

The combined length of the alignments that comprise SAW Alternative 2 is substantially shorter than the lengths of both SAW Alternatives 1 and 4. Existing right-of-way constraints would be similar to those of SAW Alternative 1, but reduced by the shorter length. SAW Alternative 2, like SAW Alternative 1, has a reasonably continuous grade change from beginning to end, except for the "sag" on the Gas Main Alignment in Moreno Valley.

SAW Alternative 4

SAW Alternative 4 is similar in length to SAW Alternative 1 and substantially longer than that of SAW Alternative 2. Existing right-of-way constraints would likely be similar to those of the other SAW Alternatives. SAW Alternative 4 also has a reasonably continuous grade change from beginning to end with only local "peaks" and "valleys" that had some influence on the locations of pump stations. The North Alignment would intercept brine flows from the existing gravity Brine Line main that generally parallels this alignment (Reaches IV-D and IV-E), reducing flows in those Reaches. Those gravity flows could be captured at the proposed pump stations along this alignment.

Design Flows

Projections of Brine Line flows in the proposed IEI were addressed in TM 3.2 of this Appraisal Analysis, as average flows. The projected average flows used for the conceptual design and hydraulic analysis of each of the three SAW Alternatives under consideration in this Appraisal Analysis match those developed by SAWPA staff in the SAWPA Investigation report [3] discussed previously herein.

A Peak Rate Factor (PRF) of 1.16 was applied to the average flows to calculate the peak flows used to develop the conceptual design for each of the SAW Alternatives and to perform the hydraulic analysis of each. This PRF is the same as that used by CDM in the Salinity Management Program and by SAWPA staff in the SAWPA Investigation report.

Pressure System Design

As noted above, the three SAW Alternatives under consideration would operate under pressure. The highest point along the proposed IEI route is located near the common point of termination of all three SAW Alternatives in the City of Beaumont. The ground elevation at the high point is nearly 2,100 feet above the lowest ground elevation on the IEI route near Prado Dam. Therefore, a series of pump stations is proposed along the alignments of all three SAW Alternatives.

The following considerations were addressed in the development of the conceptual design for each SAW Alternative:

Hydraulic Grade Line

Hydraulic Grade Line (HGL) represents the piezometric head in a fluid conveyance facility, such as the proposed IEI. In the case of the pressurized portion of the proposed IEI in Santa Ana Watershed, the HGL represents the pressure in the pipe. The HGL is determined by various system hydraulic considerations including design flow, pipe size, velocity of flow and associated friction loss, locations and sizes of pump stations, and topography along the alignment.

In a pressurized system running uphill, like the proposed IEI in Santa Ana Watershed, pump stations are used to add energy to the flows, and the HGL resembles a series of steps. Like a stairway in a building, the height of the steps (i.e. the preferred HGL design) should be tailored to the circumstances, within a preferred range (neither too high, nor too short), and the HGL design should match into the elevation of the “landing” at the end of the steps (i.e. the ground elevation at the end of the system).

Operating Pressure

Optimizing the system design includes consideration of the relationship between operating pressures and system construction, maintenance and operational costs. A system designed for low operating pressures would typically require a large number of pump stations with smaller steps to overcome the large elevation change (2,100 feet). An alternative design for the same system with a smaller number of pump stations would typically have larger steps. Larger pumps would be needed at those pump stations to deliver higher operating pressures to overcome those larger steps. Higher operating pressures in the pipeline require pipe materials with correspondingly higher pressure ratings. Higher operating pressures would also tend to increase the construction and operating costs of connections to the pipeline.

The conceptual designs for the three SAW Alternatives were developed with a goal of limiting system operating pressures to minimize construction and operating costs. In general, operating pressures in the SAW Alternatives would range up to 100 psi. However, steep terrain causes substantially greater operating pressures (nearly 300 psi) on the outlet side of certain pump stations in the conceptual design for all three SAW Alternatives. Pipe materials with appropriate pressure ratings must be addressed in the project planning, design and construction.

Pumping Requirements

For all three SAW Alternatives, the location of the first pump station, identified herein as PS 1-BL, coincides with the proposed point of connection to the existing Brine Line gravity system near the County Line Master Meter. The additional pump stations necessary for each alternative were located for this Appraisal Analysis based on system hydraulic considerations. The system design flows and topography along each alignment were the primary considerations in selecting the locations and sizes of these additional pump stations, with the objective of minimizing system operating pressures for the site conditions.

The conceptual designs for pump stations developed for the three SAW Alternatives are based on generalized pump performance curves available in WaterCad using 80% pump efficiency. The pump sizes were calculated using the same methodology used in the SAWPA Investigation.

Pipe Sizes, Velocity of Flow and Friction Losses

Similarly, the system design flows were the primary considerations in selecting the pipe sizes for the IEI, with the objective of establishing appropriate velocities of flow in the pipe. The velocity of pipe flow must be sufficient to help flush the lines and low enough to avoid the need for unnecessarily high system operating pressures or friction losses. Pipe sizes were generally selected to achieve average velocities ranging between 3 feet per second and 4 feet per second. Pipe roughness coefficients were selected based on smooth-walled pipe materials such as cement-lined ductile iron pipe or concrete pipe.

Inland Empire Interceptor Alternatives in San Gorgonio Pass and Coachella Valley

General Description

The SAWPA Investigation did not include a detailed evaluation of the alignment of the proposed IEI through the San Gorgonio Pass and Coachella Valley areas. Therefore, two alternative alignments were developed for this portion for consideration in this Appraisal Analysis. These are identified in this TM 3.3 as Coachella Valley (CV) Alignment A and Coachella Valley (CV) Alignment B. These alignments are depicted on **Exhibits 6** and **7** in **Appendix A**.

The point of beginning of both alignments is in the City of Beaumont, common with the point of termination of the three SAW Alternatives discussed in the previous section of this TM 3.3. And the point of termination common to both alignments is located near the north edge of the Salton Sea. As noted earlier in this TM 3.3, the point of beginning is near the highest point along the proposed IEI route, over 2,800 feet above the current level of the Salton Sea, which is approximately 230 feet below mean sea level. Therefore, both CV Alignments would operate by gravity flow.

The San Gorgonio Pass area is the location of the communities of Beaumont, Banning and Cabazon, and of tribal lands of the Morongo Band of Mission Indians. The area is dominated by major transportation and utility corridors. Land use in the Pass is predominantly low density residential, with some commercial and light industrial uses attracted by the highway and railroad transportation corridors. The east end of the Pass is dominated by expansive fields of wind turbine electrical generators, which extend into the uppermost portion of Coachella Valley.

The Coachella Valley is characterized by two distinct areas, the West Valley and the East Valley. The West Valley, the upper portion, extends from the Palm Springs area eastward to the communities of La Quinta and Indio. Land use in this area is predominately low-density urban, characterized by numerous resort residential golf course communities. The East Valley, the lower portion, extends from the Coachella community southeastward to the Salton Sea. Land use in this area is predominately agricultural.

Though the San Gorgonio Pass and Coachella Valley areas are less densely urbanized than the upper Santa Ana Watershed, alignment opportunities for a major new utility are similarly limited by terrain and existing land use patterns. The proposed CV Alignments were developed with a goal of making the best possible use of likely "paths of least resistance". Therefore, CV Alignment A follows the Coachella Canal for a substantial portion of its length, and CV Alignment B follows the Whitewater River / Coachella Wash Storm Water Channel (CVSC). And, as discussed in TM 3.2 of this Appraisal Analysis, the proposed IEI presents an opportunity for SAWPA to expand the Brine Line service area to include these areas. Therefore, the CV Alignments were also developed with consideration to facilitating future service connections.

If the results of this Appraisal Analysis support further investigation of the proposed IEI, then selection and refinement of the preferred alignment(s) should be included in the scope of subsequent design reports. The preferred alignment through the San Gorgonio Pass and Coachella Valley areas may be a hybrid of both CV Alignments. For example, while CV Alignment B may be preferred in the Coachella Valley area, constraints associated with that alignment in the San Gorgonio Pass area (e.g. proximity to existing electrical power transmission and/or generating facilities) may favor portions of CV Alignment A.

Alignments

Exhibits depicting the routes of the two CV Alignments in plan-view with matching profile of the existing ground elevations along the route are provided in **Appendix A**. The alignments are summarized, with the plan & profile Exhibit and the length of each Alignment, in **Table 2** below:

Table 2 – Proposed Coachella Valley Alignments

Alignment	Plan & Profile Exhibit	CV Alignment Length (Feet)
CV Alignment A	6	448,000
CV Alignment B	7	377,000

The routes of the CV Alignments are generally described as follows, with associated Exhibits identified:

CV Alignment A

CV Alignment A is depicted on **Exhibit 6** in **Appendix A**. It begins at the point of termination of the three SAW Alternatives in the vicinity of the intersection of S. California Avenue and W. 4th Street in the City of Beaumont in the San Gorgonio Pass area. It generally runs east in the 1st Street and Westward Avenue alignments through Beaumont and Banning. Between Banning and Cabazon, it crosses to the north side of I-10, where it runs in or alongside of an existing gas main easement to the Whitewater River area. It then crosses back to the south side of I-10 to the vicinity of N. Indian Canyon Drive in the Palm Springs area, where it crosses once again to the north side of I-10. From there, it continues generally southeast toward the City of Indio where it intersects with the Coachella Canal. It runs southeast alongside of the Coachella Canal to the 60th Avenue alignment north of Mecca, then south in the 60th Avenue alignment to the Whitewater River / Coachella Wash Storm Channel (CVSC) in the vicinity of Salton Sea.

CV Alignment A is approximately 13 miles longer than CV Alignment B. Much of the portion in the San Gorgonio Pass area, is located in areas that are somewhat more rural in character (and possibly less encumbered by existing infrastructure) than CV Alignment B. However, in the Coachella Valley area, the route of CV Alignment A is likely much more constrained than CV Alignment B. For example, available space in the Coachella Canal right-of-way is limited, especially in the more urbanized portions to the north, with numerous potential conflicts with existing irrigation turn-outs, drop structures, drainage crossings and other facilities.

Because the Coachella Canal delivers water to Coachella Valley in the direction opposite of the proposed direction of flow in the proposed CV Alignment A, the pipe slope for this portion of CV Alignment A is adverse to existing grade. And, because the elevation of the Canal is above adjoining areas of Coachella Valley, CV Alignment A would also typically be above future direct service connections in the Valley.

Therefore, prospective future Brine Line customers would need either to pump their flows to connect to the proposed IEI at the nearest possible location or to extend their service line some distance downstream to make a gravity connection.

CV Alignment B

Like CV Alignment A, CV Alignment B begins in the vicinity of the intersection of S. California Avenue and W. 4th Street in the City of Beaumont in the San Gorgonio Pass area. It generally runs east in the unimproved frontage road alignment between the south side of I-10 and the north side of the Union Pacific Railroad (UPRR) to the vicinity of S.R. 111. It continues to run alongside of the UPRR to N. Indian Canyon Drive in the Palm Springs area, then south to the CVSC. It then follows the CVSC corridor to the vicinity of Salton Sea. CV Alignment B is depicted on **Exhibit 7** in **Appendix A**.

As noted above, the length of the proposed CV Alignment B is substantially shorter than that of CV Alignment A. The portion of CV Alignment B in the Coachella Valley area is located in the Whitewater River / CVSC right-of-way, which is wide with few longitudinal constraints. CVWD staff has indicated to Reclamation representatives that space could be made available in the south side of that right-of-way for the proposed IEI. The proposed IEI would need to be constructed with minimum cover of 20 feet due to the potential for scour during major storm events, and encasement or rock matting may be necessary. Portions of that facility are located on tribal lands in easements specific to flood conveyance and it would be necessary to obtain additional easement rights. Wetland impacts may influence the IEI design, especially in the southerly (downstream) portion of the CVSD.

Largely because it follows the Whitewater River / CVSC, CV Alignment B has a nearly continuous grade change from beginning to end with minimal "humps" and "sags". And, because the Whitewater River / CVSC is "downhill" from adjoining areas of Coachella Valley, CV Alignment B would also likely be down-gradient from future direct service connections in Coachella Valley. Prospective future Brine Line customers would be more likely able to use gravity connections to the proposed IEI in Alignment B than in Alignment A. Conversely, IEI manhole covers in the Whitewater River / CVSC right-of-way would need to be sealed to prevent infiltration of water in the channel.

Alternatives Considered & Design Flows

Projections of Brine Line flows in the proposed IEI were addressed in TM 3.2 of this Appraisal Analysis, as Average Flows, both with and without projected flows from the potential service area expansion in the San Gorgonio Pass and Coachella Valley areas. For purpose of comparison, conceptual designs were developed for both CV Alignments using both sets of flow projections with Energy Recovery Facilities designed to maintain full pipe flow. The CV Alternatives with flows from the potential Expanded Service Area are identified as A-1 and B-1. The CV Alternatives with flows from only the Existing Service Area are identified as A-2 and B-2.

Each Alignment was also investigated for flows from the potential Expanded Service Area with no Energy Recovery Facilities or other design measures to help maintain full pipe flow. The hydraulic analysis results for these alternatives (using SewerCAD) indicated unacceptably high velocities (greater than approximately 10 feet per second) in numerous pipe segments in the system. These CV Alternatives are identified as A-3 and B-3.

These CV Alternatives and the projected Average Flows for each are summarized in **Table 3** below.

Table 3 – Coachella Valley Alternatives – Average Flows

Alignment	Alternative	Energy Recovery	Service Area	Projected Average Flows at Salton Sea (2060)		
				(MGD)	(gpm)	(cfs)
CV Alignment A	A-1	With	Expanded	75.1	52,150	n/a
	A-2	With	Existing	32.1	22,292	n/a
	A-3	Without	Existing	32.1	n/a	49.7

CV Alignment B	B-1	With	Expanded	75.1	52,150	n/a
	B-2	With	Existing	32.1	22,292	n/a
	B-3	Without	Existing	32.1	n/a	49.7

A Peak Rate Factor (PRF) of 1.16 was applied to the Average Flows tabulated above to calculate the Peak Flows used to develop the conceptual design for each of the CV Alternatives and to perform the hydraulic analysis of each. This PRF is the same as that used by CDM in the Salinity Management Program and by SAWPA staff in the SAWPA Investigation report. The Peak Flows are summarized in **Table 4** on the next page.

Table 4 – Coachella Valley Alternatives – Peak Flows

Alignment	Alternative	Energy Recovery	Service Area	Projected Peak Flows at Salton Sea (2060)		
				(MGD)	(gpm)	(cfs)
CV Alignment A	A-1	With	Expanded	87.4	60,636	n/a
	A-2	With	Existing	37.3	25,937	n/a
	A-3	Without	Existing	37.3	n/a	57.8
CV Alignment B	B-1	With	Expanded	87.4	60,636	n/a
	B-2	With	Existing	37.3	25,937	n/a
	B-3	Without	Existing	37.3	n/a	57.8

Gravity System Design

As noted previously in this TM 3.3, the ground elevation at the highest point along the proposed IEI route is over 2,800 feet above the current level of the Salton Sea. Therefore, the IEI would operate by gravity flow for both CV Alignments under consideration.

Because hydraulic conditions in gravity mains are generally best when the pipes are flowing full, the conceptual IEI designs for both CV Alignments presented in this Appraisal Analysis were developed with full pipe flow as a goal. However, this full pipe flow design goal was made difficult by the large grade change from the San Gorgonio Pass area to the Salton Sea. Pipe slopes were steep in portions of both CV Alignments as a result of this grade change. The initial hydraulic analyses of both CV Alignments revealed that high velocities of flow would occur in the system as a result of those steep pipe slopes that would cause significant operational issues, if allowed to occur.

These high flow velocities represent surplus energy in the system. Various system design adjustments, such as grade adjustments and alternative pipe sizes, were considered when the system hydraulic analyses were being performed in an effort to achieve the desired hydraulic characteristics in the system. Hydraulic analyses of the various designs considered revealed that the level of energy in the system could not be adequately controlled without removing some portion of that energy. Removal of this surplus energy could be accomplished either by dissipating energy or by capturing it for some beneficial use.

Considerations addressed in the development of the conceptual design for each CV Alternative and in performing the system hydraulic analyses of those conceptual designs include the following:

Hydraulic Grade Line

In the case of a gravity system, the hydraulic grade line (HGL) represents the piezometric head in the system. This represents the elevation of the water surface that would be observed in manholes on the system under design flow conditions. The HGL is calculated based on various system hydraulic considerations including design flow, pipe size, pipe elevation and slope, velocity of flow and friction losses. The pipe elevation and slope is largely dictated by the topography along the alignment. For full pipe flow, the preferred HGL design would be above the elevation of the top of the pipe but below ground elevation wherever possible.

Pressure system situations occur where the HGL is above the ground elevation. Pressurized segments are more expensive to construct, operate and maintain than conventional (unpressurized) gravity systems. For such pressurized segments, manholes must be sealed to operate under pressure; pipe must be appropriately pressure-rated; and service connections must be pumped. Therefore, pressurized segments were initially avoided during development of conceptual designs for the IEI. However, the need to control the energy in the system discussed below was assigned a higher priority, and the HGL is typically above ground elevations in segments upstream of the proposed energy recovery facility locations.

Pipe Sizes and Velocity of Flow

Selection of pipe sizes for a gravity system is typically based on design flows and pipe slopes with the objective of achieving the best possible hydraulic characteristics. Optimal hydraulic efficiency typically occurs in gravity mains when the depth of flow is at least 80% of the pipe diameter (for circular pipe). Therefore, the conceptual IEI designs for both CV Alignments were developed with full pipe flow as a goal.

The desired range of velocity of flow in gravity mains is typically great enough to provide flushing of the lines, but low enough to avoid turbulence and scour. Conceptual designs were developed to provide average velocities under full pipe flow conditions in the range between 3 feet per second and 10 feet per second.

Energy Recovery Facilities (Turbine Generators)

As discussed above, hydraulic analyses of the various IEI alternatives considered revealed surplus energy in the flows causing unacceptably high velocities and preventing full pipe flow. The desired hydraulic characteristics could not be achieved without removing energy, which can be accomplished either by restricting the flows to dissipate energy or by capturing the energy for some beneficial use. Both solutions introduce construction and operational costs, which indicates suggests the proposed IEI is a good opportunity to design for energy recovery. Turbine generators could be used to capture the surplus energy to produce electrical power to help offset the cost of pumping the IEI flows in upper Santa Ana Watershed.

Strategic locations were selected for turbine generators based on the system hydraulic characteristics. The HGL in the IEI was allowed to rise above ground elevations upstream of those locations to maximize the available potential energy at the turbine generators. As a result, pipe segments upstream of turbine generators would function as pressure mains with the associated design, construction and operational considerations noted above. The conceptual designs were developed with a goal of limiting operating pressure at the turbine generators to approximately 100 psi. However, higher pressures occur under design conditions in select locations. This design approach is consistent with the hydraulic characteristics of commercially available turbine generators.

Alternative Turbine Generators

Low-head turbine generators have recently been introduced into the energy recovery equipment marketplace. This technology was considered for this Appraisal Analysis as an alternative to the more traditional energy recovery design described above to avoid added costs associated with pressurized pipe segments. Low-head turbine generators could allow placement of turbine generators at more widely distributed and strategic locations along the CV Alignment(s). This would allow more effective distribution of the potential energy capture in the system.

An example of a low-head turbine generator is the "LucidPipe Power System" recently developed by Lucid Energy, Inc. The "LucidPipe Power System" was developed to capture energy from flows in large diameter gravity pipelines. Lucid Energy, Inc. conducted a pilot project in a water pipeline in Riverside, CA belonging to WMWD, a SAWPA member agency, and completed its first commercial installation at Riverside Public Utilities. However, the technical information available for the "LucidPipe Power System" was not sufficient to incorporate this alternative in the conceptual designs or hydraulic analyses, and Lucid Energy, Inc. did not respond to a Reclamation request for additional technical information and cost data. Therefore, this technology was not included among the alternative conceptual designs developed for this Appraisal Analysis.

The potential for reduced construction and operational costs warrants further consideration of available low-head turbine generator technologies. If further study or design development for the proposed IEI is performed, SAWPA may wish to include a more detailed investigation of the technical considerations and costs of available low-head turbine generators. This investigation should consider the durability of low-head turbine generators in response to potential brine scale formation in the proposed IEI.

Brine Scale Formation

Operational issues have been experienced in the existing gravity-flow Brine Line system due to scale formation. The information available from SAWPA regarding this scale formation indicates that it is from both organic and inorganic sources. CDM reported to SAWPA in ***"DRAFT Memorandum, Subject: Santa Ana Regional Interceptor (SARI) Solids Control Alternatives Conceptual***

Costs" [5] dated April 2011, that bench testing of desalination brine samples with no air-to-water contact "did not exhibit the inorganic solids formation seen in the open containers." CDM also reported that it "has been observed with pressurized brine lines operated in Texas and Florida that scale formation can be prevented by maintaining full pipe flows with no air-to-water contact." This information, though inconclusive, suggests that full pipe flow operation in the proposed IEI may help to reduce inorganic scale formation.

However, CDM also noted in the cited memorandum that pressurization "should not be expected to have an impact on formation of organic suspended solids." And the information available from SAWPA on this topic also suggests that organic material represents a large percentage of the suspended solids in the Brine Line flows. Therefore, while full pipe flow may help to reduce scale formation, it should not be expected to prevent it.

Hydraulic Analyses

Background

As discussed previously in this TM 3.3, the various alternatives under consideration were developed for the purpose of comparative analysis, and the purpose of this TM 3.3 is to present the conceptual designs for each alternative under consideration. Hydraulic analysis was a necessary part of development of the conceptual design for each alternative. The hydraulic analyses were used to determine conceptual design components, such as pipe sizes for each segment, locations and sizes of pump stations, locations and sizes of turbine generators, etc.

Methodology

WaterCAD and SewerCAD design software were both used to perform hydraulic analyses and conceptual design for the various alternatives under consideration. WaterCAD and SewerCAD are both marketed by Bentley Systems, Inc. WaterCAD can be used to perform hydraulic analysis and design of pressurized transmission systems, and SewerCAD can be used to perform these tasks for conventional gravity sewer mains.

The highest point along the proposed IEI route is nearly 2,100 feet above the lowest point in the upper Santa Ana Watershed. Each of the three alternatives considered for the portion of the proposed IEI in the upper Santa Ana Watershed would include a series of pump stations to lift flows to the high point in San Gorgonio Pass and would operate as a transmission main under pressure. Therefore, WaterCAD was used to perform the hydraulic analysis and design for all three SAW Alternatives.

The highest point along the proposed IEI route is nearly 2,800 feet above the current level of the Salton Sea, which is approximately 230 feet below mean sea level. As discussed previously in this TM 3.3, both alignments considered for the portion of the proposed IEI through San Gorgonio Pass and Coachella Valley would operate by gravity flow. However, as discussed previously herein, for the alternatives for which energy recovery facilities (turbine generators) are proposed, the full pipe flow conditions are the hydraulic equivalent of pressure mains. Therefore, WaterCAD was also used for the hydraulic analysis of the two alternatives for each of the CV Alignments for which turbine generators are proposed (Alternatives A-1, A-2, B-1, and B-2).

For purpose of comparison, hydraulic analyses and conceptual design were performed for a third scenario for each of the two CV Alignments in which turbine generators were **not** used. SewerCAD was used to perform these hydraulic analyses (Alternatives A-3 and B-3). These results are presented to illustrate the need to design for the surplus energy and high velocities of flow in the system. Because of the unacceptably high velocities, CV Alternatives A-3 and B-3 will be given no further consideration in this Appraisal Analysis.

Santa Ana Watershed Alternatives Hydraulic Analyses

A hydraulic analysis was performed in conjunction with development of the conceptual design for each SAW Alternative. The results of the hydraulic analysis for each SAW Alternative considered are presented in **Tables** in **Appendix B**, which are listed in **Table 5** below. The hydraulic grade line (HGL) for the SAW Alternatives are depicted graphically on **Exhibits** in **Appendix B**, which are also listed in **Table 5**.

Table 5 –Santa Ana Watershed Alternatives Hydraulic Analyses

SAW Alternative No.	Hydraulic Analysis Results Table No.	Pump Stations Design Table No.	HGL Profile Exhibit Nos.
1	12	13	8 & 9
2	14	15	10
4	16	17	11, 12 & 13

Note: SAW Alternative 3 was not selected for further consideration due to large estimated construction costs.

Coachella Valley Alternatives Hydraulic Analyses

A hydraulic analysis was performed in conjunction with development of the conceptual design for each alternative for each CV Alignment. The results of the hydraulic analysis for each of the CV Alternatives are presented in **Tables** in **Appendix B**, which are listed in **Table 6** on the next page. The hydraulic grade line (HGL) for the CV Alternatives are depicted graphically on **Exhibits** in **Appendix B**, which are also listed in **Table 6**.

Table 6 – Coachella Valley Alternatives Hydraulic Analyses

CV Alternative No.	Hydraulic Analysis Results Table No.	Energy Recovery Facility Design Table No.	HGL Profile Exhibit Nos.
A-1	18	19	14
A-2	20	21	14 *
A-3	22	N.A.	15
B-1	23	24	16
B-2	25	26	16 *
B-3	27	N.A.	17

* Note: The hydraulic grade line (HGL) profile for CV Alternative A-2 is graphically similar to that of CV Alternative A-1, and the HGL profile for CV Alternative B-2 is graphically similar to that of CV Alternative B-1.

Water Quality Treatment

Background

The water quality issues in the Salton Sea and the associated environmental impacts result primarily from the existing water mass imbalance and accumulation of salts, nutrients and other contaminants. These issues are common among terminal water bodies in arid climates. Several plans have been proposed in recent years for restoration of the Salton Sea [6] [7] [8] [9] in response to the deteriorating water mass imbalance and associated deteriorating water quality. Implementation of these restoration plans has been impeded by the estimated costs.

The Basin Plan [11] was adopted with the intent to “optimize the beneficial uses of state waters within the Colorado River Basin Region of California by preserving and protecting the quality of these waters.” It is clear from the discussion of the Specific Surface Water Objectives for the Salton Sea in the Basin Plan (and various other information sources) that the water quality standards established in the Basin Plan for flows entering the Sea are much higher than the existing and projected conditions in the Sea.

The proposed IEI has the potential to provide significant benefits to the Salton Sea, including delivery of a new reliable source of water to the Salton Sea to help improve the overall Salton Sea water mass balance. Of course, those flows would convey significant concentrations of TSS, BOD and TDS, which would be expected to influence concentrations of dissolved oxygen, bacteria, dissolved oxygen, and other water quality parameters in the Sea for which specific standards are addressed in the Basin Plan. Therefore, management of the TSS, BOD and TDS in the flows is an important consideration in the planning and design of the proposed IEI.

Treatment of the flows to reduce TSS and BOD concentrations could be most effectively accomplished prior to release to the Sea. Wastewater treatment ponds and constructed wetlands are two approaches that are both potentially well suited to the proposed IEI for this purpose. Various combinations of wastewater treatment ponds and constructed wetlands were considered for treatment of the IEI flows for TSS and BOD in this Appraisal Analysis. These alternatives are collectively identified herein as the Inland Empire Interceptor Treatment Facility (TF).

The proposed TF is envisioned to be located at the downstream end of the IEI near the north shore of the Sea. In addition to reducing TSS and BOD concentrations, the TF could trap heavy metals, nitrogen and other undesirable constituents in the IEI flows. It could also help restore fish and wildlife habitat that have been displaced from the Sea as water quality conditions have deteriorated. It could be developed as a separate facility from the "habitat complex" included in the various Salton Sea restoration plan alternatives, or it could be part of a combined habitat complex. The proposed TF is treated as a separate facility in this TM 3.3.

Constructed wetland facilities already exist in Coachella Valley. For example, Valley Sanitary District developed a constructed wetland in the Indio area known as the Coachella Valley Wild Bird Center to provide post-secondary treatment of effluent from the Valley Sanitary District Water Reclamation Facility. Effluent from the Wild Bird Center is discharged to the Whitewater River / CVSC. And the Torres-Martinez Band of Mission Indians has also developed a constructed wetland alongside the Whitewater River / CVSC near the Salton Sea.

Water treatment processes used to reduce TSS and BOD concentrations are not effective at significantly reducing TDS concentrations. Therefore, if removal of salt from IEI flows were deemed necessary to reduce or mitigate for accumulation of salts from the IEI in the Salton Sea, then this treatment could best be accomplished using a separate process.

The brine pool proposed as part of the Salton Sea restoration plan alternatives discussed previously, if implemented, offers a reasonable solution to the increased salt loads in the Salton Sea resulting from the proposed IEI flows. The salts could accumulate in the brine pool, where they could be precipitated under super-saturated conditions.

However, as also noted previously, implementation of a Salton Sea restoration plan and the associated brine pool has been impeded by the estimated costs. Therefore, a salt evaporation pond facility is presented in this TM 3.3 in Appendix C as an alternative approach to remove from the Salton Sea salts attributable to the IEI flows. It could serve as a centralized treatment mechanism for salt removal in lieu of the brine pool.

The discussion in the rest of this section is limited to TSS and BOD considerations.

Effluent Standards

The EPA effluent standards for secondary wastewater treatment cited in the Basin Plan [11] limits TSS and BOD concentrations in flows entering the Salton Sea to 30 mg/L. These EPA effluent standards were promulgated for surface water bodies throughout the U.S. and correspond to a level of water quality much better than existing conditions at the Salton Sea. Thus, the current Basin Plan limits would require treatment of the IEI flows to higher quality than the receiving water body.

In an arid climate like that of the Salton Sea area, water treated to EPA effluent standards would typically have many uses. Water of that quality would typically be valued too highly to justify discharging it to a water body with much lower quality from which it could not be recovered. As a result, the Basin Plan discourages effluent discharges to the Sea that could improve the water mass imbalance. Therefore, if restoration of the Salton Sea is to be encouraged, more flexible standards should be considered for TSS and BOD concentrations in discharges to the Sea.

Under the EPA National Pollutant Discharge Elimination System (NPDES) program, the conditions of a permit may allow concentrations of TSS, BOD and other contaminants in discharges greater than the EPA effluent standards for secondary wastewater treatment. Effluent limitations less restrictive than the EPA effluent standards have been allowed in NPDES permits issued for certain facilities located in Coachella Valley. Average TSS concentrations up to 95 mg/L and monthly average BOD concentrations up to 45 mg/L have been approved.

The Basin Plan includes an amendment process. Amendments to the Basin Plan have been adopted previously for specific circumstances in which discharges to the Sea do not meet the water quality standards established in the Plan. For example, the CRWQCB amended the Basin Plan by adoption of Sedimentation/Siltation Total Maximum Daily Loads (TMDLs) for discharges to the Sea from the Alamo River and the New River. The adopted TMDLs correspond with annual average TSS concentrations of 200 mg/L in those flows, which is a significant increase over the EPA effluent standards cited in the Basin Plan (30 mg/L). Therefore, it seems reasonable to speculate that the CRWQCB may approve an amendment to the Basin Plan to allow discharges from the proposed IEI that would not comply with all applicable water quality standards in the Plan, but would offer substantial offsetting benefits.

IEI effluent standards for TSS and BOD should ultimately be determined based on more detailed investigations and through coordination with other Salton Sea stakeholders. Coordination with other Salton Sea stakeholders could also facilitate collaborative implementation of Salton Sea restoration plan facilities, improved Salton Sea water mass balance, improved Salton Sea water quality, restoration of wildlife habitat, mitigation for IEI environmental impacts, etc.

Constructed Wetlands Description

The US Environmental Protection Agency (EPA) publication entitled ***Manual: Constructed Wetlands Treatment of Municipal Wastewaters*** [10] (CW Manual) describes "the capabilities of constructed wetlands" and "a functional design approach" for treatment of municipal wastewater. It also indicates that a constructed wetland may be used for treatment of industrial effluents. A constructed wetland can perform many of the functions of a conventional wastewater treatment system with low operational and maintenance requirements. A constructed wetland can also provide other benefits, including removal of pathogens, heavy metals (e.g. cadmium, chromium, iron, lead, manganese, selenium and zinc), and nitrogen.

The CW Manual identifies two types of constructed wetland treatment systems: "Free Water Surface" wetland and "Vegetated Submerged Bed" subsurface flow wetland. A Free Water Surface constructed wetland is a shallow wetland, which can utilize either a single zone planted with emergent aquatic plants, or a sequential treatment process with three distinct wetland zone categories.

The proposed Treatment Facility (TF) is envisioned to include a Free Water Surface constructed wetland. A Free Water Surface constructed wetland (FWS CW) uses a sequential treatment process with at least three zones. Each of the three sequential zones performs a specific function in the treatment process as follows:

- Zone 1 is a shallow-water area with floating and emergent vegetation and anaerobic conditions that removes TSS by sedimentation and flocculation. It also removes BOD, heavy metals, pathogens and nitrogen.
- Zone 2 is a deeper open-water area with submergent vegetation that uses sunlight exposure, aeration, digestion, oxidation and reduction to remove BOD and pathogens. It also removes pathogens and suspends new TSS resulting from wetland biological processes.
- Zone 3 is a "polishing compartment", which like Zone 1 is a shallow-water area with floating and emergent vegetation and anaerobic conditions. Zone 3 provides denitrification and removal of the new TSS from Zone 2 by sedimentation and flocculation and, like Zone 1, also provides some removal of BOD and pathogens.

Using the CW Manual [10], a FWS CW can be designed to provide treatment for flows with specific influent concentrations of TSS and BOD for which effluent concentrations would meet or exceed EPA effluent standards (30 mg/L). The Introduction to the CW Manual indicates that constructed wetlands "require large land areas, 4 to 25 acres per million gallons of flow per day." These data suggest that, if a stand-alone FWS CW was used for the proposed TF, the surface area would range in size up to approximately 1,880 acres for the projected average daily flow of 75.1 MGD in Year 2060. This large land area suggests a location in a rural area with relatively low land costs, and the relatively low operational costs and low energy requirements of a CW may help offset costs associated with the large land area.

The conceptual TF design in this Appraisal Analysis would operate by gravity flow to make use of the energy available in the IEI flows. Multiple sets of the sequential series of zones, or "trains", designed to operate in parallel are recommended to accommodate project phasing and to facilitate operational aspects. Multiple trains could also facilitate dispersal of flows to the Sea or to the "habitat complex" at the north end of the Sea proposed in various Salton Sea restoration plans. And extra trains that provide TF capacity greater than the design flows could allow the system to operate without interruption when a train needs to be removed from service for maintenance. The area calculations for the conceptual TF design in this Appraisal Analysis do not include any such extra trains.

Coordination with other Salton Sea stakeholders could facilitate incorporating the proposed FWS CW directly into the "habitat complex" of the Salton Sea restoration plans. Site specific factors that should be taken into consideration in the design of a FWS CW include rates of flow entering the facility, water quality characteristics of flows entering the facility (e.g. TSS and BOD concentrations), topography, climate (e.g. temperature variation, evapotranspiration rates and precipitation), and wildlife activity. The effectiveness of a FWS CW is a function of plant density, and the minimum start-up time is typically at least one growing season to attain sufficient plant density. Mosquito breeding can be managed through development of a balanced ecosystem supplemented, if necessary, by intervention with biological or chemical agents.

Constructed Wetland Pre-treatment

The CW Manual [10] presupposes that wastewater entering a CW has undergone primary or secondary treatment. Primary treatment is a sedimentation process; secondary treatment is a biological process. Like in Zone 1 of a CW, the primary treatment sedimentation process provides effective TSS removal and solids accumulation, which are maximized under low velocity, laminar flow conditions. The maximum projected TSS concentrations in the IEI flows are in excess of 500 mg/L, which is greater than TSS concentrations typically expected in primary treatment effluent. The secondary treatment biological process primarily removes BOD.

Wastewater treatment ponds (also known as stabilization ponds or oxidation ponds) are widely used to perform primary and secondary treatment processes. The TSS concentrations in the IEI flows entering the CW could be reduced by first routing those flows through wastewater treatment ponds. Using wastewater treatment ponds as the first stage of the TF train could improve the effectiveness of the CW and reduce the need for redundancy in the design (thus potentially reducing the overall size of the facility). Therefore, wastewater treatment ponds were included among the conceptual designs developed for the TF for this Appraisal Analysis.

Constructed Wetland Inlet Settling Zone

The bulk of the TSS removal and solids accumulation in a FWS CW occurs during the first 2 days at the influent end of Zone 1. Some accumulation of litter and settled non-degradable solids in that area is likely. Therefore, the CW Manual [10] suggests incorporating an inlet settling zone at the upstream end of Zone 1.

The inlet settling zone would be an open water area deeper than the adjoining emergent wetland area of Zone 1. It would facilitate the initial TSS removal process, distribute the flows into the wetlands, and facilitate access for periodic maintenance (mechanical solids removal). The size of the inlet settling zone suggested in the CW Manual is 10 to 25 percent of the areal size of the CW. Pre-treatment in wastewater treatment ponds would likely fulfill the TSS removal function of the CW inlet settling zone, minimizing the size of the inlet settling zone.

Wastewater Treatment Pond Description

The U.S. Environmental Protection Agency (EPA) publication entitled ***Principles of Design and Operations of Wastewater Treatment Pond Systems for Plant Operators, Engineers and Managers*** [15] (WTP Manual) "provides an overview of wastewater treatment pond systems through the discussion of factors affecting treatment, process design principles and applications, aspects of physical design and construction, effluent total suspended solids (TSS), algae, nutrient removal alternatives and cost and energy requirements." Wastewater treatment ponds can be used alone or in combination with other processes for the treatment of domestic or industrial wastewater to reduce concentrations of TSS and BOD with low operational and maintenance requirements.

The WTP Manual identifies three types of treatment ponds: Anaerobic, Facultative, and Aerobic. The most commonly used treatment pond type is the facultative pond. Facultative Treatment Ponds (FTP) can be either aerobic or anaerobic and, without mechanical aeration, typically has an aerobic layer overlying an anaerobic layer.

As noted previously, the proposed FTP, as conceptually designed for this Appraisal Analysis, would be a part of the TF train located immediately upstream of the inlet settling zone at Zone 1. The primary function of the FTP would be TSS removal and solids accumulation to reduce TSS loading rates in the CW.

Like the CW Manual, the recommended design criteria in the WTP Manual are intended to produce a design for which FTP effluent TSS and BOD concentrations would meet or exceed EPA effluent standards (30 mg/L).

Wastewater Treatment Pond and Constructed Wetland Design Methodologies

The WTP Manual cites the ***Recommended Standards for Wastewater Facilities*** [16] (Ten States Standards) in addressing design methodology and criteria for FTP facilities. The WTP Manual and Ten States Standards identify the primary variables in the design of a FTP as Area Loading Rate (ALR) and detention time or Hydraulic Residence Time (HRT). ALR represents the maximum loading rates of TSS or BOD in a FTP associated with specific effluent concentrations. HRT is the length of time it would take for a water particle to travel through the FTP and is calculated as the ratio of the volume of water in the FTP and the average rate of flow.

The maximum ALR for a FTP varies with temperature, and is greater in warm climates and lower in colder climates. The minimum HRT for a FTP also varies with temperature and is shorter in warm climates and longer in colder climates. For design purposes, intermediate climates are generally identified with average air temperature during the coldest months between 0°C (32°F) and 15°C (59°F). Though the Salton Sea is located in a desert area with high temperatures during summer months, the average temperature during the coldest month is approximately 12°C (54°F), which categorizes the area climate as intermediate.

The ALR and HRT design criteria in both the WTP Manual and the CW Manual were developed to produce conceptual designs for which effluent TSS and BOD concentrations would meet or exceed EPA effluent standards (30 mg/L). These criteria were used for conceptual design of TF alternatives for which either a FTP or a CW would discharge to the Salton Sea. The minimum surface area of a FTP or CW is the larger of the areas calculated separately using ALR and HRT. A multiplier of 1.30 was applied to the calculated FTP and CW surface areas to account for necessary buffers, containment berms, access roads, etc. However, this multiplier was not developed to include extra trains that could provide TF capacity greater than the design flows, which may be desired for operational purposes.

As noted above, the CW Manual presupposes that wastewater entering a CW has undergone primary or secondary treatment. And a FTP can be used alone or in combination with other processes to reduce concentrations of TSS and BOD in wastewater. Therefore, alternative conceptual TF designs were also considered in this Appraisal Analysis for which a FTP would be used to pre-treat IEI flows, followed by treatment in a CW.

The conceptual design of these hybrid treatment facilities was hindered by a lack of available design criteria specific to wastewater treatment ponds operating in series with constructed wetland facilities. This approach was used with the objective of optimizing the properties of both processes to minimize the total area of the TF. Since the CW would provide the level of treatment necessary to meet or exceed EPA effluent standards for TSS and BOD for discharge to receiving waters, it would not be necessary for the FTP discharges to the CW to meet those standards. The WTP Manual presupposes that wastewater treatment ponds could function as stand-alone facilities and produce effluent that would meet or exceed EPA effluent standards. Use of the WTP Manual criteria for conceptual design of the FTP without modifications to account for the subsequent treatment in the CW would result in unnecessary system redundancy.

Therefore, it was necessary to develop “modified” ALR and HRT criteria for design of these hybrid treatment facilities. Specifically, it was necessary to develop “modified” ALR and HRT criteria for FTP design that would result in effluent with concentrations of TSS and BOD higher than EPA effluent standards. The “modified” FTP criteria used for conceptual design of these hybrid TF alternatives were estimated from descriptions in the WTP Manual of facultative wastewater treatment pond performance characteristics and supporting data.

Wastewater Treatment Pond Design Criteria

The ALR for BOD identified in the WTP Manual ranges from 11 to 90 kg/ha per day (9.8 to 80.1 lbs/acre per day) at average flow to meet or exceed EPA effluent standards (30 mg/L). In intermediate climates, the range narrows from approximately 22 to 45 kg/ha per day (19.6 to 40.1 lbs/acre per day). The conceptual TF design calculations for a stand-alone FTP were performed using ALR for BOD of 40 kg/ha per day (35.6 lbs/acre per day).

Neither the WTP Manual nor ***Recommended Standards for Wastewater Facilities*** [16] (Ten States Standards) provide a recommended ALR range for TSS. The conceptual TF design calculations for a stand-alone FTP were performed using ALR for TSS of 30 kg/ha per day (26.8 lbs/acre per day).

The HRT identified in the WTP Manual ranges from 5 to 180 days at average flow. In intermediate climates, the range narrows from approximately 50 days to 90 days. The conceptual TF design calculations for a stand-alone FTP were performed using minimum HRT of 90 days.

The depth of a FTP typically ranges from 0.9 m (3 ft) to 2.4 m (8 ft). An average depth of 8 feet was used for the FTP for this Appraisal Analysis to discourage growth of aquatic vegetation that could impede laminar flow and cause localized increases of velocity of flow. Ten States Standards recommends that a FTP should have at least three cells designed to facilitate both series and parallel operation. The maximum size of a cell should be approximately 16 ha (40 acres).

The ALR for BOD used for FTP conceptual design in hybrid alternatives (in which the FTP would be used to pre-treat IEI flows to the CW) was 80 kg/ha per day (71.3 lbs/acre per day) to achieve approximately 60% BOD removal. The minimum HRT used for FTP conceptual design in hybrid alternatives was 45 days to achieve approximately 80% TSS removal and approximately 44% BOD removal. These design criteria were estimated from discussion of treatment pond performance characteristics and supporting data in the WTP Manual.

As noted above, a multiplier of 1.30 was applied to the calculated FTP surface areas to account for necessary buffers, containment berms, access roads, etc. This multiplier was not developed to include extra trains that could provide FTP capacity greater than the design flows.

Constructed Wetland Design Criteria

The treatment process varies between the three Zones of a CW. Nevertheless, the Area Loading Rates recommended for BOD and TSS in the CW Manual [10] for a stand-alone FWS CW apply system-wide and do not vary by Zone. Similarly, though some seasonal variation in treatment effectiveness can occur in a CW, especially in colder climates, the Area Loading Rates recommended in the CW Manual for BOD and TSS for a stand-alone FWS CW are not specific to climate type or to seasonal factors.

The ALR range for BOD recommended in the CW Manual for a stand-alone FWS CW to treat average flow to meet or exceed EPA effluent standards (30 mg/L) is 40 to 60 kg/ha per day (35.6 to 53.6 lbs/acre per day). The conceptual TF design calculations for FWS CW were performed using 60 kg/ha per day (53.4 lbs/acre per day).

Similarly, the ALR range for TSS recommended in the CW Manual for a stand-alone FWS CW to treat average flow to meet or exceed EPA effluent standards (30 mg/L) is 30 to 50 kg/ha per day (26.8 to 44.5 lbs/acre per day). The conceptual TF design calculations for FWS CW were performed using 50 kg/ha per day (44.5 lbs/acre per day).

The treatment process variations between the three Zones of a CW do influence the recommended HRT in the CW Manual. For the emergent vegetative wetlands of Zones 1 and 3, the CW Manual recommends a maximum HRT of two days at average flow. HRT greater than two days in either Zone is not considered beneficial since the sedimentation and flocculation process has been effectively completed in that time and further removal of soluble constituents would not be expected due to anaerobic conditions in both Zones. For the submergent vegetation and open water surface wetlands of Zone 2, treatment is a function of both detention time and temperature. Algal growth generally starts to occur after two to three days and warmer climates favor short HRT at the low end of that range.

Therefore, the conceptual TF design calculations for a stand-alone FWS CW were performed using the sum of the HRT described for each of the three Zones, or six days.

Zone 2 and Zone 3 may be repeated within a CW treatment train if additional Zone 2 detention time is necessary or desired to achieve the desired level of treatment. If Zone 2 and Zone 3 are repeated, then the total design HRT would increase to include the additional detention time in the repeated Zones.

The CW Manual recommends an outlet collection zone at the downstream end of Zone 3 (similar to the inlet settling zone in Zone 1 discussed above) to collect flows from the shallow, vegetated area for discharge to receiving waters. And, due to the anaerobic conditions that prevail in Zone 3, the CW Manual also recommends incorporating a mechanism for re-aeration of the flows prior to discharge to receiving waters. The greater depth and open water surface of an outlet collection zone could facilitate measures for aerating the flows.

As noted above, a multiplier of 1.30 was applied to the calculated CW surface areas to account for necessary buffers, containment berms, access roads, etc. This multiplier was not developed to include extra trains that could provide CW capacity greater than the design flows.

Constructed Wetland Facility Conceptual Design

Projections of flows in the proposed IEI and of the associated concentrations of BOD and TSS (as well as TDS) were discussed in Technical Memorandum No. 3.2 of this Appraisal Analysis. Projections were developed for the existing SAWPA service area in upper Santa Ana Watershed and for the potential SAWPA service area expansion in the San Gorgonio Pass and Coachella Valley areas.

The projected average flows, the average concentrations of BOD and TSS, and the associated annual BOD and TSS loads from TM 3.2 for Year 2060 are presented in **Table 7** below.

Table 7 – Forecasted 2060 Inland Empire Interceptor BOD & TSS Loads

	Average Flow (2060)	BOD		TSS	
		Concen-tration	Load	Concen-tration	Load
	(MGD)	(mg/L)	(Tons/ Year)	(mg/L)	(Tons/ Year)
Existing SAWPA Service Area	32.1	285	13,942	510	24,937
Potential Coachella Valley Service Area Expansion	43.0	156	10,232	352	23,094
TOTAL	**75.1**	**211**	**24,174**	**420**	**48,031**

Calculations were performed to determine the minimum surface area of a stand-alone Free Water Surface Constructed Wetland (FWS CW) (TF Alternative 1) for the proposed Treatment Facility (TF) to meet or exceed EPA effluent standards (30 mg/L) for the flows and the TSS and BOD loads presented in **Table 7** above. Calculations were also performed to determine the minimum surface area of a stand-alone Facultative Wastewater Treatment Pond (FTP) (TF Alternative 2). These conceptual design calculations were performed for each TF alternative for each ALR and HRT discussed above. The results are summarized in **Table 8** below.

Table 8 – Stand-alone Constructed Wetland (TF Alternative 1) and Stand-alone Facultative Treatment Pond (TF Alternative 2) Discharges Treated to EPA Effluent Standards

	Avg. Flow (2060)	Minimum Surface Area (Acres)					
		Facultative Treatment Pond (2)			Constructed Wetland (1)		
		BOD	TSS	HRT	BOD	TSS	HRT
	(MGD)	ALR = 40 kg/ ha-day	ALR = 30 kg/ ha-day	90 days	ALR = 60 kg/ ha-day	ALR = 50 kg/ ha-day	6 days
Existing SAWPA Service Area	32.1	2,781	6,633	1,463	1,854	3,979	351
Expanded Service Area	**75.1**	**4,822**	**12,774**	**3,424**	**3,215**	**7,665**	**822**

The minimum surface area for either the stand-alone FWS CW (TF Alternative 1) or the stand-alone FTP (TF Alternative 2) for a given flow condition would be the largest calculated area for the given flow. For example, the minimum surface area for a FWS CW to treat the flows from the expanded service area (Alternative 1) would be approximately 7,665 acres or 12 square miles. Alternative designs were developed for consideration based on these results with the objective of optimizing the minimum surface area of the proposed TF.

The results presented in **Table 8** indicated the following:

- Facultative Treatment Pond (FTP) areas are smaller than the comparable FWS CW areas, which is reflective of the higher design area loading rates (ALR) for a FTP.
- Area loading rates (ALR) have a greater influence on the surface area of the proposed TF than hydraulic retention time (HRT).
- The surface area of the proposed TF could be reduced if higher area loading rates could be used.
- The ALR for TSS has a greater influence on the surface area of the proposed TF than the ALR for BOD.

- Because the TSS concentrations are higher and the ALR for TSS is lower than for BOD, TSS is the controlling parameter for determining the surface area of the proposed TF.
- The surface area of the proposed TF could be reduced if TSS concentrations in the flows could be reduced.

An alternative conceptual TF design (TF Alternative 3) was considered for which a FTP would be used to provide limited TSS and BOD removal (pre-treatment) prior to treatment of flows in a FWS CW, which would then discharge to the Salton Sea with TSS and BOD concentrations that would meet or exceed EPA effluent standards. Calculations were performed to determine the minimum surface areas of both the FTP and the FWS CW for this hybrid TF Alternative 3. The results are summarized in **Table 9** below.

Table 9 – Facultative Treatment Pond in Series with Constructed Wetland (TF Alternative 3)
Discharges Treated to EPA Effluent Standards

	Avg. Flow (2060)	Minimum Surface Area (Acres)					
		Facultative Treatment Pond (3.1)			Constructed Wetland (3.2)		
		BOD	TSS	HRT	BOD	TSS	HRT
	(MGD)	ALR = 80 kg/ ha-day	n/a	45 days	ALR = 60 kg/ ha-day	ALR = 50 kg/ ha-day	6 days
Existing SAWPA Service Area	32.1	1,391	n/a	731	1,039	796	351
Expanded Service Area	**75.1**	**2,411**	**n/a**	**1,712**	**1,800**	**1,533**	**822**

The combined minimum surface area for a FTP (2,411 acres) and FWS CW (1,800 acres) operating in series to treat the flows from the expanded service area would be approximately 4,211 acres or nearly 7 square miles. Though large, this hybrid TF area would be significantly less than the area of either a stand-alone FTP or a stand-alone FWS CW as presented in **Table 8**.

As discussed previously in this TM 3.3, the water quality standards in the Basin Plan for discharges to the Salton Sea discourage new flows to the Sea that could contribute to its restoration. This concept gave rise to consideration in this Appraisal Analysis of TF alternatives under which effluent TSS and BOD concentrations would be higher than EPA effluent standards but lower than existing concentrations in the Salton Sea.

One such TF alternative would be a stand-alone FWS CW designed to treat a portion of the IEI flows with the effluent then blended with the balance of the IEI flows to provide discharge with average TSS concentration of approximately 200 mg/L. Calculations were performed to determine the minimum surface areas of the wastewater treatment pond and the constructed wetland for this alternative (TF Alternative 4). The results are summarized in **Table 10** below.

Table 10 – Stand-alone Constructed Wetland Treatment of Partial Flow (TF Alternative 4)
Blended Discharges with 200 mg/L± TSS Concentration

	Avg. Flow (2060)	Minimum Surface Area (Acres)		
		BOD	TSS	HRT
	(MGD)	ALR = 60 kg/ha-day	ALR = 50 kg/ha-day	6 days
Existing SAWPA Service Area	32.1	1,106	2,653	234
Expanded Service Area	**75.1**	**1,641**	**4,560**	**489**

The minimum surface area for the stand-alone FWS CW to provide treatment of partial flows from the expanded service area for blending to produce discharges with average TSS concentration of approximately 200 mg/L (TF Alternative 4) would be approximately 4,560 acres, over 7 square miles. This area is similar to the combined area of a FTP and FWS CW operating in series to meet or exceed EPA effluent standards (TF Alternative 3) as presented in **Table 9**.

TF Alternative 5 was considered to incorporate aspects of TF Alternatives 3 and 4. As in TF Alternative 3, a FTP would be used to provide pre-treatment of partial flows prior to treatment in a FWS CW. As in TF Alternative 4, the partial flows would be blended with the balance of the IEI flows to produce discharges with average TSS concentration of approximately 200 mg/L. Calculations were performed to determine the minimum surface areas of both the FTP and the FWS CW for this hybrid design (TF Alternative 5). The results are summarized in **Table 11** on the following page.

Table 11 – Facultative Treatment Pond in Series with Constructed Wetland Treatment of Partial Flow (TF Alternative 5) Blended Discharges with 200 mg/L+ TSS Concentration

	Avg. Flow (2060)	Minimum Surface Area (Acres)					
		Facultative Treatment Pond (5.1)			Constructed Wetland (5.2)		
		BOD ALR	TSS ALR	HRT	BOD ALR	TSS ALR	HRT
	(MGD)	80 kg/ ha-day	n/a	45 days	60 kg/ ha-day	50 kg/ ha-day	6 days
Existing SAWPA Service Area	32.1	927	n/a	488	693	312	234
Expanded Service Area	**75.1**	**1,434**	**n/a**	**1,019**	**1,071**	**731**	**489**

The combined minimum surface area for a FTP (1,434 acres) and FWS CW (1,071 acres) operating in series to treat the flows from the expanded service area would be approximately 2,505 acres or nearly 4 square miles. Though large, the TF Alternative 5 surface area is significantly less than the areas of the other TF alternatives considered above.

The wide range of the calculated minimum surface areas for the TF alternatives considered suggests that adoption of flexible standards for TSS and BOD concentrations in discharges to the Salton Sea could dramatically affect the size of facilities necessary to treat the proposed IEI flows.

Permit Requirements

Background

The proposed Inland Empire Interceptor (IEI) is located in the upper Santa Ana Watershed and in areas adjacent to the Salton Sea, which is a part of the Colorado River Watershed. The Salton Sea would be the receiving water body for the proposed IEI, and the discharges from the project would be subject to the requirements of the U.S. Clean Water Act and the California Porter-Cologne Water Quality Control Act.

Categories

Various permits, certifications, agreements and other approvals are typically necessary to construct major utility projects like the proposed IEI. These approvals fall into several major categories, which include the following:

- Legal considerations.
- Environmental and drainage permits, certifications and other approvals.
- Rights-of-way and easements acquisition.
- Encroachment permits for existing easements and rights-of-way.
- Land use approvals.
- Construction permits and approvals.

Legal Considerations

Legal considerations would likely include a water rights decision from the State of California under the Porter-Cologne Act regarding the proposed transfer of brine from the Santa Ana Watershed to the Salton Sea. This water rights decision would likely be a significant factor in the review by California Regional Water Quality Control Board, Colorado River Basin Region (CRWQCB) of an amendment to the Colorado River Basin Water Quality Control Plan (Basin Plan) for the proposed IEI.

Environmental and Drainage Approvals

Permits, certifications and other approvals required from federal, state and local governmental entities for environmental and drainage aspects of major utility projects like the proposed IEI typically include reviews and approvals of the project for potential environmental impacts. Federal permits and other approvals that may be required include:

- CWA Environmental Impact Review (EIR) process.
- CWA Section 404 permit(s).

Permits and other approvals that may be required from the State of California include:

- Basin Plan Amendment.
- NPDES permit(s).
- CWA Section 401 Certification(s).
- SWPP permit(s).
- Lake/Streambed Alteration Agreement(s) from California Department of Fish and Game.
- California Endangered Species Act Section 2081 Incidental Take permit(s).

Rights-of-Way and Easements Acquisition

The alignment alternatives considered in this Appraisal Analysis are generally proposed to be located in or adjoining existing transportation, drainage and/or utility corridors (public or private) wherever possible to minimize acquisition costs for easements or right-of-way necessary for the proposed IEI. Some portions of the proposed IEI alignments are located adjoining (but outside of) the existing rights-of-way or easements for existing facilities that are not likely to be compatible with the proposed IEI, including freeways, railroads, gas mains, etc. Acquisition of rights-of-way or easements would be necessary for those portions of the IEI project. Acquisition agreements may be required with governmental entities, sovereign entities, private organizations and/or individuals with ownership interest in lands along the alignments under consideration.

Sovereign entities with land ownership along the proposed alignments include the Morongo Band of Mission Indians and the Torres-Martinez Band of Mission Indians. Both of the proposed CV Alignments cross Morongo Band lands. The preferred location of the proposed TF may be on Torres-Martinez Band lands. There may also be other sovereign entities with ownership interests in lands along the alignments under consideration for this project from whom easements or rights-of-way may need to be acquired.

Encroachment Permits for Existing Rights-of-Way and Easements

As noted above, the alignment alternatives considered in this Appraisal Analysis are generally proposed to be located in or adjoining existing transportation, drainage and/or utility corridors (public or private) wherever possible. Crossings of existing easements or right-of-way for those facilities or other encroachments are certain to be necessary for a project of this type. Appropriate consideration for these crossings will be a necessary part of planning and design for the project.

Encroachment agreements or permits would be required for such crossings other encroachments for the proposed IEI from the public, private and/or sovereign entities with ownership and/or easement rights in any such existing easements or rights-of-way. The encroachment approvals required for this IEI project would likely include:

- Caltrans encroachment permit(s).
- Local governmental entity encroachment permit(s).
- Special district encroachment permit(s).
- UPRR right-of-way encroachment agreement(s).
- Right-of-way or easement encroachment agreement(s) with privately (or publicly) owned utilities, including power companies and gas companies.

Land Use Approvals

Land use approvals would typically be required from local governmental entities for a project of this type, in particular for above-ground facilities, such as pump stations, that would be located on land parcels distinct from public rights-of-way and easements. Land use approvals that may be required from local governmental entities for this IEI project include:

- Comprehensive Plan Amendment(s)
- Zoning Variance(s) and Waiver(s)
- Special Use Permit(s)
- Conditional Use Permit(s)

Construction Permits and Approvals

Various other construction permits and approvals are typically required from local governmental entities and special districts for major utility projects like the proposed IEI. These approvals typically include review of improvement plans and maps.

References

[1] ***Santa Ana Watershed Salinity Management Program, Phase 2 SARI Planning Technical Memorandum***, Camp, Dresser & McKee (CDM), et al for Santa Ana Watershed Project Authority, May 2010.

[2] ***Santa Ana Watershed Salinity Management Program, Summary Report***, CDM, et al for Santa Ana Watershed Project Authority, July 2010.

[3] ***Inland Empire Brine Line Disposal Option Concept Investigation*** (Draft), Santa Ana Watershed Project Authority, October 2011.

[4] ***DRAFT Memorandum, Subject: Santa Ana Regional Interceptor (SARI) Solids Control Alternatives Conceptual Costs***, CDM for Santa Ana Watershed Project Authority, April 1, 2011.

[5] ***Central Arizona Salinity Study, Strategic Alternatives for Brine Management in the Valley of the Sun***, Bureau of Reclamation, January 2010.

[6] ***Restoration of the Salton Sea, Summary Report***, Bureau of Reclamation, September 2007.

[7] ***Salton Sea Species Conservation Habitat Project Draft Environmental Impact Report***, by California Department of Fish and Game and California Department of Water Resources with assistance from Cardno ENTRIX, for U.S. Army Corps of Engineers and California Natural Resources Agency, August 2011.

[8] ***Salton Sea Ecosystem Restoration Program Draft Programmatic Environmental Impact Report***, for California Natural Resources Agency, by California Department of Fish and Game and California Department of Water Resources with assistance from CDM, June 2007.

[9] ***Salton Sea Revitalization & Restoration, Salton Sea Authority Plan for Multi-Purpose Project, Executive Summary***, Salton Sea Authority, June 2006.

[10] ***Manual: Constructed Wetlands Treatment of Municipal Wastewaters***, U.S. Environmental Protection Agency, 1999.

[11] ***Water Quality Control Plan: Colorado River Basin - Region 7***, Colorado River Basin Regional Water Quality Control Board, 2006.

[12] ***Evaporation Pond Sizing with Water Balance and Make-up Water Calculations***, Idaho National Engineering and Environmental Laboratory, Engineering Design File, 2001.

[13] ***Hydrologic Regimen of Salton Sea, California***, U.S. Geological Survey, Professional Paper 486-C, 1966.

[14] ***Membrane Concentrate Disposal: Practices and Regulation***, Desalination and Water Purification Research and Development Program Report No. 69, Bureau of Reclamation, September 2001.

[15] ***Principles of Design and Operations of Wastewater Treatment Pond Systems for Plant Operators, Engineers and Managers***, U.S. Environmental Protection Agency, 2001.

[16] ***Recommended Standards for Wastewater Facilities,*** ("Ten States Standards") Great Lakes Upper Mississippi River Board of State Public Health and Environmental Managers, 1990.

Appendix A – GIS Exhibits

Santa Ana Watershed Alignments

The routes for each of the SAW Alignments are depicted on separate 11” X 17” **Exhibits** in plan-view on GIS base maps with stationing and matching profile of the existing topography along the route. These **Exhibits** are provided as Adobe Acrobat-readable pdf files separate from this TM 3.3 due to the large file sizes, and are identified as follows:

Exhibit 1 – Gas Main Alignment	(6 pages)
Exhibit 2 – North Alignment	(7 pages)
Exhibit 3 – EMWD North Alignment	(3 pages)
Exhibit 4 – IEBL Alignment	(1 page)
Exhibit 5 – IEUA Alignment	(1 page)

Coachella Valley Alignments Exhibits

Like the SAW Alignments, the routes for each of the two CV Alignments are depicted on separate 11” X 17” Exhibits in plan-view on GIS base maps with stationing and matching profile of the existing topography along the route. These Exhibits are provided as pdf files separate from this TM 3.3 due to the large file sizes and are identified as follows:

Exhibit 6 – CV Alignment A (Coachella Canal)	(11 pages)
Exhibit 7 – CV Alignment B (CV Stormwater Channel)	(11 pages)

Appendix B – Conceptual Designs and Hydraulic Analyses Results

Santa Ana Watershed Alternatives

As discussed in the "Hydraulic Analysis" section of this TM 3.3, the results of the hydraulic analysis and the profile of the hydraulic grade line (HGL) for each of the SAW Alternatives considered are summarized in **Tables** and on **Exhibits** provided in this **Appendix B**. **Table 5** from the "Hydraulic Analyses" section of this TM 3.3 is repeated below for convenience.

Table 5 – Santa Ana Watershed Alternatives Hydraulic Analyses

SAW Alternative No.	Hydraulic Analysis Results Table No.	Pump Stations Design Table No.	HGL Profile Exhibit Nos.
1	12	13	8 & 9
2	14	15	10
4	16	17	11, 12 & 13

Note: SAW Alternative 3 was not selected for further consideration due to large estimated construction costs.

Table 12 – SAW Alternative 1 - Summary of WaterCAD Results for Pipe Segments

Pipe Segment Label	Segment Start Station	Pipe Elev. (Start) (ft)	Hydraulic Grade Line (In) (ft)	Pressure (In) (psi)	Segment End Station	Pipe Elev. (End) (ft)	Hydraulic Grade Line (Out) (ft)	Pressure (Out) (psi)	Seg-ment Length (ft)	Pipe Dia. (in)	Flow (gpm)	Velocity of Flow (ft/s)	Headloss Gradient (ft/ft)
IEBL-1a	0 + 02	424.7	590.0	71.6	23 + 21	445.5	587.9	61.6	2,321	42	15,312	3.55	0.00089
IEBL-1b	23 + 21	445.5	587.9	61.6	107 + 24	468.5	580.5	48.4	8,403	42	15,312	3.55	0.00089
IEBL-1c	107 + 24	468.5	580.5	48.4	123 + 51	546.3	579.0	14.2	1,627	42	15,312	3.55	0.00089
IEBL-1d	123 + 51	546.3	579.0	14.2	125 + 84	477.5	578.8	43.8	233	42	15,312	3.55	0.00089
G-1a	125 + 84	477.5	578.8	43.8	286 + 96	543.4	564.5	9.1	16,112	42	15,312	3.55	0.00089
G-1b	286 + 96	543.4	734.5	82.8	650 + 05	693.3	702.3	3.8	36,309	42	15,312	3.55	0.00089
G-2a	650 + 05	693.3	1,102.3	177.2	871 + 17	890.2	1,082.6	83.3	22,112	42	15,312	3.55	0.00089
G-2b	871 + 17	890.2	1,082.6	83.3	947 + 74	1,063.2	1,075.8	5.4	7,657	42	15,312	3.55	0.00089
G-3a	947 + 74	1,063.2	1,355.8	126.8	1020 + 48	1,335.8	1,349.4	5.9	7,275	42	15,312	3.55	0.00089
G-3b	1020 + 48	1,335.8	1,349.4	5.9	1070 + 15	1,095.4	1,345.0	108.0	4,967	42	15,312	3.55	0.00089
G-3c	1070 + 15	1,095.4	1,345.0	108.0	1100 + 00	1,124.3	1,342.3	94.4	2,985	42	15,312	3.55	0.00089
G-4a	1100 + 00	1,124.3	1,712.3	254.8	1167 + 92	1,599.0	1,706.3	46.4	6,792	42	15,312	3.55	0.00089
G-4b	1167 + 92	1,599.0	1,706.3	46.4	1276 + 09	1,690.4	1,696.7	2.7	10,817	42	15,312	3.55	0.00089
G-4c	1276 + 09	1,690.4	1,696.7	2.7	1416 + 07	1,512.5	1,684.3	74.3	13,998	42	15,312	3.55	0.00089
G-4d	1416 + 07	1,512.5	1,684.3	74.3	1750 + 80	1,584.3	1,654.5	30.4	33,473	42	15,312	3.63	0.00089
G-4e	1750 + 80	1,584.3	1,654.5	30.4	1911 + 42	1,570.5	1,649.9	34.3	16,062	54	25,937	3.63	0.00069
G-5a	1911 + 42	1,570.5	1,993.4	183.2	2045 + 50	1,783.0	1,984.1	89.9	13,408	54	25,937	3.63	0.00069
G-5b	2045 + 50	1,783.0	1,984.1	89.9	2070 + 00	1,951.9	1,982.4	13.1	2,450	54	25,937	3.63	0.00069
G-6a	2070 + 00	1,951.9	2,632.4	294.9	2124 + 47	2,490.0	2,628.6	60.0	5,447	54	25,937	3.63	0.00069
G-6b	2124 + 47	2,490.0	2,628.6	60.0	2165 + 65	2,217.8	2,625.8	176.5	4,119	54	25,937	3.63	0.00069
G-6c	2165 + 65	2,217.8	2,625.8	176.5	2348 + 70	2,488.2	2,613.1	54.0	18,305	54	25,937	3.63	0.00069
G-6d	2348 + 70	2,488.2	2,613.1	54.0	2412 + 38	2,576.0	2,608.7	14.1	6,365	54	25,937	3.63	0.00069
EN-1a	0 + 02	1,412.5	1487.5	32.4	126 + 60	1,436.5	1,467.4	13.4	12,660	30	8,650	3.93	0.00159
EN-1b	126 + 60	1,436.5	1,467.4	13.4	300 + 00	1,405.5	1,439.8	14.9	17,353	30	8,650	3.93	0.00159
EN-1c	300 + 00	1,405.5	1,439.8	14.9	440 + 00	1,413.4	1,417.6	1.7	13,986	30	8,650	3.93	0.00159
EN-2a	440 + 00	1,413.4	1,734.0	138.9	800 + 06	1,488.7	1,676.8	81.5	36,006	30	8,650	3.93	0.00159
EN-2b	800 + 06	1,488.7	1,676.8	81.5	871 + 18	1,601.1	1,665.4	27.8	7,178	30	8,650	3.93	0.00159
EN-2c	871 + 18	1,601.1	1,665.4	27.8	941 + 01	1,584.3	1,654.5	30.3	6,917	30	8,650	3.93	0.00159

Note: Segment G-4e Start at Station 1750+80 is the point of connection of EMWD North Alignment (Segment EN-2c End) at Station 941+01.

Table 13 – SAW Alternative 1 - Summary of WaterCAD Results for Pump Stations

Pipe Segment Label	Pump Station Label	P. S. Location (Station)			Pipe Elevation (ft)	Hydraulic Grade Line (In) (ft)	Pressure (In) (psi)	Flow (gpm)	Pump Design Head (ft)	Pump Size (HP)	Hydraulic Grade Line (Out) (ft)	Pressure (Out) (psi)
IEBL-1a	1-BL	0	+	02	424.7	440.0	6.6	15,312	150	725	590.0	71.6
G-1b	1-G	286	+	96	543.4	564.5	9.1	15,312	170	822	734.5	82.8
G-2a	2-G	650	+	05	693.3	702.3	3.8	15,312	400	1,933	1,102.3	177.2
G-3a	3-G	947	+	74	1,063.2	1,075.8	5.4	15,312	280	1,353	1,355.8	126.8
G-4a	4-G	1100	+	00	1,124.3	1,342.3	94.4	15,312	370	1,788	1,712.3	254.8
G-5a	5-G	1911	+	42	1,570.5	1,649.9	34.3	25,937	344	2,812	1,993.4	183.2
G-6a	6-G	2070	+	00	1,951.9	1,982.4	13.1	25,937	650	5,322	2,632.4	294.9
EN-1a	1-EN	0	+	02	1,412.5	1,422.5	4.3	8,650	65	177	1,487.5	32.4
EN-2a	2-EN	440	+	00	1,413.4	1,417.6	1.7	8,650	316	864	1,734.0	138.9

Exhibit 8 - SAW Alternative 1 - Profile of Gas Main & IEBL Alignments

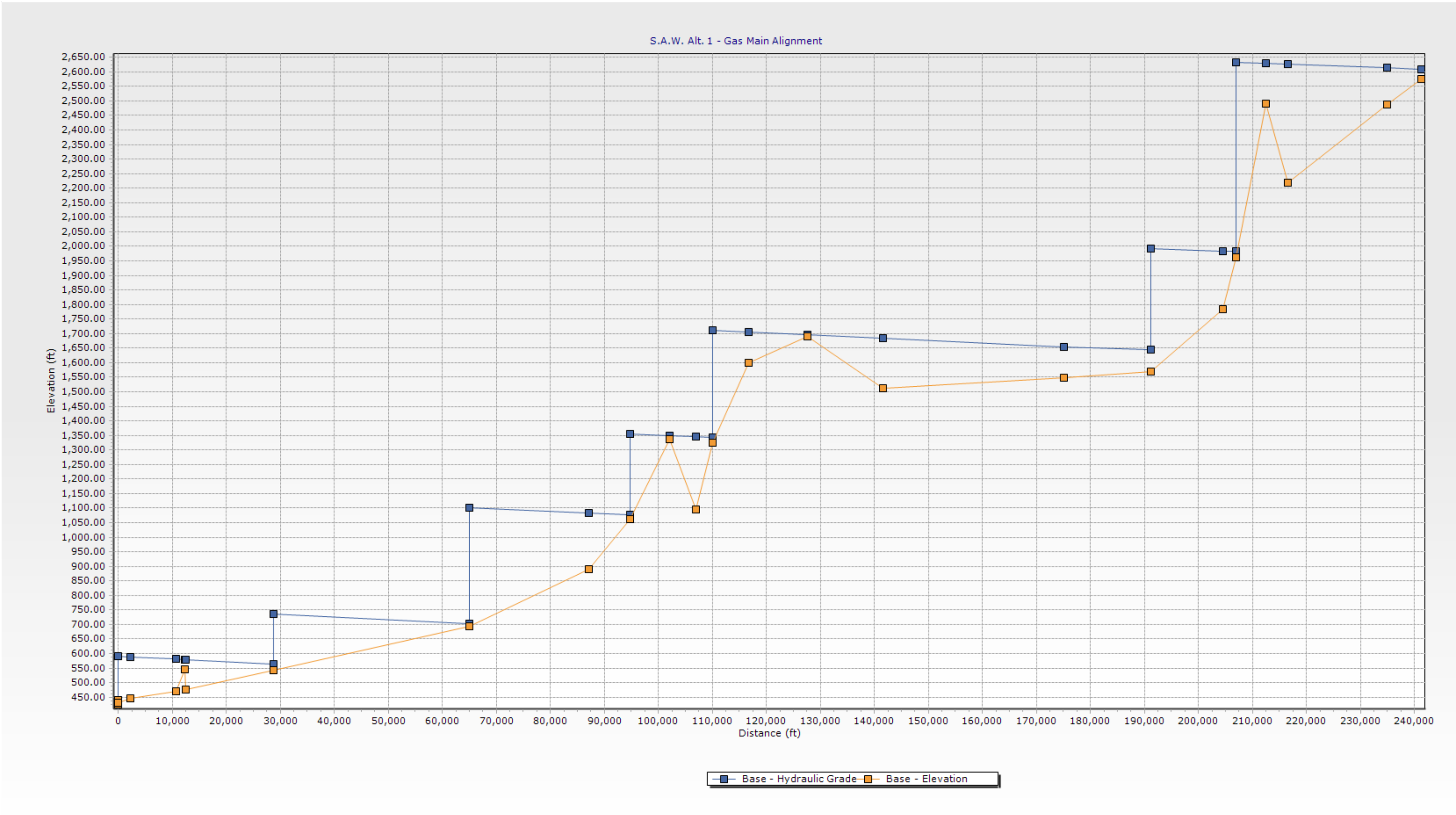


Exhibit 9 - SAW Alternative 1 – Profile of EMWD Alignment

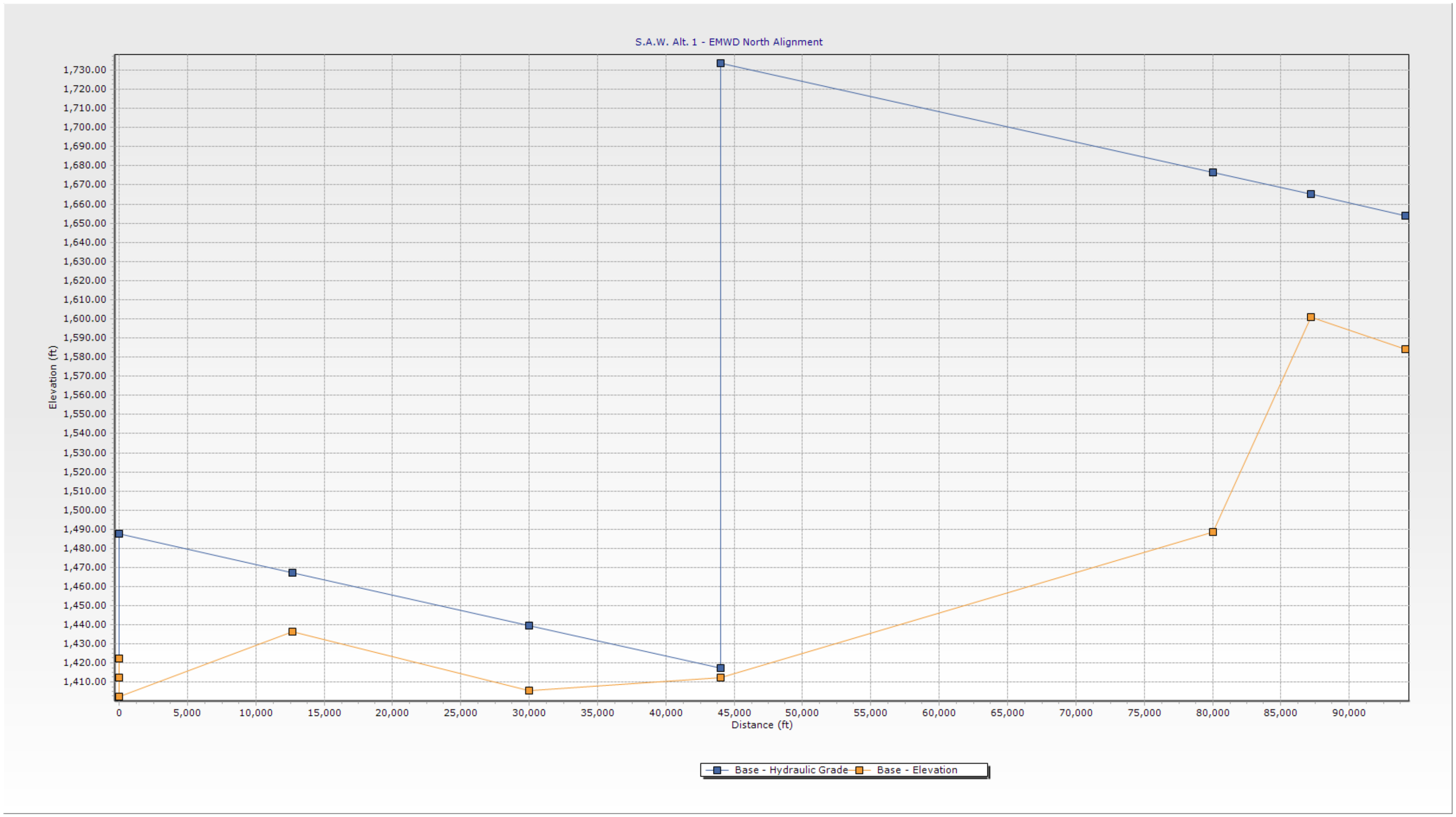


Table 14 – SAW Alternative 2 - Summary of WaterCAD Results for Pipe Segments

Pipe Segment Label	Segment Start Station	Pipe Elev. (Start) (ft)	Hydraulic Grade Line (In) (ft)	Pressure (In) (psi)	Segment End Station	Pipe Elev. (End) (ft)	Hydraulic Grade Line (Out) (ft)	Pressure (Out) (psi)	Seg-ment Length (ft)	Pipe Dia. (in)	Flow (gpm)	Velocity of Flow (ft/s)	Headloss Gradient (ft/ft)
IEBL-1a	0 + 02	424.7	590.0	71.6	23 + 21	445.5	588.4	61.8	2,321	54	25,937	3.63	0.00069
IEBL-1b	23 + 21	445.5	588.4	61.8	107 + 24	468.5	582.6	49.4	8,403	54	25,937	3.63	0.00069
IEBL-1c	107 + 24	468.5	582.6	49.4	123 + 51	546.3	581.4	15.2	1,627	54	25,937	3.63	0.00069
IEBL-1d	123 + 51	546.3	581.4	15.2	125 + 84	477.5	581.3	44.9	233	54	25,937	3.63	0.00069
G-1a	125 + 84	477.5	581.3	44.9	286 + 96	543.4	570.1	11.5	16,112	54	25,937	3.63	0.00069
G-1b	286 + 96	543.4	720.1	76.5	650 + 05	693.3	695.0	0.6	36,309	54	25,937	3.63	0.00069
G-2a	650 + 05	693.3	1,085.0	169.7	871 + 17	890.2	1,069.6	77.6	22,112	54	25,937	3.63	0.00069
G-2b	871 + 17	890.2	1,069.6	77.6	947 + 74	1,063.2	1,064.3	0.4	7,657	54	25,937	3.63	0.00069
G-3a	947 + 74	1,063.2	1,344.3	121.8	1020 + 48	1,335.8	1,339.3	1.5	7,275	54	25,937	3.63	0.00069
G-3b	1020 + 48	1,335.8	1,339.3	1.5	1070 + 15	1,095.4	1,335.9	104.0	4,967	54	25,937	3.63	0.00069
G-3c	1070 + 15	1,095.4	1,335.9	104.0	1100 + 00	1,124.3	1,333.8	90.7	2,985	54	25,937	3.63	0.00069
G-4a	1100 + 00	1,124.3	1,703.8	251.1	1167 + 92	1,599.0	1,699.1	43.3	6,792	54	25,937	3.63	0.00069
G-4b	1167 + 92	1,599.0	1,699.1	43.3	1276 + 9	1,690.4	1,691.6	0.5	10,817	54	25,937	3.63	0.00069
G-4c	1276 + 09	1,690.4	1,691.6	0.5	1354 + 56	1,602.7	1,686.1	36.1	7,848	54	25,937	3.63	0.00069
G-4d	1354 + 56	1,602.7	1,686.1	36.1	1416 + 07	1,512.5	1,681.9	73.3	6,151	54	25,937	3.63	0.00069
G-4e	1416 + 07	1,512.5	1,681.9	73.3	1750 + 80	1,549.7	1,658.7	47.2	33,473	54	25,937	3.63	0.00069
G-4f	1750 + 80	1,549.7	1,658.7	47.2	1911 + 42	1,570.5	1,647.5	33.3	16,062	54	25,937	3.63	0.00069
G-5a	1911 + 42	1,570.5	1,987.5	180.7	2045 + 50	1,783.0	1,978.3	89.9	13,408	54	25,937	3.63	0.00069
G-5b	2045 + 50	1,783.0	1,978.3	89.9	2070 + 00	1,951.9	1,976.6	10.6	2,450	54	25,937	3.63	0.00069
G-6a	2070 + 00	1,951.9	2,631.6	294.5	2111 + 99	2,390.4	2,628.7	103.1	4,199	54	25,937	3.63	0.00069
G-6b	2111 + 99	2,390.4	2,628.7	103.1	2124 + 47	2,490.0	2,627.8	59.6	1,248	54	25,937	3.63	0.00069
G-6c	2124 + 47	2,490.0	2,627.8	59.6	2165 + 65	2,217.8	2,624.9	176.1	4,119	54	25,937	3.63	0.00069
G-6d	2165 + 65	2,217.8	2,624.9	176.1	2348 + 70	2,488.2	2,612.3	53.7	18,305	54	25,937	3.63	0.00069
G-6e	2348 + 70	2,488.2	2,612.3	53.7	2412 + 38	2,576.0	2607.8	13.8	6,365	54	25,937	3.63	0.00069

Table 15 – SAW Alternative 2 - Summary of WaterCAD Results for Pump Stations

Pipe Segment Label	Pump Station Label	P. S. Location (Station)	Pipe Elevation (ft)	Hydraulic Grade Line (In) (ft)	Pressure (In) (psi)	Flow (gpm)	Pump Design Head (ft)	Pump Size (HP)	Hydraulic Grade Line (Out) (ft)	Pressure (Out) (psi)
IEBL-1a	**1-BL**	0 + 02	424.7	440.0	6.6	25,937	150	1,228	590.0	71.6
G-1b	**1-G**	286 + 96	543.4	570.1	11.5	25,937	150	1,228	720.1	76.5
G-2a	**2-G**	650 + 05	693.3	695.0	0.6	25,937	390	3,193	1,085.0	169.7
G-3a	**3-G**	947 + 74	1,063.2	1,064.3	0.4	25,937	280	2,292	1,344.3	121.8
G-4a	**4-G**	1100 + 00	1,124.3	1,333.8	90.7	25,937	370	3,029	1,703.8	251.1
G-5a	**5-G**	1911 + 42	1,570.5	1,647.5	33.3	25,937	340	2,784	1,987.5	180.7
G-6a	**6-G**	2070 + 00	1,951.9	1,988.9	16.0	25,937	655	5,363	2,631.6	294.5

Exhibit 10 - SAW Alternative 2 - Profile of Gas Main & IEBL Alignments

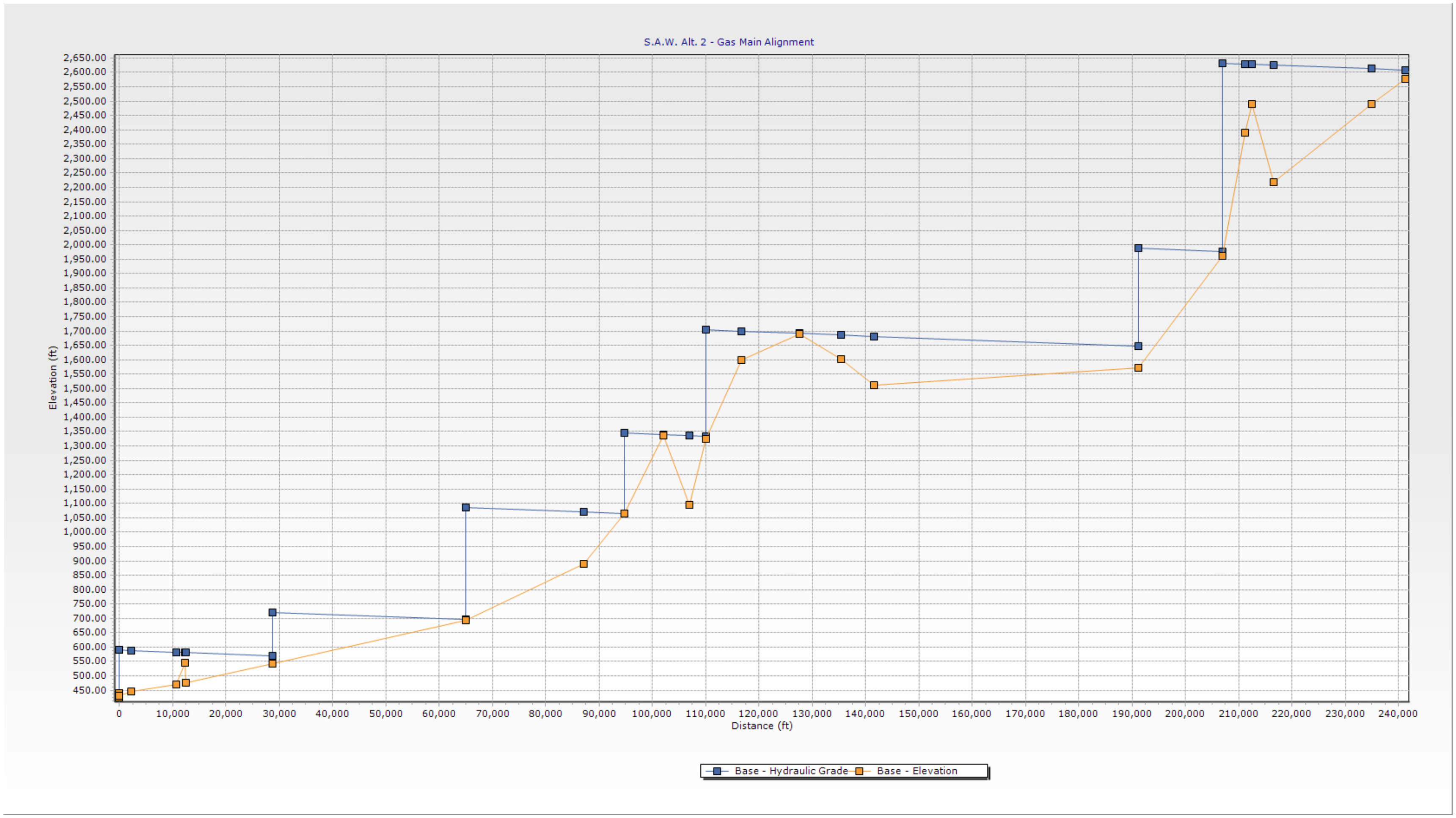


Table 16 – SAW Alternative 4 - Summary of WaterCAD Results for Pipe Segments

Pipe Segment Label	Segment Start Station	Pipe Elev. (Start) (ft)	Hydraulic Grade Line (In) (ft)	Pressure (In) (psi)	Segment End Station	Pipe Elev. (End) (ft)	Hydraulic Grade Line (Out) (ft)	Pressure (Out) (psi)	Seg-ment Length (ft)	Pipe Dia. (in)	Flow (gpm)	Velocity of Flow (ft/s)	Headloss Gradient (ft/ft)
IEBL-1a	0 + 02	424.7	663.3	55.6	23 + 21	445.5	660.9	93.3	2,321	42	15,590	3.61	0.00092
IEBL-1b	23 + 21	445.5	661.9	93.3	107 + 24	468.5	653.2	80.0	8,403	42	15,590	3.61	0.00092
IEBL-1c	107 + 24	468.5	653.2	80.0	123 + 51	546.3	651.7	45.6	1,627	42	15,590	3.61	0.00092
IEBL-1d	123 + 51	546.3	651.7	45.6	125 + 84	477.5	651.4	75.3	233	42	15,590	3.61	0.00092
IEBL-2	125 + 84	477.5	651.4	75.3	365 + 47	548.4	629.8	35.2	23,963	42	15,590	3.61	0.00092
IEUA-1	0 + 01	570.9	640.0	29.9	89 + 99	586.6	639.2	22.8	8,999	16	347	0.55	0.000088
N-1a	0 + 00	586.6	639.2	22.8	54 + 34	548.4	629.8	35.2	5,434	16	1,736	2.77	0.00173
N-1b	54 + 34	548.4	629.8	35.2	60 + 20	539.1	629.1	39.0	586	42	17,326	4.01	0.00112
N-1c	60 + 20	539.1	854.1	136.5	580 + 00	734.4	787.2	22.8	51,980	42	18,715	4.33	0.00129
N-1d	580 + 00	734.4	787.2	22.8	705 + 00	740.2	767.6	11.8	12,500	42	20,798	4.82	0.00157
N-2a	705 + 00	740.2	1,067.6	141.8	715 + 00	754.1	1,066.1	135.2	1,000	42	20,798	4.82	0.00157
N-2b	715 + 00	754.1	1,066.1	135.2	839 + 33	907.6	1,046.0	59.9	12,433	42	21,145	4.9	0.00161
N-2c	839 + 33	907.6	1,046.0	59.9	878 + 75	824.7	1,039.6	93.0	3,942	42	21,145	4.9	0.00161
N-2d	878 + 75	824.7	1,039.6	93.0	1020 + 00	873.8	1,016.8	61.9	14,125	42	21,145	4.9	0.00161
N-2e	1020 + 00	873.8	1,016.8	61.9	1350 + 19	926.4	952.3	11.2	33,019	42	23,437	5.43	0.00195
N-3a	1350 + 19	926.4	1,427.3	217.1	1424 + 00	953.6	1,412.9	199.0	7,381	42	23,437	5.43	0.00195
N-3b	1424 + 00	953.6	1,412.9	199.0	1800 + 16	1,303.8	1,324.2	8.8	37,616	42	25,937	6.01	0.00236
N-4a	1800 + 16	1,303.8	1,824.2	225.5	2020 + 00	1,667.4	1,772.4	45.4	21,984	42	25,937	6.01	0.00236
N-4b	2020 + 00	1,667.4	1,772.4	45.4	2050 + 18	1,758.8	1,770.3	4.9	3,018	54	25,937	3.63	0.00069
N-5	2050 + 18	1,758.8	2,210.3	195.7	2300 + 18	2,174.5	2,193.0	7.9	25,000	54	25,937	3.63	0.00069
N-6a	2300 + 18	2,174.5	2,413.0	103.3	2402 + 87	2,402.3	2,405.9	1.6	10,269	54	25,937	3.63	0.00069
N-6b	2402 + 87	2,402.3	2,405.9	1.6	2498 + 01	2,268.1	2,399.3	56.7	9,514	54	25,937	3.63	0.00069
N-6c	2498 + 01	2,268.1	2,399.3	56.7	2530 + 39	2,339.1	2,397.1	25.0	3,238	54	25,937	3.63	0.00069
N-7	2530 + 39	2,339.1	2,627.1	124.7	2789 + 24	2,576.0	2,609.8	14.6	25,885	54	25,937	3.63	0.00069

Notes: Segment N-1a Start at Station 0+00 is the point of connection of IEUA Alignment (Segment IEUA-1 End) at Station 89+99.
Segment N-1b Start at Station 54+34 is the point of connection of IEBL Alignment (Segment IEBL-2 End) at Station 365+47.

Table 17 – SAW Alternative 4 - Summary of WaterCAD Results for Pump Stations

Pipe Segment Label	Pump Station Label	P. S. Location (Station)			Pipe Elevation (ft)	Hydraulic Grade Line (In) (ft)	Pressure (In) (psi)	Flow (gpm)	Pump Design Head (ft)	Pump Size (HP)	Hydraulic Grade Line (Out) (ft)	Pressure (Out) (psi)
IEBL-1a	**1-BL**	0	+	02	424.7	440.3	6.6	15,590	223	1,097	660.3	55.6
IEUA-1	**1-IE**	0	+	01	570.9	590.0	8.2	347	50	5	640.0	29.9
N-1c	**1-N**	60	+	20	539.1	629.1	39.0	18,715	225	1,329	854.1	136.5
N-2a	**2-N**	705	+	00	740.2	767.6	11.8	20,798	300	1,970	1,067.6	141.8
N-3a	**3-N**	1350	+	19	926.4	952.3	11.2	23,437	475	3,514	1,427.3	217.1
N-4a	**4-N**	1800	+	16	1,303.8	1,324.2	8.8	25,937	500	4,094	1,824.2	225.5
N-5	**5-N**	2050	+	18	1,758.8	1,770.3	4.9	25,937	440	3,602	2,210.3	195.7
N-6a	**6-N**	2300	+	18	2,174.5	2,193.0	7.9	25,937	220	1,801	24,13.0	103.3
N-7	**7-N**	2530	+	39	2,339.1	2,397.1	25.0	25,937	230	1,883	2,627.1	124.7

Exhibit 11 - SAW Alternative 4 - Profile of North Alignment

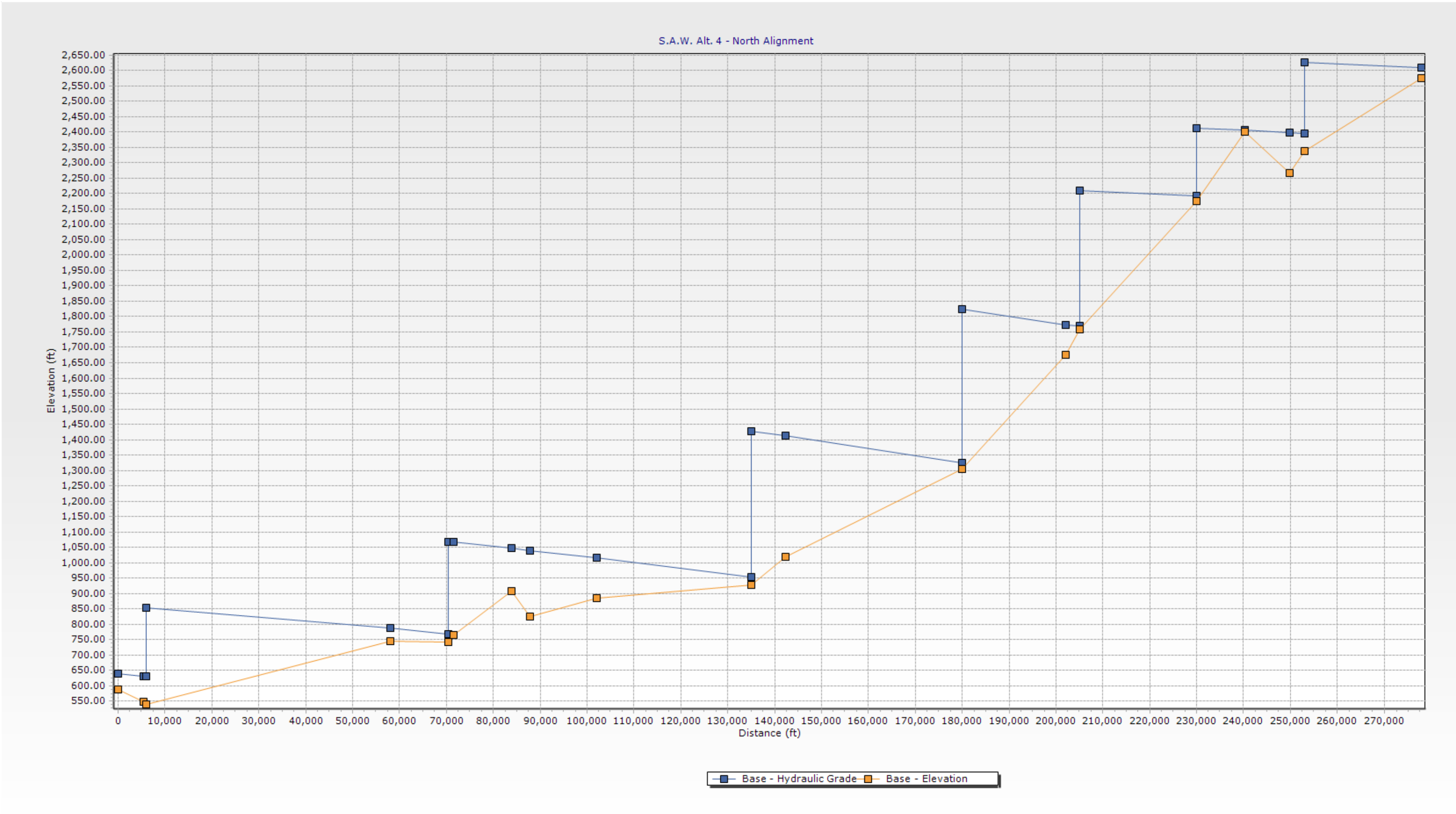


Exhibit 12 - SAW Alternative 4 - Profile of IEBL Alignment

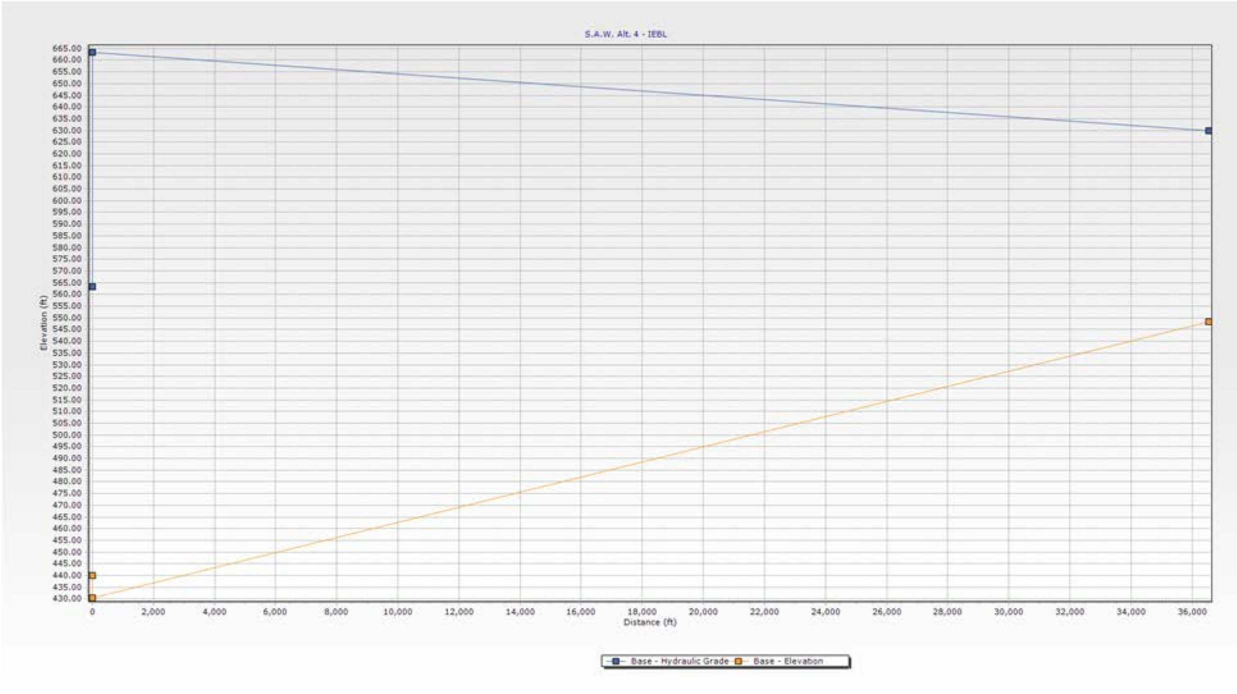
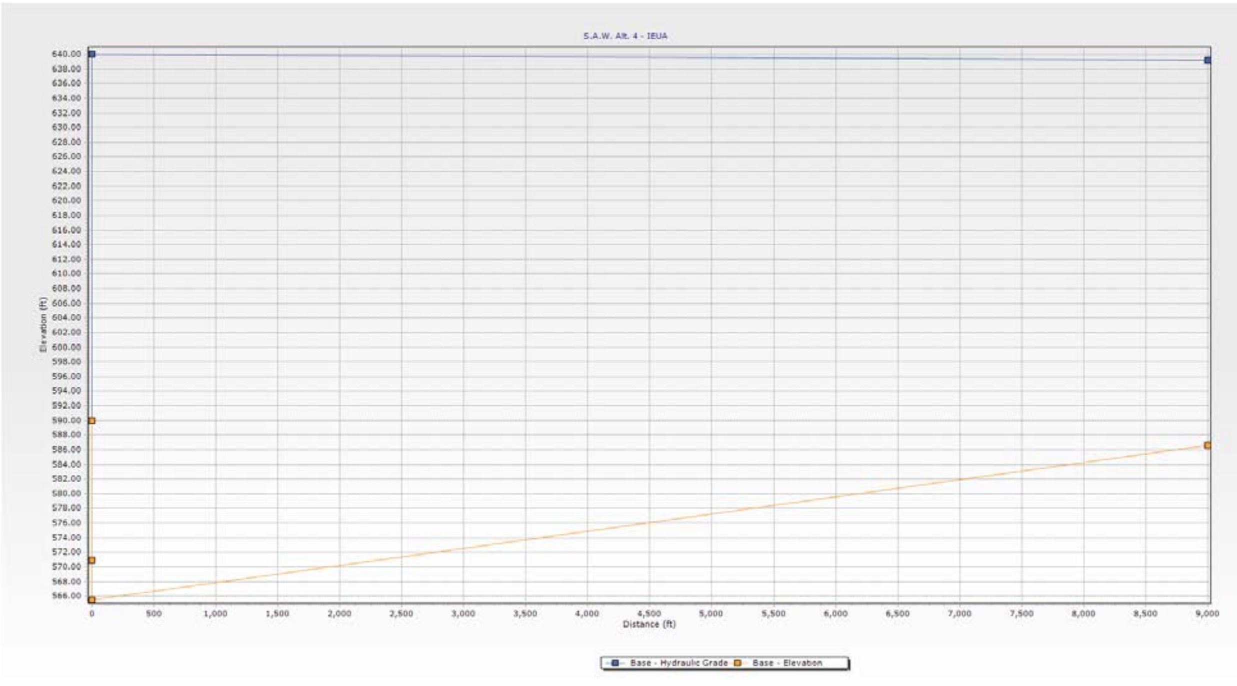


Exhibit 13 - SAW Alternative 4 - Profile of IEUA Alignment



Coachella Valley Alternatives

As discussed in the "Hydraulic Analysis" section of this TM 3.3, the results of the hydraulic analysis and the profile of the hydraulic grade line (HGL) for each of the CV Alternatives considered are summarized in **Tables** and on **Exhibits** provided in this **Appendix B**. **Table 6** from the "Hydraulic Analyses" section of this TM 3.3 is repeated below for convenience.

Table 6 – Coachella Valley Alternatives Hydraulic Analyses

CV Alternative No.	Hydraulic Analysis Results Table No.	Energy Recovery Facility Design Table No.	HGL Profile Exhibit Nos.
A-1	18	19	14
A-2	20	21	
A-3	22	N.A.	15
B-1	23	24	16
B-2	25	26	
B-3	27	N.A.	17

Table 18 – CV Alternative A-1* Summary of WaterCAD Results for Pipe Segments

Start Station	Pipe Elev. (Start) (ft)	Hydraulic Grade Line (Start) (ft)	Pressure (Start) (psi)	End Station	Pipe Elev. (End) (ft)	Hydraulic Grade Line (End) (ft)	Pressure (End) (psi)	Segment Length (ft)	Pipe Dia. (in)	Flow (gpm)	Velocity of Flow (ft/s)	Headloss Gradient (ft/ft)
0 + 00	2,570.0	2,600.0	13.0	47 + 50	2,551.0	2,576.0	10.9	4,750	36	25,937	8.18	0.004994
47 + 50	2,551.0	2,576.0	10.9	272 + 26	2,389.9	2,464.0	32.1	22,476	36	25,937	8.18	0.004994
272 + 26	2,389.9	2,464.0	32.1	781 + 23	1,983.9	2,209.8	97.8	50,897	36	25,937	8.18	0.004994
781 + 23	1,983.9	1,989.8	2.6	929 + 96	1,583.9	1,915.5	143.5	14,873	36	25,937	8.18	0.004994
929 + 96	1,583.9	1,650.5	28.9	1095 + 45	1,385.0	1,567.9	79.2	16,549	36	25,937	8.18	0.004994
1095 + 45	1,385.0	1,492.9	46.7	1136 + 60	1,383.9	1,472.4	38.3	4,115	36	25,937	8.18	0.004994
1136 + 60	1,383.9	1,472.4	38.3	1180 + 00	1,320.5	1,450.7	56.3	4,340	36	25,937	8.18	0.004994
1180 + 00	1,320.5	1,450.7	56.3	1219 + 04	1,210.9	1,431.2	95.3	3,904	36	25,937	8.18	0.004994
1219 + 04	1,210.9	1,431.2	95.3	1258 + 60	1,368.0	1,411.5	18.8	3,956	36	25,937	8.18	0.004994
1258 + 60	1,368.0	1,411.5	18.8	1320 + 00	1,283.9	1,403.9	51.9	6,140	48	25,937	4.60	0.001230
1320 + 00	1,283.9	1,403.9	51.9	1880 + 51	591.1	1,254.2	286.9	56,051	48	39,428	6.99	0.002671
1880 + 51	591.1	654.2	27.3	1982 + 55	584.1	627.0	18.5	10,204	48	39,428	6.99	0.002671
1982 + 55	584.1	627.0	18.5	2827 + 63	84.0	401.3	137.2	84,508	48	39,428	6.99	0.002671
2827 + 63	84.0	261.3	76.7	2960 + 00	47.9	226.1	77.1	13,137	48	39,428	6.99	0.002671
2960 + 00	47.9	226.1	77.1	3120 + 83	-16.0	183.0	86.2	16,083	48	39,428	6.99	0.002671
3120 + 83	-16.0	183.0	86.2	3193 + 17	-17.0	156.7	75.2	9,917	48	39,428	6.99	0.002671
3220 + 00	-17.0	156.7	75.2	3254 + 55	24.1	150.7	54.8	3,455	54	42,509	5.96	0.001730
3254 + 55	24.1	150.7	54.8	3590 + 32	24.0	92.6	29.7	33,577	54	42,509	5.96	0.001730
3590 + 32	24.0	92.6	29.7	4060 + 00	-16.0	11.0	11.6	44,907	54	42,509	5.96	0.001730
4060 + 00	-16.0	11.0	11.6	4302 + 49	-215.7	-55.0	69.4	26,310	54	54,625	7.65	0.002753
4302 + 49	-215.7	-195.0	8.8	4410 + 50	-240.2	-225.0	6.5	11,847	54	54,625	7.65	0.002753
4410 + 50	-240.2	-225.0	6.5	4480 + 00	-240.2	-239.0	0.5	5,904	60	60,636	6.88	0.001999

*** Note:** CV Alternative A-1 represents Alignment A with flows from the potential Expanded Service Area **with** Energy Recovery facilities.

Table 19 – CV Alternative A-1* Summary of WaterCAD Results for Turbine Generators

Turbine Location (Station)	Pipe Inv. Elev. (In) (ft)	Hydraulic Grade Line (In) (ft)	Pressure (In) (psi)	Flow (gpm)	Turbine Head (ft)	Hydraulic Grade Line (Out) (ft)	Pressure (Out) (psi)
781 + 23	1,983.9	2,209.8	97.8	25,937	220.0	1,989.8	2.6
929 + 96	1,583.9	1,915.5	143.5	25,937	265.0	1,650.5	28.9
1095 + 45	1,385.0	1,567.9	79.2	25,937	75.0	1,492.9	46.7
1880 + 51	591.1	1,254.2	286.9	25,937	600.0	654.2	27.3
2827 + 63	84.0	401.3	137.4	39,428	140.0	261.3	76.8
4302 + 49	-215.7	-55.0	69.4	42,509	140.0	-195.0	8.8

*** Note:** CV Alternative A-1 represents Alignment A with flows from the potential Expanded Service Area **with** Energy Recovery facilities.

Exhibit 14 – CV Alternative A-1 Profile

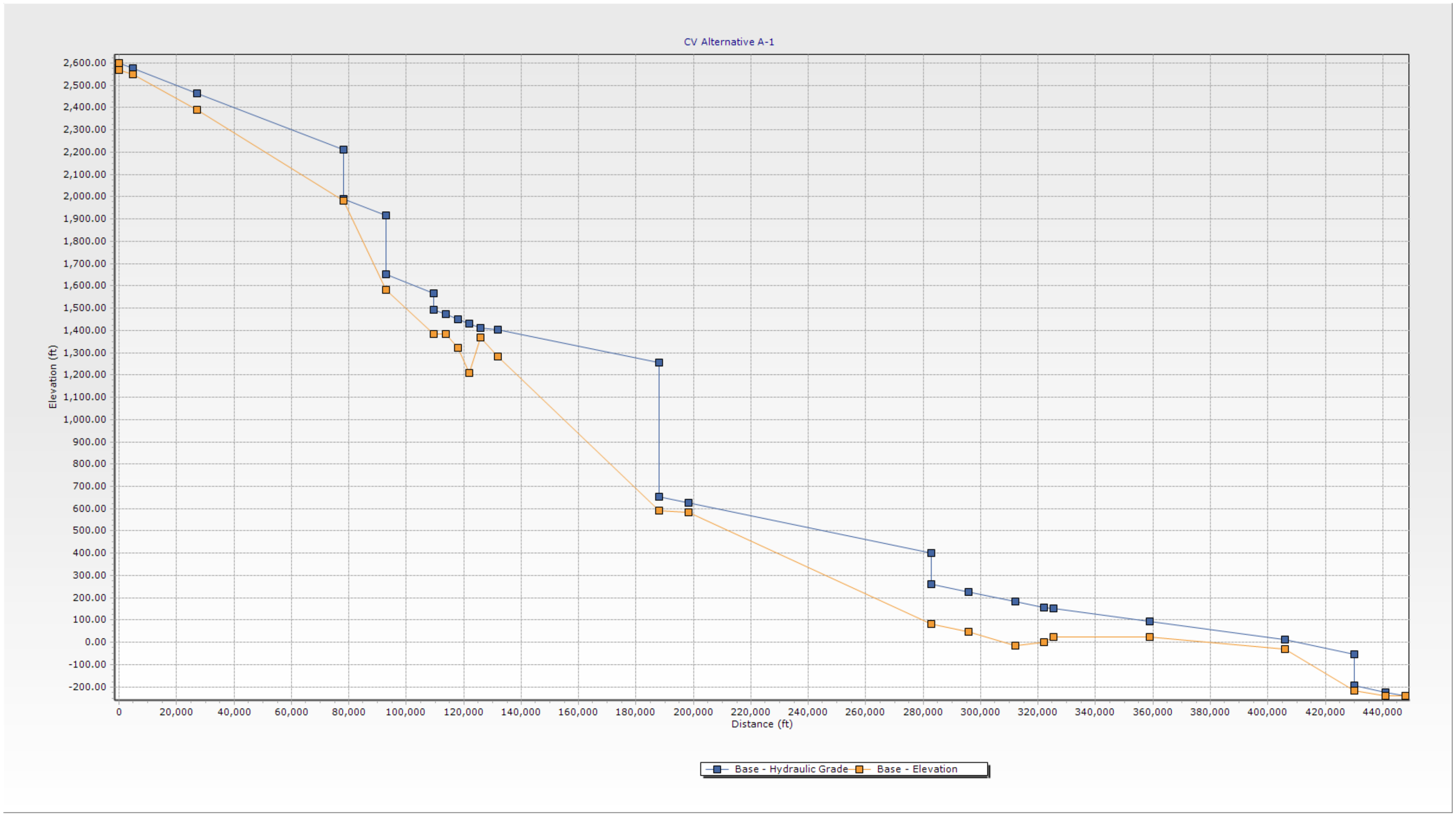


Table 20 – CV Alternative A-2* Summary of WaterCAD Results for Pipe Segments

Start Station	Pipe Elev. (Start) (ft)	Hydraulic Grade Line (Start) (ft)	Pressure (Start) (psi)	End Station	Pipe Elev. (End) (ft)	Hydraulic Grade Line (End) (ft)	Pressure (End) (psi)	Segment Length (ft)	Pipe Dia. (in)	Flow (gpm)	Velocity of Flow (ft/s)	Headloss Gradient (ft/ft)
0 + 00	2,570.0	2,600.0	13.0	47 + 50	2,551.0	2,576.3	10.9	4,750	36	25,937	8.18	0.004994
47 + 50	2,551.0	2,576.3	10.9	272 + 26	2,389.9	2,464.0	32.1	22,476	36	25,937	8.18	0.004994
272 + 26	2,389.9	2,464.0	32.1	781 + 23	1,983.9	2,209.8	97.8	50,897	36	25,937	8.18	0.004994
781 + 23	1,983.9	2,009.8	11.2	929 + 96	1,583.9	1,935.5	152.2	14,873	36	25,937	8.18	0.004994
929 + 96	1,583.9	1,595.5	5.0	1095 + 45	1,385.0	1,512.9	55.4	16,549	36	25,937	8.18	0.004994
1095 + 45	1,385.0	1,452.9	29.3	1136 + 60	1,383.9	1,432.4	21.0	4,115	36	25,937	8.18	0.004994
1136 + 60	1,383.9	1,432.4	21.0	1180 + 00	1,320.5	1,410.7	39.0	4,340	36	25,937	8.18	0.004994
1180 + 00	1,320.5	1,410.7	39.0	1219 + 04	1,210.9	1,391.2	78.0	3,904	36	25,937	8.18	0.004994
1219 + 04	1,210.9	1,391.2	78.0	1258 + 60	1,368.0	1,371.5	1.5	3,956	36	25,937	8.18	0.004994
1258 + 60	1,368.0	1,371.5	1.5	1340 + 76	1,283.9	1,330.5	20.1	8,216	36	25,937	8.18	0.004994
1340 + 76	1,283.9	1,330.5	20.1	1880 + 51	591.1	1,060.9	203.3	53,975	36	25,937	8.18	0.004994
1880 + 51	591.1	620.9	12.9	1982 + 55	584.1	596.9	5.5	10,204	36	25,937	8.18	0.004994
1982 + 55	584.1	596.9	5.5	2233 + 83	284.3	537.7	109.6	25,128	42	25,937	6.01	0.002357
2233 + 83	284.3	477.7	83.8	2827 + 63	84.0	337.7	109.9	59,380	42	25,937	6.01	0.002357
2827 + 63	84.0	337.7	109.9	2960 + 00	47.9	306.7	112.0	13,137	42	25,937	6.01	0.002357
2960 + 00	47.9	306.7	112.0	3120 + 83	-16.0	268.8	123.2	16,083	42	25,937	6.01	0.002357
3120 + 83	-16.0	268.8	123.2	3193 + 17	-17.0	251.8	116.3	7,234	42	25,937	6.01	0.002357
3193 + 17	-17.0	251.8	116.3	3254 + 55	24.1	237.3	92.2	6,138	42	25,937	6.01	0.002357
3254 + 55	24.1	237.3	92.2	3590 + 32	24.0	158.0	58.1	33,577	42	25,937	6.01	0.002357
3590 + 32	24.0	158.0	58.1	3854 + 61	10.4	96.0	37.0	26,429	42	25,937	6.01	0.002357
3854 + 61	10.4	96.0	37.0	3967 + 40	49.1	69.0	8.7	11,279	42	25,937	6.01	0.002357
3967 + 40	49.1	69.0	8.7	4302 + 49	-215.7	-10.0	89.1	33,509	42	25,937	6.01	0.002357
4302 + 49	-215.7	-150.0	28.4	4420 + 96	-240.2	-178.0	27.1	11,847	42	25,937	6.01	0.002357
4420 + 96	-240.2	-178.0	27.1	4480 + 00	-240.2	-191.5	21.1	5,904	42	25,937	6.01	0.002357

*** Note:** CV Alternative A-2 represents Alignment A with flows from the Existing Service Area **with** Energy Recovery facilities.

Table 21 – CV Alternative A-2* Summary of WaterCAD Results for Turbine Generators

Turbine Location (Station)	Pipe Inv. Elev. (In) (ft)	Hydraulic Grade Line (In) (ft)	Pressure (In) (psi)	Flow (gpm)	Turbine Head (ft)	Hydraulic Grade Line (Out) (ft)	Pressure (Out) (psi)
781 + 23	1,983.9	2,209.8	97.8	25,937	200.0	2,009.8	11.2
929 + 96	1,583.9	1,935.5	152.2	25,937	340.0	1,595.5	5.0
1095 + 45	1,385.0	1,512.9	55.4	25,937	60.0	1,452.9	29.3
1880 + 51	591.1	1,060.9	203.3	25,937	440.0	620.9	12.9
2827 + 63	284.3	537.7	109.6	25,937	60.0	477.7	83.8
4302 + 49	-215.7	-10.0	89.1	25,937	140.0	-150.0	28.4

*** Note:** CV Alternative A-2 represents Alignment A with flows from the Existing Service Area **with** Energy Recovery facilities.

Table 22 – CV Alternative A-3* Summary of SewerCAD Results for Pipe Segments (Sheet 1 of 3)

Start Station			Ground Elev. (Start) (ft)	Pipe Inv. Elev. (Start) (ft)	Hyd. Grade Line (Start) (ft)	Depth of Flow (Start) (in)	End Station			Ground Elev. (Stop) (ft)	Pipe Inv. Elev. (Stop) (ft)	Hyd. Grade Line (Stop) (ft)	Depth of Flow (Stop) (ft)	Pipe Length (ft)	Pipe Slope (ft/ft)	Pipe Dia. (in)	Flow (cfs)	Average Velocity (ft/s)	Capacity (Full Flow) (cfs)
0	+	00	2,586.0	2,570.0	2588.5	42	9	+	63	2,564.7	2,548.7	2,585.4	42	963	0.022	42	57.76	6.0	149.6
9	+	63	2,564.7	2,548.7	2585.4	42	16	+	45	2,575.3	2,559.3	2,583.1	42	682	-0.016	42	57.76	6.0	-125.4
16	+	45	2,575.3	2,559.3	2583.1	36	33	+	32	2,583.7	2,567.7	2,570.2	30	1,686	-0.005	36	57.76	8.2	-47.1
33	+	32	2,583.7	2,567.7	2570.2	30	47	+	52	2,611.4	2,550.0	2,552.6	31	1,420	0.012	36	57.76	11.6	74.5
47	+	52	2,611.4	2,550.0	2552.6	31	213	+	85	2,499.7	2,483.7	2,486.2	30	16,634	0.004	42	57.76	7.5	63.5
213	+	85	2,499.7	2,483.7	2486.2	30	272	+	26	2,405.9	2,391.0	2,392.8	22	5,840	0.016	36	57.76	12.8	84.0
272	+	26	2,405.9	2,391.0	2393.4	29	283	+	41	2,426.2	2,385.0	2,387.5	30	1,115	0.005	42	57.76	8.5	73.8
283	+	41	2,426.2	2,385.0	2387.5	30	384	+	08	2,300.6	2,284.6	2,286.8	26	10,068	0.010	36	57.76	10.6	66.6
384	+	08	2,300.6	2,284.6	2287.1	30	463	+	40	2,200.3	2,184.3	2,186.3	24	7,931	0.013	36	57.76	11.7	75.0
463	+	40	2,200.3	2,184.3	2186.8	30	518	+	05	2,100.3	2,084.3	2,087.5	36	5,465	0.018	36	57.76	13.5	90.2
518	+	05	2,100.3	2,084.3	2087.5	38	640	+	26	2,079.0	2,063.0	2,066.7	45	12,221	0.002	48	57.76	5.4	60.0
640	+	26	2,079.0	2,063.0	2066.7	45	698	+	23	2,159.2	2,055.0	2,057.5	30	5,797	0.001	48	57.76	4.6	53.4
698	+	23	2,159.2	2,055.0	2057.5	30	781	+	23	1,999.9	1,983.9	1,986.2	28	8,300	0.009	36	57.76	9.9	61.7
781	+	23	1,999.9	1,983.9	1986.3	29	809	+	97	1,899.7	1,883.7	1,885.3	19	2,875	0.035	30	57.76	17.1	76.6
809	+	97	1,899.7	1,883.7	1886.1	29	844	+	81	1,799.7	1,783.7	1,786.2	30	3,483	0.029	30	57.76	15.8	69.5
844	+	81	1,799.7	1,783.7	1786.2	30	897	+	54	1,700.4	1,684.4	1,686.1	21	5,274	0.019	36	57.76	13.7	91.5
897	+	54	1,700.4	1,684.4	1686.9	30	929	+	96	1,599.9	1,583.9	1,585.4	18	3,242	0.031	36	57.76	16.6	117.4
929	+	96	1,599.9	1,583.9	1586.4	30	1047	+	15	1,500.2	1,484.2	1,486.5	28	11,719	0.009	36	57.76	9.9	61.5
1047	+	15	1,500.2	1,484.2	1486.5	27	1095	+	45	1,399.7	1,385.0	1,388.2	39	4,830	0.021	48	57.76	14.1	205.9
1095	+	45	1,399.7	1,385.0	1388.2	39	1125	+	47	1,411.8	1,380.0	1,382.3	27	3,002	0.002	48	57.76	5.3	58.6
1125	+	47	1,411.8	1,380.0	1382.3	27	1136	+	60	1,399.9	1,375.0	1,377.2	27	1,113	0.004	48	57.76	8.0	96.3

*** Notes:**
- CV Alternative A-3 represents Alignment A with flows from the Existing Service Area **without** Energy Recovery facilities.
- Shaded cells for Depth of Flow indicate pipe flowing full.

Table 22 - CV Alternative A-3* Summary of SewerCAD Results for Pipe Segments (Sheet 2 of 3)

Start Station	Ground Elev. (Start) (ft)	Pipe Inv. Elev. (Start) (ft)	Hyd. Grade Line (Start) (ft)	Depth of Flow (Start) (in)	End Station	Ground Elev. (Stop) (ft)	Pipe Inv. Elev. (Stop) (ft)	Hyd. Grade Line (Stop) (ft)	Depth of Flow (Stop) (ft)	Pipe Length (ft)	Pipe Slope (ft/ft)	Pipe Dia. (in)	Flow (cfs)	Average Velocity (ft/s)	Capacity (Full Flow) (cfs)
1136 + 60	1,399.9	1,375.0	1377.3	27	1207 + 88	1,300.6	1,284.6	1,330.8	48	7,128	0.013	48	57.76	11.8	161.8
1207 + 88	1,300.6	1,284.6	1330.8	60	1219 + 04	1,226.9	1,210.9	1,330.3	60	1,116	0.066	60	57.76	2.9	669.3
1219 + 04	1,226.9	1,210.9	1330.3	60	1235 + 27	1,301.1	1,285.1	1,329.5	60	1,623	-0.046	60	57.76	2.9	-556.8
1235 + 27	1,301.1	1,285.1	1329.5	60	1258 + 60	1,384.0	1,325.0	1,328.0	36	2,333	-0.017	60	57.76	2.9	-340.6
1258 + 60	1,384.0	1,325.0	1328.0	36	1273 + 14	1,332.5	1,322.0	1,325.6	43	1,454	0.002	48	57.76	5.9	65.2
1273 + 14	1,332.5	1,322.0	1325.6	43	1289 + 03	1,371.9	1,320.0	1,322.4	29	1,589	0.001	48	57.76	4.6	51.0
1289 + 03	1,371.9	1,320.0	1322.4	29	1340 + 76	1,299.9	1,283.9	1,286.0	26	5,172	0.007	42	57.76	9.4	84.1
1340 + 76	1,299.9	1,283.9	1286.3	29	1378 + 21	1,199.6	1,183.6	1,185.4	21	3,745	0.027	30	57.76	15.4	67.1
1378 + 21	1,199.6	1,183.6	1186.0	29	1415 + 53	1,100.2	1,084.2	1,086.0	21	3,732	0.027	30	57.76	15.3	66.9
1415 + 53	1,100.2	1,084.2	1086.6	29	1458 + 53	1,000.2	984.2	986.6	29	4,301	0.023	30	57.76	14.5	62.5
1458 + 53	1,000.2	984.2	986.6	29	1516 + 10	901.3	885.3	886.9	19	5,757	0.017	42	57.76	13.3	131.9
1516 + 10	901.3	885.3	887.7	29	1568 + 22	799.8	783.8	785.4	19	5,212	0.019	42	57.76	13.9	140.4
1568 + 22	799.8	783.8	786.1	27	1721 + 23	700.1	684.1	686.1	24	15,301	0.007	48	57.76	9.2	115.9
1721 + 23	700.1	684.1	686.4	27	1880 + 51	607.1	591.1	594.6	42	15,929	0.006	48	57.76	8.9	109.8
1880 + 51	607.1	591.1	594.6	42	1945 + 98	694.6	585.0	587.6	32	6,547	0.001	54	57.76	4.3	60.0
1945 + 98	694.6	585.0	587.6	32	1982 + 55	600.1	575.0	577.5	30	3,657	0.003	48	57.76	6.6	75.1
1982 + 55	600.1	575.0	577.5	30	2058 + 76	500.2	484.2	486.2	24	7,622	0.012	36	57.76	11.4	72.8
2058 + 76	500.2	484.2	486.7	30	2181 + 55	400.9	384.9	387.3	28	12,279	0.008	36	57.76	9.7	60.0
2181 + 55	400.9	384.9	387.4	30	2233 + 83	300.3	284.3	286.0	21	5,228	0.019	36	57.76	13.8	92.5
2233 + 83	300.3	284.3	286.5	27	2450 + 90	200.0	184.0	186.1	25	21,707	0.005	54	57.76	8.1	133.7
2450 + 90	200.0	184.0	186.2	26	2827 + 63	100.0	84.0	86.1	25	37,673	0.003	66	57.76	6.6	173.0

*** Notes:** - CV Alternative A-3 represents Alignment A with flows from the Existing Service Area **without** Energy Recovery facilities.
- Shaded cells for Depth of Flow indicate pipe flowing full.

Table 22 - CV Alternative A-3* Summary of SewerCAD Results for Pipe Segments (Sheet 3 of 3)

Start Station	Ground Elev. (Start) (ft)	Pipe Inv. Elev. (Start) (ft)	Hyd. Grade Line (Start) (ft)	Depth of Flow (Start) (in)	End Station	Ground Elev. (Stop) (ft)	Pipe Inv. Elev. (Stop) (ft)	Hyd. Grade Line (Stop) (ft)	Depth of Flow (Stop) (ft)	Pipe Length (ft)	Pipe Slope (ft/ft)	Pipe Dia. (in)	Flow (cfs)	Average Velocity (ft/s)	Capacity (Full Flow) (cfs)
2827 + 63	100.0	84.0	86.1	25	3120 + 83	0.0	-16.0	36.8	66	29,320	0.003	66	57.76	7.2	196.1
3120 + 83	0.0	-16.0	36.8	72	3193 + 17	-1.0	-17.0	35.4	72	7,234	0.000	72	57.76	2.0	49.8
3193 + 17	-1.0	-17.0	35.4	72	3254 + 55	40.1	24.1	34.3	72	6,138	-0.007	72	57.76	2.0	-346.5
3254 + 55	40.1	24.1	34.3	72	3590 + 32	40.0	24.0	27.8	45	33,577	0.000	72	57.76	2.0	0.0
3590 + 32	40.0	24.0	27.8	45	3796 + 69	41.0	12.0	16.7	56	20,637	0.001	60	57.76	3.6	62.8
3796 + 69	41.0	12.0	16.7	56	3808 + 25	47.4	11.0	16.2	60	1,156	0.001	60	57.76	4.3	76.6
3808 + 25	47.4	11.0	16.2	60	3854 + 61	26.4	10.4	13.6	38	4,636	0.000	60	57.76	2.9	29.6
3854 + 61	26.4	10.4	13.6	38	3967 + 40	49.1	0.0	2.8	34	11,280	0.001	60	57.76	4.4	79.1
3967 + 40	49.1	0.0	2.8	34	4039 + 39	0.0	-16.0	-13.5	30	7,198	0.002	48	57.76	6.1	67.7
4039 + 39	0.0	-16.0	-13.5	30	4150 + 08	-99.9	-115.9	-113.7	27	11,070	0.009	36	57.76	10.2	63.4
4150 + 08	-99.9	-115.9	-113.5	29	4302 + 49	-199.7	-215.7	-213.0	32	15,241	0.007	42	57.76	9.2	81.4
4302 + 49	-199.7	-215.7	-213.0	32	4420 + 96	-224.2	-240.2	-218.9	60	11,847	0.002	60	57.76	6.0	118.4
4420 + 96	-224.2	-240.2	-218.9	72	4480 + 00	-224.2	-236.2	-220.0	72	5,904	-0.001	72	57.76	2.0	-110.2

*** Notes:** - CV Alternative A-3 represents Alignment A with flows from the Existing Service Area **without** Energy Recovery facilities.
- Shaded cells for Depth of Flow indicate pipe flowing full.

Exhibit 15 - CV Alternative A-3 Profile

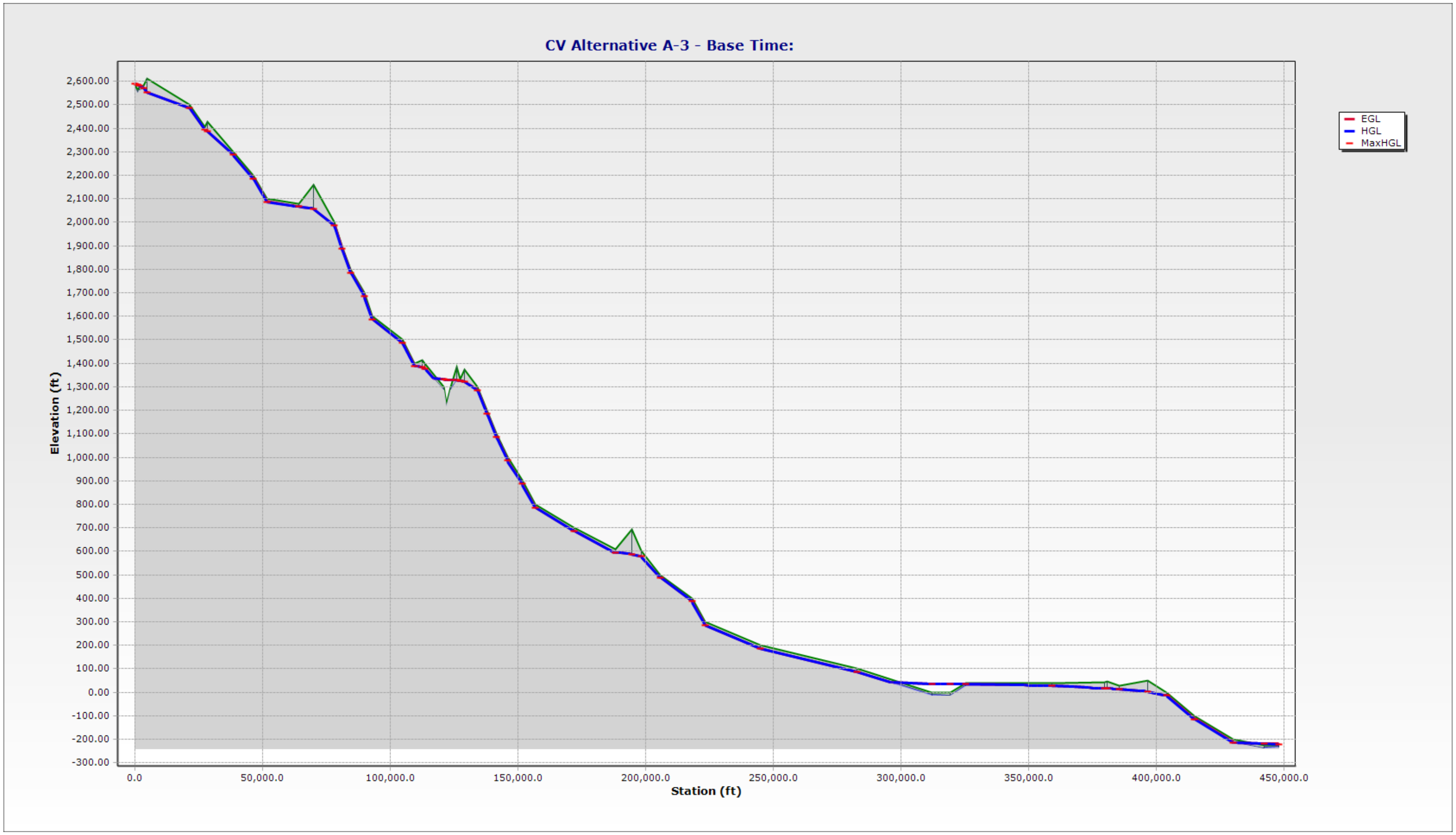


Table 23 – CV Alternative B-1* Summary of WaterCAD Results for Pipe Segments

Start Station	Pipe Elev. (Start) (ft)	Hydraulic Grade Line (Start) (ft)	Pressure (Start) (psi)	End Station	Pipe Elev. (End) (ft)	Hydraulic Grade Line (End) (ft)	Pressure (End) (psi)	Segment Length (ft)	Pipe Dia. (in)	Flow (gpm)	Velocity of Flow (ft/s)	Headloss Gradient (ft/ft)
0 + 00	2,570.0	2,600.0	12.9	26 + 90	2,559.2	2,586.6	11.8	2,690	36	25,937	8.18	0.004994
26 + 90	2,559.2	2,586.6	11.8	272 + 99	2,383.8	2,463.7	34.6	24,609	36	25,937	8.18	0.004994
272 + 99	2,383.8	2,393.7	4.2	792 + 41	1,484.3	2,134.3	281.2	51,942	36	25,937	8.18	0.004994
792 + 41	1,484.3	1,494.3	4.3	978 + 36	1,184.2	1,401.4	94.0	18,595	36	25,937	8.18	0.004994
978 + 36	1,184.2	1,401.4	94.0	1110 + 00	1,111.8	1,335.7	96.9	13,164	36	25,937	8.18	0.004994
1110 + 00	1,111.8	1,115.7	1.6	1364 + 04	684.0	1,047.8	157.4	25,404	48	39,428	6.99	0.002671
1364 + 04	684.0	692.8	3.7	1403 + 39	634.0	682.0	20.9	3,935	48	39,428	6.99	0.002671
1403 + 39	634.0	682.0	20.9	1592 + 01	484.0	631.6	64.0	18,862	48	39,428	6.99	0.002671
1592 + 01	484.0	491.6	3.2	1725 + 33	384.2	456.3	31.2	13,332	48	39,428	6.99	0.002671
1725 + 33	384.2	456.3	31.2	1905 + 65	283.2	408.2	54.1	18,032	48	39,428	6.99	0.002671
1905 + 65	283.2	408.2	54.1	2038 + 20	224.1	372.8	64.3	13,255	48	39,428	6.99	0.002671
2038 + 20	224.1	227.8	1.5	2196 + 12	183.8	185.6	0.8	15,792	48	39,428	6.99	0.002671
2196 + 12	183.8	185.6	0.8	2292 + 48	145.7	159.8	6.1	9,636	48	39,428	6.99	0.002671
2292 + 48	145.7	159.8	6.1	2396 + 46	78.6	132.1	23.1	10,398	48	39,428	6.99	0.002671
2396 + 46	78.6	132.1	23.1	2518 + 59	58.6	99.4	17.7	12,213	48	39,428	6.99	0.002671
2518 + 59	58.6	99.4	17.7	2593 + 28	25.9	79.5	23.2	7,469	48	39,428	6.99	0.002671
2593 + 28	25.9	79.5	23.2	2729 + 09	-16.0	43.2	25.6	13,581	48	39,428	6.99	0.002671
2729 + 09	-16.0	43.2	25.6	2860 + 00	-49.2	8.2	24.9	13,091	48	39,428	6.99	0.002671
2860 + 00	-49.2	8.2	24.9	3380 + 50	-166.2	-81.8	36.5	52,050	54	42,509	5.96	0.001730
3380 + 50	-166.2	-81.8	36.5	3593 + 78	-216.0	-140.5	32.7	21,328	54	54,625	7.65	0.002753
3593 + 78	-216.0	-140.5	32.7	3690 + 00	-227.0	-167.0	26.0	9,622	54	54,625	7.65	0.002753
3690 + 00	-227.0	-167.0	26.0	3775 + 97	-240.2	-184.2	24.2	8,597	60	60,636	6.88	0.001999

* **Note:** CV Alternative B-1 represents Alignment B using flows from the potential Expanded Service Area **with** Energy Recovery facilities.

Table 23 – CV Alternative B-1* Summary of WaterCAD Results for Turbine Generators

Turbine Location (Station)	Pipe Elev. (In) (ft)	Hydraulic Grade Line (In) (ft)	Pressure (In) (psi)	Flow (gpm)	Turbine Head (ft)	Hydraulic Grade Line (Out) (ft)	Pressure (Out) (psi)
272 + 99	2,383.8	2,463.7	34.6	25,937	70.0	2,393.7	4.2
792 + 41	1,484.3	2,134.3	281.2	25,937	640.0	1,494.3	4.3
1110 + 00	1,111.8	1,335.7	96.9	25,937	220.0	1,115.7	1.6
1364 + 04	684.0	1,047.8	157.4	25,937	355.0	692.8	3.7
1592 + 01	484.0	631.6	64.0	39,428	140.0	491.6	3.2
2038 + 20	224.1	372.8	64.3	39,428	145.0	227.8	1.5

*** Note:** CV Alternative B-1 represents Alignment B using flows from the potential Expanded Service Area **with** Energy Recovery facilities.

Exhibit 16 - CV Alternative B-1 Profile

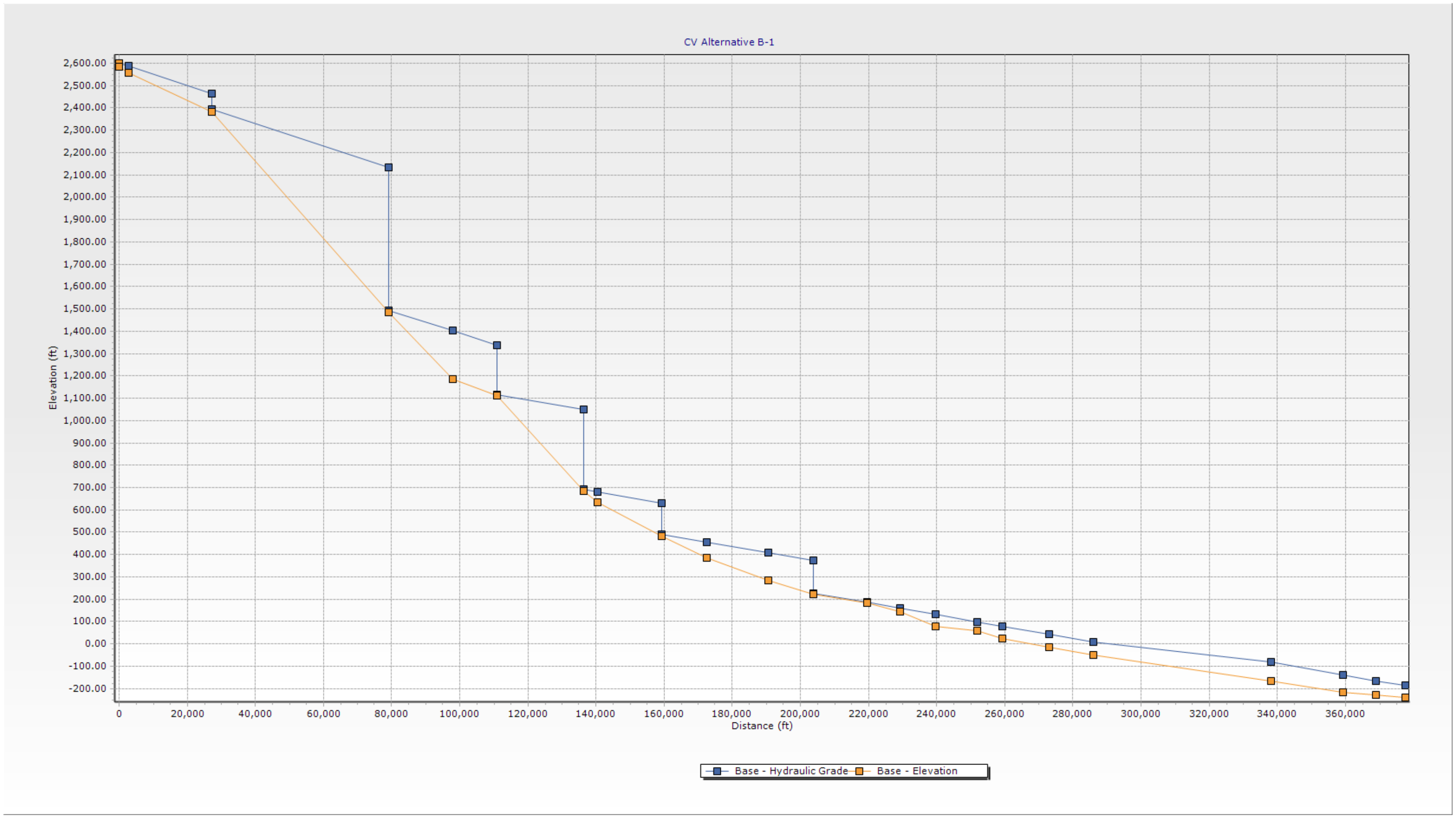


Table 24 – CV Alternative B-2* Summary of WaterCAD Results for Pipe Segments

Start Station			Pipe Elev. (Start) (ft)	Hydraulic Grade Line (Start) (ft)	Pressure (Start) (psi)	End Station			Pipe Elev. (End) (ft)	Hydraulic Grade Line (End) (ft)	Pressure (End) (psi)	Segment Length (ft)	Pipe Dia. (in)	Flow (gpm)	Velocity of Flow (ft/s)	Headloss Gradient (ft/ft)
0	+	00	2,570.0	2,600.0	12.9	26	+	90	2,559.2	2,586.6	11.8	2,690	36	25,937	8.18	0.004994
26	+	90	2,559.2	2,586.6	11.8	272	+	99	2,383.8	2,463.7	34.6	24,609	36	25,937	8.18	0.004994
272	+	99	2,383.8	2,463.7	34.6	792	+	41	1,484.3	2,204.3	311.5	51,942	36	25,937	8.18	0.004994
792	+	41	1,484.3	1,504.3	8.6	932	+	11	1,184.2	1,434.5	108.3	13,970	36	25,937	8.18	0.004994
932	+	11	1,184.2	1,434.5	108.3	978	+	36	1,184.2	1,411.4	98.3	4,625	36	25,937	8.18	0.004994
978	+	36	1,184.2	1,211.4	11.7	1110	+	00	1,111.8	1,125.7	14.7	13,164	36	25,937	8.18	0.004994
1110	+	00	1,111.8	1,145.7	14.7	1364	+	04	684.0	1,018.8	144.9	25,404	36	25,937	8.18	0.004994
1364	+	04	684.0	718.8	15.0	1403	+	39	634.0	699.2	28.2	3,935	36	25,937	8.18	0.004994
1403	+	39	634.0	699.2	28.2	1592	+	01	484.0	605.0	52.3	18,862	36	25,937	8.18	0.004994
1592	+	01	484.0	605.0	52.3	1725	+	33	384.2	538.4	66.7	13,332	36	25,937	8.18	0.004994
1725	+	33	384.2	538.4	66.7	1905	+	65	283.2	495.9	92.0	18,032	42	25,937	6.01	0.002357
1905	+	65	283.2	495.9	92.0	2038	+	20	224.1	464.7	104.1	13,255	42	25,937	6.01	0.002357
2038	+	20	224.1	234.7	4.5	2196	+	12	183.8	197.5	5.9	15,792	42	25,937	6.01	0.002357
2196	+	12	183.8	197.5	5.9	2292	+	48	145.7	174.8	12.6	9,636	42	25,937	6.01	0.002357
2292	+	48	145.7	174.8	12.6	2396	+	46	78.6	150.2	31.0	10,398	42	25,937	6.01	0.002357
2396	+	46	78.6	150.2	31.0	2518	+	59	58.6	121.5	27.2	12,213	42	25,937	6.01	0.002357
2518	+	59	58.6	121.5	27.2	2593	+	28	25.9	103.9	33.7	7,469	42	25,937	6.01	0.002357
2593	+	28	25.9	103.9	33.7	2729	+	09	-16.0	71.8	38.0	13,581	42	25,937	6.01	0.002357
2729	+	09	-16.0	71.8	38.0	2860	+	00	-49.2	41.0	39.0	13,091	42	25,937	6.01	0.002357
2860	+	00	-49.2	41.0	39.0	3380	+	50	-166.2	-81.7	36.6	52,050	42	25,937	6.01	0.002357
3380	+	50	-166.2	-81.7	36.6	3593	+	78	-216.0	-132.0	36.4	21,328	42	25,937	6.01	0.002357
3593	+	78	-216.0	-132.0	36.4	3690	+	00	-227.0	-154.6	31.3	9,622	42	25,937	6.01	0.002357
3690	+	00	-227.0	-154.6	31.3	3775	+	97	-240.2	-174.9	28.3	8,597	42	25,937	6.01	0.002357

*** Note:** CV Alternative B-2 represents Alignment B using flows from the Existing Service Area **with** Energy Recovery facilities

Table 25 – CV Alternative B-2* Summary of WaterCAD Results for Turbine Generators

Turbine Location (Station)	Pipe Inv. Elev. (In) (ft)	Hydraulic Grade Line (In) (ft)	Pressure (In) (psi)	Flow (gpm)	Turbine Head (ft)	Hydraulic Grade Line (Out) (ft)	Pressure (Out) (psi)
792 + 41	1,484.3	2,204.3	311.5	25,937	700.0	1,504.3	8.6
978 + 36	1,184.2	1,411.4	98.3	25,937	200.0	1,211.4	11.7
1364 + 04	684.0	1,018.8	144.9	25,937	300.0	718.8	15.0
2038 + 20	224.1	464.7	104.1	25,937	230.0	234.7	4.5

*** Note:** CV Alternative B-2 represents Alignment B using flows from the Existing Service Area **with** Energy Recovery facilities.

Table 26 – CV Alternative B-3* Summary of SewerCAD Results for Pipe Segments (Sheet 1 of 3)

Start Station			Ground Elev. (Start) (ft)	Pipe Inv. Elev. (Start) (ft)	Hyd. Grade Line (Start) (ft)	Depth of Flow (Start) (ft)	Stop Station			Ground Elev. (Stop) (ft)	Pipe Inv. Elev. (Stop) (ft)	Hyd. Grade Line (Stop) (ft)	Depth of Flow (Stop) (ft)	Pipe Length (ft)	Pipe Slope (ft/ft)	Pipe Dia. (in)	Flow (cfs)	Ave. Vel-ocity (ft/s)	Capacity (Full Flow) (cfs)
0	+	00	2,586.0	2,570.0	2,639.8	36.0	26	+	88	2,620.9	2,604.9	2,619.7	36.0	2,688	-0.013	36	57.76	8.2	-76.0
26	+	88	2,620.9	2,604.9	2,619.7	36.0	70	+	72	2,600.1	2,584.1	2,586.6	29.5	4,384	0.005	36	57.76	8.2	45.9
70	+	72	2,600.1	2,584.1	2,586.6	29.5	78	+	83	2,590.0	2,574.0	2,576.0	23.9	811	0.012	36	57.76	11.6	74.4
78	+	83	2,590.0	2,574.0	2,576.5	29.5	150	+	52	2,520.8	2,504.8	2,507.6	33.5	7,169	0.010	36	57.76	10.5	65.5
150	+	52	2,520.8	2,504.8	2,507.6	33.5	156	+	40	2,526.8	2,501.0	2,503.5	29.5	588	0.006	36	57.76	8.2	53.6
156	+	40	2,526.8	2,501.0	2,503.5	29.5	272	+	99	2,399.8	2,383.8	2,386.0	25.8	11,659	0.010	36	57.76	10.7	66.9
272	+	99	2,399.8	2,383.8	2,386.3	29.5	336	+	90	2,300.2	2,284.2	2,286.0	22.1	6,391	0.016	36	57.76	12.7	83.3
336	+	90	2,300.2	2,284.2	2,286.7	29.5	398	+	49	2,199.9	2,183.9	2,185.7	21.7	6,160	0.016	36	57.76	12.9	85.1
398	+	49	2,199.9	2,183.9	2,186.4	29.5	453	+	35	2,100.1	2,084.1	2,085.9	21.0	5,486	0.018	36	57.76	13.5	90.0
453	+	35	2,100.1	2,084.1	2,086.6	29.5	515	+	82	2,000.0	1,984.0	1,985.8	21.8	6,247	0.016	36	57.76	12.9	84.4
515	+	82	2,000.0	1,984.0	1,986.5	29.5	564	+	07	1,900.9	1,884.9	1,886.6	20.2	4,825	0.021	36	57.76	14.2	95.6
564	+	07	1,900.9	1,884.9	1,887.4	29.5	623	+	37	1,800.4	1,784.4	1,786.2	21.5	5,931	0.017	36	57.76	13.1	86.8
623	+	37	1,800.4	1,784.4	1,786.9	29.5	686	+	22	1,700.0	1,684.0	1,685.8	21.8	6,285	0.016	36	57.76	12.8	84.3
686	+	22	1,700.0	1,684.0	1,686.5	29.5	740	+	24	1,599.8	1,583.8	1,585.5	20.9	5,402	0.019	36	57.76	13.6	90.8
740	+	24	1,599.8	1,583.8	1,586.3	29.5	792	+	41	1,500.3	1,484.3	1,486.0	20.6	5,218	0.019	36	57.76	13.8	92.1
792	+	41	1,500.3	1,484.3	1,486.8	29.5	861	+	61	1,399.7	1,383.7	1,385.6	22.6	6,920	0.015	36	57.76	12.4	80.4
861	+	61	1,399.7	1,383.7	1,386.2	29.5	932	+	11	1,299.7	1,283.7	1,285.6	22.8	7,049	0.014	36	57.76	12.3	79.4
932	+	11	1,299.7	1,283.7	1,286.2	29.5	978	+	36	1,200.2	1,184.2	1,200.1	36.0	4,626	0.022	36	57.76	14.4	97.8
978	+	36	1,200.2	1,184.2	1,200.1	36.0	1110	+	00	1,115.6	1,099.6	1,102.1	29.5	13,164	0.006	36	57.76	8.2	53.5
1110	+	00	1,115.6	1,099.6	1,102.1	29.5	1123	+	92	1,100.1	1,084.1	1,086.2	24.8	1,392	0.011	36	57.76	11.1	70.4
1123	+	92	1,100.1	1,084.1	1,086.5	28.6	1184	+	35	1,000.5	984.5	986.1	19.7	6,042	0.016	42	57.76	13.1	129.2

*** Notes:** - CV Alternative B-3 represents Alignment B with flows from the Existing Service Area **without** Energy Recovery facilities.
- Shaded cells for Depth of Flow indicate pipe flowing full.

Table 27 - CV Alternative B-3* Summary of SewerCAD Results for Pipe Segments (Sheet 2 of 3)

Start Station			Ground Elev. (Start) (ft)	Pipe Inv. Elev. (Start) (ft)	Hyd. Grade Line (Start) (ft)	Depth of Flow (Start) (ft)	Stop Station			Ground Elev. (Stop) (ft)	Pipe Inv. Elev. (Stop) (ft)	Hyd. Grade Line (Stop) (ft)	Depth of Flow (Stop) (ft)	Pipe Length (ft)	Pipe Slope (ft/ft)	Pipe Dia. (in)	Flow (cfs)	Ave. Vel-ocity (ft/s)	Capacity (Full Flow) (cfs)
1184	+	35	1,000.5	984.5	986.9	28.6	1235	+	88	900.1	884.1	885.7	18.7	5,153	0.019	42	57.76	13.9	140.4
1235	+	88	900.1	884.1	886.5	28.6	1241	+	21	890.0	874.0	875.6	19.0	533	0.019	42	57.76	13.7	138.5
1241	+	21	890.0	874.0	876.4	28.6	1290	+	31	799.9	783.9	785.5	19.1	4,910	0.018	42	57.76	13.6	136.3
1290	+	31	799.9	783.9	786.3	28.6	1364	+	04	700.1	684.1	685.8	20.9	7,373	0.014	42	57.76	12.1	117.1
1364	+	04	700.1	684.1	686.5	28.6	1377	+	60	686.9	670.9	672.8	23.0	1,356	0.010	42	57.76	10.7	99.3
1377	+	60	686.9	670.9	673.3	28.6	1382	+	65	702.9	666.0	667.9	23.0	505	0.010	42	57.76	10.7	99.1
1382	+	65	702.9	666.0	668.4	28.6	1403	+	39	650.0	634.0	636.6	31.3	2,074	0.015	42	57.76	12.7	125.0
1403	+	39	650.0	634.0	636.6	31.3	1428	+	28	640.0	624.0	626.4	28.6	2,488	0.004	42	57.76	7.5	63.8
1428	+	28	640.0	624.0	626.4	28.6	1494	+	33	600.2	584.2	586.4	26.9	6,605	0.006	42	57.76	8.9	78.1
1494	+	33	600.2	584.2	586.6	28.6	1592	+	01	500.0	484.0	485.9	22.7	9,768	0.010	42	57.76	10.9	101.9
1592	+	01	500.0	484.0	486.3	27.5	1725	+	33	400.2	384.2	386.1	23.0	13,332	0.007	48	57.76	9.7	124.3
1725	+	33	400.2	384.2	386.5	27.5	1905	+	65	299.2	283.2	285.3	25.1	18,032	0.006	48	57.76	8.7	107.5
1905	+	65	299.2	283.2	285.5	27.5	2038	+	20	240.1	224.1	226.5	28.8	13,256	0.004	48	57.76	8.0	95.9
2038	+	20	240.1	224.1	226.5	28.8	2107	+	90	215.0	199.0	201.3	27.5	6,970	0.004	48	57.76	7.4	86.2
2107	+	90	215.0	199.0	201.3	27.5	2125	+	66	207.0	191.0	193.2	26.8	1,776	0.005	48	57.76	8.0	96.4
2125	+	66	207.0	191.0	193.3	27.5	2169	+	11	200.3	170.0	172.4	29.3	4,345	0.005	48	57.76	8.2	99.9
2169	+	11	200.3	170.0	172.4	29.3	2179	+	64	200.0	165.0	167.4	28.6	1,053	0.005	42	57.76	8.1	69.3
2179	+	64	200.0	165.0	167.4	28.6	2189	+	16	199.9	160.0	162.4	28.2	953	0.005	42	57.76	8.4	72.9
2189	+	16	199.9	160.0	162.4	28.6	2196	+	12	199.8	156.0	158.3	27.4	696	0.006	42	57.76	8.7	76.3
2196	+	12	199.8	156.0	158.4	28.6	2202	+	80	173.8	151.0	153.1	25.0	668	0.007	42	57.76	9.7	87.1
2202	+	80	173.8	151.0	153.3	27.5	2206	+	74	165.0	149.0	153.0	47.8	394	0.005	48	57.76	8.4	102.3

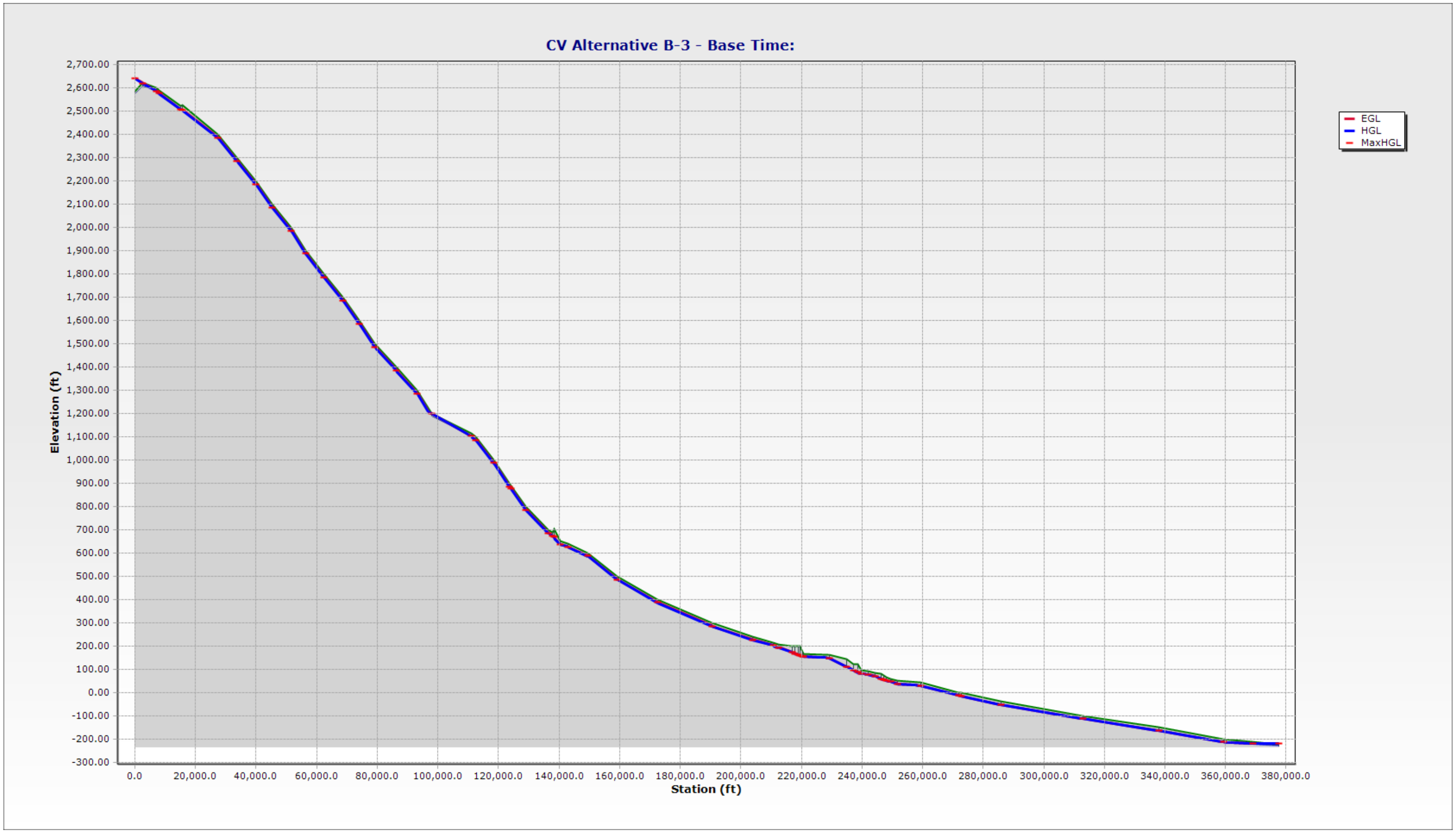
*** Notes:**
- CV Alternative B-3 represents Alignment B with flows from the Existing Service Area **without** Energy Recovery facilities.
- Shaded cells for Depth of Flow indicate pipe flowing full.

Table 27 - CV Alternative B-3* Summary of SewerCAD Results for Pipe Segments (Sheet 3 of 3)

Start Station	Ground Elev. (Start) (ft)	Pipe Inv. Elev. (Start) (ft)	Hyd. Grade Line (Start) (ft)	Depth of Flow (Start) (ft)	Stop Station	Ground Elev. (Stop) (ft)	Pipe Inv. Elev. (Stop) (ft)	Hyd. Grade Line (Stop) (ft)	Depth of Flow (Stop) (ft)	Pipe Length (ft)	Pipe Slope (ft/ft)	Pipe Dia. (in)	Flow (cfs)	Ave. Vel-ocity (ft/s)	Capacity (Full Flow) (cfs)
2206 + 74	165.0	149.0	153.0	47.8	2292 + 48	161.7	145.7	148.1	28.6	8,574	0.000	66	57.76	3.1	65.9
2292 + 48	161.7	145.7	148.1	28.6	2349 + 87	145.0	108.0	110.2	26.0	5,739	0.007	42	57.76	9.2	81.5
2349 + 87	145.0	108.0	110.4	28.6	2371 + 75	122.0	93.0	95.1	25.7	2,188	0.007	42	57.76	9.4	83.3
2371 + 75	122.0	93.0	95.4	28.6	2386 + 81	120.0	84.0	86.3	27.0	1,506	0.006	42	57.76	8.9	77.8
2386 + 81	120.0	84.0	86.4	28.6	2396 + 46	94.6	78.6	81.6	35.4	965	0.006	42	57.76	8.6	75.3
2396 + 46	94.6	78.6	81.6	35.4	2419 + 16	90.0	74.0	76.7	31.8	2,271	0.002	48	57.76	5.8	64.7
2419 + 16	90.0	74.0	76.7	31.8	2443 + 86	83.4	67.4	69.7	27.5	2,469	0.003	48	57.76	6.5	74.3
2443 + 86	83.4	67.4	69.7	27.5	2463 + 74	80.0	57.0	59.1	25.6	1,988	0.005	48	57.76	8.5	103.9
2463 + 74	80.0	57.0	59.3	27.5	2473 + 08	75.0	53.0	55.3	27.2	935	0.004	48	57.76	7.9	94.0
2473 + 08	75.0	53.0	55.3	27.5	2480 + 29	65.0	49.0	51.4	28.7	721	0.006	48	57.76	8.7	107.0
2480 + 29	65.0	49.0	51.4	28.7	2493 + 58	60.2	44.2	46.5	27.6	1,329	0.004	48	57.76	7.4	86.3
2493 + 58	60.2	44.2	46.5	27.6	2518 + 59	50.0	34.0	37.0	36.0	2,502	0.004	48	57.76	7.7	91.7
2518 + 59	50.0	34.0	37.0	36.0	2593 + 28	41.9	25.9	28.2	27.4	7,469	0.001	60	57.76	4.7	85.8
2593 + 28	41.9	25.9	28.2	27.4	2719 + 87	0.0	-16.0	-13.7	27.5	12,660	0.003	54	57.76	7.2	113.1
2719 + 87	0.0	-16.0	-13.7	27.5	2729 + 09	0.0	-19.0	-16.6	28.9	922	0.003	54	57.76	7.1	112.2
2729 + 09	0.0	-19.0	-16.6	28.9	2860 + 00	-38.9	-54.9	-52.4	30.6	13,091	0.003	54	57.76	6.7	103.0
2860 + 00	-38.9	-54.9	-52.4	30.6	3128 + 82	-100.1	-116.1	-113.6	29.9	26,882	0.002	54	57.76	6.2	93.8
3128 + 82	-100.1	-116.1	-113.6	29.9	3380 + 50	-150.2	-166.2	-163.8	28.6	25,168	0.002	60	57.76	5.9	116.2
3380 + 50	-150.2	-166.2	-163.8	28.6	3593 + 78	-200.0	-216.0	-213.1	34.6	21,328	0.002	60	57.76	6.3	125.8
3593 + 78	-200.0	-216.0	-213.1	34.6	3690 + 00	-212.5	-228.5	-218.4	60.0	9,622	0.001	60	57.76	5.0	93.8
3690 + 00	-212.5	-228.5	-218.4	72.0	3775 + 97	-224.2	-234.2	-220.0	72.0	8,597	0.001	72	57.76	2.0	109.1

*** Notes:**
- CV Alternative B-3 represents Alignment B with flows from the Existing Service Area **without** Energy Recovery facilities.
- Shaded cells for Depth of Flow indicate pipe flowing full.

Exhibit 17 - CV Alternative B-3 Profile



Appendix C – Salt Removal (Evaporation Ponds)

Background

Treatment processes used to reduce TSS and BOD concentrations in water are not effective at removing TDS (salt), and the Treatment Facility proposed in this TM 3.3 cannot be expected to significantly reduce the salt loads in the IEI flows. Therefore, a separate process would be necessary if removal of salt associated with the proposed IEI flows were deemed necessary.

The Salton Sea restoration plans discussed previously in this TM 3.3 include several alternative designs, most of which include a Brine Pool located at the deeper portion of the Sea. Salts would accumulate in the proposed brine pool and precipitate from super-saturated concentrations. The brine pool represents a reasonable solution to the salt mass imbalance in the Sea. The brine pool could also be used to manage the salt from the proposed IEI.

However, if the brine pool does not become available for management of the salt from the IEI, then an alternative approach may be necessary. A conceptual design for a Salt Evaporation Pond Facility (EPF) is presented in this Appendix C as an alternative approach to remove salts attributable to the IEI flows from the Salton Sea.

Effluent Standards

The projected TDS mass load from the IEI was discussed in Technical Memorandum No. 3.2 of this Appraisal Analysis. The projected average rate of discharge from the IEI in Year 2060 is 75.1 MGD, of which 43.0 MGD was projected to originate from Coachella Valley. The average TDS concentration in the IEI flows was projected to increase from approximately 5,200 mg/L (currently) to a maximum of approximately 6,800 mg/L (by approximately Year 2020). This projected TDS concentration exceeds the limits established in the Basin Plan [11] for waters flowing into the Salton Sea from Coachella Valley, which are 2,000 mg/L, average and 2,500 mg/L, peak.

The total projected TDS mass in the IEI flows in Year 2060 would be approximately 2,131 tons/day. The Basin Plan TDS limit (2,000 mg/L) would allow approximately 359 tons/day in the portion of the projected IEI flows originating from Coachella Valley.

If the Basin Plan (as amended) would not allow TDS in IEI flows originating from outside of the Coachella Valley to be released to the Salton Sea, then the maximum TDS mass in the IEI flows that could be released to the Salton Sea in Year 2060 would be 359 tons/day. In that case, some form of management or removal of salt would be required for the 1,772 tons/day of TDS in the

IEI flows in Year 2060 that would exceed that limit. These results are summarized in **Table 28** below.

Table 27 – TDS Removal Rate (2060)

	Average Flow	TDS Mass		IEI TDS Removal Rate
		IEI Mass (6,800 mg/L)	Basin Plan Limit (2,000 mg/L)	
	(MGD)	(tons/day)	(tons/day)	(tons/day)
Existing SAWPA Service Area	32.1	910	0	910
Potential Coachella Valley Service Area Expansion	43.0	1,221	359	862
Total (Expanded Service Area)	**75.1**	**2,131**	**359**	**1,772**

Evaporation Ponds Description

Salt evaporation ponds are a low technology approach to salt management. Large land areas are used for shallow ponds designed to hold brine from which the water is evaporated, leaving the salt for collection and disposal. The volume of water that would be lost to evaporation would be minimized by using brine with the highest possible TDS concentration available. This would also help minimize the area of the evaporation ponds.

If an Evaporation Pond Facility (EPF) was used for management of the salt in the proposed IEI flows, then the Salton Sea itself would be the best available source of brine. The ***Salton Sea Ecosystem Restoration Program Draft PEIR*** [8] reported that the average TDS concentration of the Salton Sea is currently approximately 48,000 mg/L.

If 1,772 tons of TDS must be removed per day from the Salton Sea in Year 2060 as presented in **Table 28**, then the volume of brine (TDS concentration 48,000 mg/L) to be transported to the EPF would be approximately 9,915 acre-feet per year (AFY) or 8.8 MGD. This represents approximately 12% of the total projected IEI flows. Therefore, the net increase of inflows to the Salton Sea from the proposed IEI would be the balance (approximately 88%) of the projected flows, or approximately 66.3 MGD (74,265 AFY). The results of these calculations, based on these data, are summarized in **Table 29** on the following page.

Table 28 – Process Water Rate (2060)

	Average Flow (6,800 mg/L)	IEI TDS Removal Rate	Process Water (48,000 mg/L)	
	(MGD)	(tons/day)	(MGD)	(AFY)
Existing SAWPA Service Area	32.1	910	4.5	5,091
Expanded Service Area	**75.1**	**1,772**	**8.8**	**9,915**

Pumping would be necessary to transport the brine from the Salton Sea to the EPF. Locating the EPF as near the shore as possible would help minimize the cost of the pumping.

Evaporation Ponds Design Methodology

The Idaho National Engineering and Environmental Laboratory developed a methodology for design of evaporation ponds for use in the mining industry, which is presented in the report entitled ***Evaporation Pond Sizing with Water Balance and Make-up Water Calculations*** [12] (EP Manual). This methodology was used for conceptual design of the EPF for this Appraisal Analysis.

The EP Manual methodology uses the principle of conservation of the mass (Mass Balance Equation) to calculate the size of evaporation ponds using the volumes of the sources of mass entering (***Input***) and exiting (***Output***):

$$\begin{aligned} \textit{Evaporation Pond Storage}\ \Delta &= (\textit{Input}) - (\textit{Output}) \\ &= \textit{Process Water} + \textit{Direct Precipitation on Ponds} \\ &\quad + \textit{Leachate} - \textit{Evaporation} \end{aligned}$$

Process Water represents the projected rate of brine withdrawal from the Salton Sea discussed above and ***Leachate*** represents percolation into the ground and through pond containment berms. ***Direct Precipitation on Ponds*** is calculated as the average ***Precipitation Rate*** over the ***Pond Surface Area*** and ***Evaporation*** is calculated as the ***Evaporation Rate*** over the ***Pond Surface Area***.

For evaporation ponds that are correctly sized for the specific conditions, the total volume of water in the ponds would remain constant and ***Input*** should be equal to ***Output***. Therefore, the Mass Balance Equation can be represented as follows:

$$\begin{aligned} &\textit{Process Water} + (\textit{Precipitation Rate} * \textit{Pond Surface Area}) + \textit{Leachate} \\ &= (\textit{Evaporation Rate} * \textit{Pond Surface Area}) \end{aligned}$$

Therefore, the surface area of evaporation ponds necessary to remove the TDS mass (***Pond Surface Area***) was calculated as follows:

$$Pond\ Surface\ Area = \frac{Process\ Water + Leachate}{Evaporation\ Rate\ - Precipitation\ Rate}$$

Evaporation Ponds Design Criteria

The Water Balance Equation was solved using the following criteria:

- Planning for the evaporation ponds in this Appraisal Analysis includes impervious liners below the ponds and in the containment berms to prevent percolation into the ground and leaching through the containment berms. Therefore, ***Leachate = 0***.
- ***The Hydrologic Regimen of Salton Sea, California, 1966*** [13] reported for the Salton Sea that the average ***Precipitation Rate = 3.0 inches/year***.
- ***The Hydrologic Regimen of Salton Sea, California, 1966*** [1] reported that the 3-Pan Average Evaporation Rate at the Salton Sea is 100.6 inches/year. This 3-Pan Average Evaporation Rate (E_P) is a standardized measure that must be adjusted to represent the actual rate of evaporation from a surface water body (e.g. evaporation pond). The pan coefficient for the Salton Sea area is 0.69. Therefore, ***Evaporation Rate = 0.69 * E_p = 69.4 inches/year***.
- To account for necessary buffers, containment berms, access roads, etc., a ***Pond Surface Area Multiplier = 1.30*** was applied to the calculated ***Pond Surface Area*** (like the multipliers used for the Facultative Treatment Ponds and Constructed Wetlands in this TM 3.3). This multiplier was not developed to include extra ponds that could provide EPF capacity greater than the design flows, which may be desired for operational purposes.

Evaporation Ponds Conceptual Design

The EP Manual [12] methodology and the design criteria described above were used to develop the conceptual design for the EPF summarized in **Table 30** below.

Table 29 – Evaporation Pond Facility Area

	Process Water (48,000 mg/L)		Evaporation Pond Area		
			Surface	Total	
	(MGD)	(AFY)	(Acres)	(Acres)	(Sq. Mi.)
Existing SAWPA Service Area	4.5	5,091	920	1,196	1.9
Expanded Service Area	**8.8**	**9,915**	**1,792**	**2,330**	**3.6**

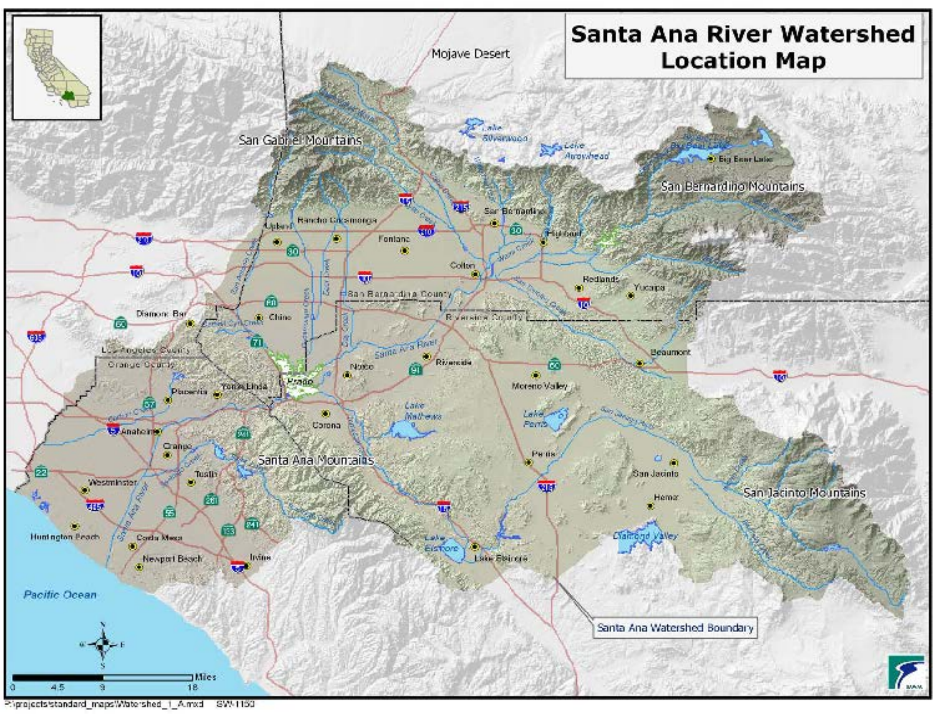
RECLAMATION

Managing Water in the West

Technical Memorandum No. 3.4
Summary of Costs and Recommended Options

Inland Empire Interceptor Appraisal Analysis

Santa Ana Watershed Basin Study, California
Lower Colorado Region



U.S. Department of the Interior
Bureau of Reclamation
Southern California Area Office

Santa Ana Watershed
Project Authority

May 2013

Mission Statements

The mission of the Department of the Interior is to protect and provide access to our Nation's natural and cultural heritage and honor our trust responsibilities to Indian Tribes and our commitments to island communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

BUREAU OF RECLAMATION
Engineering Services Office
Lower Colorado Regional Office, LC-6000

Technical Memorandum No. 3.4
Summary of Costs and Recommended Options

Inland Empire Interceptor Appraisal Analysis

Santa Ana Watershed Basin Study, California
Lower Colorado Region

Prepared by:	**Thomas Nichols, P.E.** **Civil Engineer (Hydrologic)** **Engineering Services Office, LC-6233** **Lower Colorado Region**
Reviewed by:	**Douglas B. Blatchford, P.E.** **Robert Owen, E.I.**

This page intentionally left blank.

Contents

Page

Tables

This page intentionally left blank.

Acronyms and Abbreviations

Organizations:

CDM	Camp, Dresser & McKee
CRWQCB	Colorado River Basin Regional Water Quality Control Board, State of California
CVWD	Coachella Valley Water District
EMWD	Eastern Municipal Water District
EPA	U.S. Environmental Protection Agency
ESO	Bureau of Reclamation's Engineering Services Office, Boulder City, Nevada
IEUA	Inland Empire Utilities Agency
MSWD	Mission Springs Water District
OCSD	Orange County Sanitation District
Reclamation	Bureau of Reclamation
SAWPA	Santa Ana Watershed Project Authority
SBVMWD	San Bernardino Valley Municipal Water District
SCAO	Bureau of Reclamation's Southern California Area Office, Temecula, California
USDA	U.S. Department of Agriculture
UPRR	Union Pacific Railroad
WMWD	Western Municipal Water District

Documents:

Appraisal Analysis	Inland Empire Interceptor Appraisal Analysis
Basin Plan	Water Quality Control Plan: Colorado River Basin Regional Water Quality Control Board
Basin Study	Santa Ana Watershed Basin Study
CWA	U.S. Clean Water Act
OWOW	One Water One Watershed
Porter-Cologne	California's Porter-Cologne Water Quality Control Act
SAWPA Investigation	Inland Empire Brine Line Disposal Option Concept Investigation
TM	Technical Memorandum

Facilities and Processes:

Brine Line	Inland Empire Brine Line
CLMM	County Line Master Meter
CVSC	Coachella Valley Stormwater Channel
CW	Constructed Wetland
EPF	Evaporation Pond Facility
FTP	Facultative Treatment Pond
FWS	Free Water Surface

IEBL	Inland Empire Brine Line
IEI	Inland Empire Interceptor
O&M	Operations and Maintenance
SARI	Santa Ana Regional Interceptor (aka “Brine Line”)
TF	Treatment Facilities

Parameters and Units of Measure:

AFY	Acre-Feet per Year
BOD	Biochemical Oxygen Demand (or Biological Oxygen Demand)
cfs	Cubic feet per Second
Esmt	Easement
ft	Feet
gpm	Gallons per Minute
HGL	Hydraulic Grade Line
HP	Horsepower
in	Inches
kWh	Kilowatt-hour
LF	Linear Foot
MGD	Million Gallons per Day
mg/L	Milligrams per Liter
PRF	Peak Rate Factor
psi	Pounds per Square Inch
TDS	Total Dissolved Solids
TSS	Total Suspended Solids

Introduction

Santa Ana Watershed Project Authority

SAWPA is a joint powers authority comprised of five member water districts that serve the vast majority of the Santa Ana Watershed. The area served by SAWPA is located within Orange, Riverside and San Bernardino Counties of California, bounded by the Pacific Ocean on the west, the San Bernardino Mountains to the north, and the San Jacinto Mountains to the east.

The five SAWPA Member Agencies are:

- Eastern Municipal Water District (EMWD),
- Western Municipal Water District (WMWD),
- Inland Empire Utilities Agency (IEUA),
- San Bernardino Valley Municipal Water District (SBVMWD), and
- Orange County Water District (OCWD).

Inland Empire Brine Line

SAWPA's mission is to protect water quality and enhance the water supply within the Santa Ana River Watershed. For these purposes, SAWPA developed the Inland Empire Brine Line (Brine Line), which is also known as the Santa Ana Regional Interceptor (SARI), for the purpose of exporting salt from the Santa Ana Watershed. The Brine Line includes approximately 72 miles of pipeline in multiple branches which converge in the vicinity of Prado Dam near the City of Corona. It has a planned capacity of approximately 32.5 million gallons per day (MGD) and was planned for collection and exportation of approximately 271,000 tons of salt per year from the upper Santa Ana Watershed, east of the Santa Ana Mountains. Currently (2010 & 2011), average system flows are approximately 11.7 MGD and over 75,000 tons of salt are exported per year.

An additional 21 miles of pipeline convey the combined flows to Orange County Sanitation District (OCSD) facilities for treatment and disposal by discharge to the Pacific Ocean. This pipeline has a nominal capacity of 30 MGD. The planned capacity of the Brine Line system (32.5 MGD) exceeds the hydraulic capacity of the pipeline from the Brine Line convergence near Prado Dam to the OCSD facilities. Furthermore, the agreement between SAWPA and OCSD allows Brine Line flows to the OCSD system up to only 17.0 MGD, with a contractual right to purchase up to 30.0 MGD capacity.

Project Background

The One Water One Watershed (OWOW) Plan is the integrated water management plan for the Santa Ana Watershed administered by SAWPA. The Bureau of Reclamation's Southern California Area Office (SCAO) and SAWPA submitted a proposal in June 2010 for funding of a Santa Ana Watershed Basin Study (Basin Study) in support of the OWOW Plan update, known as One Water One Watershed 2.0. In August 2010, this Basin Study was selected by Reclamation for funding. This Inland Empire Interceptor Appraisal Analysis (Appraisal Analysis) is one component of the Basin Study.

A study entitled ***Santa Ana Watershed Salinity Management Program*** [1] [2] (Salinity Management Program) was completed in 2010 by a team of consultants led by Camp, Dresser & McKee (CDM), which addressed the Brine Line capacity limitations. The Salinity Management Program identified and evaluated several potential system configuration changes to address the capacity limitations. The ***Phase 2 Technical Memorandum*** [2] included estimated costs for each of these strategies, which were indexed to Year 2010.

One of the alternatives considered is a proposed new Brine Line outfall to the Salton Sea, which was identified as Option 4 in the Salinity Management Program. The Salinity Management Program did not include a comprehensive review of Option 4, which would replace the existing outfall from the Brine Line system convergence near Prado Dam in western Riverside County to the OCSD system. Option 4 is the subject of this Appraisal Analysis and is identified herein as the Inland Empire Interceptor (IEI).

The discussion of Option 4 in the Salinity Management Program identified a need for treatment of Brine Line flows prior to discharge to the Salton Sea. However, the estimated costs presented for Option 4 include only those associated with the pipeline itself and estimated costs for treatment of Brine Line flows for Option 4 were not included.

Appraisal Analysis Objectives

Under Reclamation criteria set forth in ***Reclamation Manual, Directives and Standards, FAC 09-01: Cost Estimating*** [9], appraisal analyses "are intended to be used as an aid in selecting the most economical plan by comparing alternative features." Several alternative conceptual designs for the proposed Inland Empire Interceptor (IEI) have been developed and evaluated for this Appraisal Analysis for the purpose of comparison.

Reclamation Manual FAC 09-01 also states that appraisal analyses are to be prepared "using the available site-specific data." A literature review of previous studies and other available site-specific data was addressed in Technical

Memorandum No. 3.1 (TM 3.1). Various additional sources of available information have been identified in TM 3.2, TM 3.3 and this TM 3.4.

System flows and brine characteristics were addressed in TM 3.2. The route of the proposed IEI represents an opportunity for SAWPA to expand the Brine Line service area to include the San Gorgonio Pass and Coachella Valley areas; TM 3.2 also addressed this opportunity and the associated additional flows.

Conceptual designs for each alternative under consideration for the proposed IEI were addressed in TM 3.3. These alternatives begin at a common point in western Riverside County near Prado Dam in the upper Santa Ana Watershed, running generally eastward to a common point in San Gorgonio Pass. Two alternatives continue eastward from the common point in San Gorgonio Pass and through Coachella Valley to a common end point near the north edge of the Salton Sea in eastern Riverside County.

This TM 3.4 presents estimated costs associated with the alternative conceptual designs for the proposed IEI presented in TM 3.3 of this Appraisal Analysis. Suggested strategies for implementation of the proposed IEI are also presented in this TM 3.4.

These Technical Memoranda are summarized in a final report.

Technical Memorandum No. 3.4 – Estimated Costs

This TM 3.4 presents estimated capital construction costs and operation and maintenance costs for alternative IEI conceptual designs described in TM 3.3 of this Appraisal Analysis. These estimated costs are indexed to Year 2010 to facilitate comparison with the estimated costs presented for the various Options considered in the ***Salinity Management Program Phase 2 Technical Memorandum*** [2].

Cost Estimating Criteria

Background

As noted above, the Salinity Management Program identified and evaluated several alternatives for Brine Line system configuration changes to address anticipated capacity limitations. Salinity Management Program Technical Memorandum 2 included estimated costs for each of these strategies. One of the alternatives considered is a proposed new Brine Line outfall to the Salton Sea, which was identified as Option 4 in the Salinity Management Program. This Option 4 would replace the existing outfall from the Brine Line system convergence near Prado Dam in western Riverside County to the OCSD system.

The investigation of Option 4 in the Salinity Management Program was less comprehensive than the investigations of the other Options considered. For example, the Salinity Management Program discussion of Option 4 identified a need for treatment of Brine Line flows prior to discharge to the Salton Sea, but the estimated costs presented for Option 4 did not consider the cost of treatment.

Option 4 is the subject of this Appraisal Analysis and is identified herein as the Inland Empire Interceptor (IEI). As also noted above, appraisal analyses “are intended to be used as an aid in selecting the most economical and viable plan by comparing alternative features”. Various alternatives have been developed for the purpose of this comparative analysis and are presented in TM 3.3 of this Appraisal Analysis.

Construction Cost Estimating Criteria

The criteria used for developing the estimated construction costs for the various alternatives under consideration in this Appraisal Analysis are summarized in **Table 1** on the following page. Discussions of these criteria follow **Table 1**.

The estimated unit costs are indexed to Year 2010 to facilitate comparison with the estimated costs presented for the various Options considered in the ***Salinity Management Program Phase 2 Technical Memorandum*** [2] and with those presented in the ***Inland Empire Brine Line Disposal Option Concept Investigation*** [3]. Unit cost data from locations outside of southern California and/or from years other than Year 2010 were adjusted using Historical and Location Indexes published by ***RS Means*** [8].

Table 1 – Construction Costs Estimating Criteria

COMPONENT	ESTIMATING CRITERIA
Pipeline Base Unit Costs:	
Pressure Class 150 psi	$12.00 per inch diameter per LF
Pressure Class 200 psi	Class 150 Pipeline Base Unit Cost + $1.00 per in dia. per LF
Pressure Class 250 psi	Class 150 Pipeline Base Unit Cost + $2.00 per in dia. per LF
Pressure Class 400 psi	Class 150 Pipeline Base Unit Cost + $4.00 per in dia. per LF
Pipeline Location Cost Adjustment Factors:	
Open Country	0.74 * Pipeline Base Unit Cost
Rural Road	1.00 * Pipeline Base Unit Cost
Commercial / Residential	1.19 * Pipeline Base Unit Cost
Busy City Street	1.32 * Pipeline Base Unit Cost
Additional Pipeline Costs:	
Manholes	$14,000 or $17,000 Each.
Tunneling, Jacking & Boring	$17.50 per inch diameter (casing) per LF.
Environmental Mitigation	$14.00 per LF.
Existing Pipeline Abandonment Costs	$9.00 per inch diameter per LF
Land Costs:	
Easements & Rights-of-Way	$57.00 per LF.
Land Parcels	$56,000 per Acre.
Pump Station & Turbine Gen. Station Costs:	
Pump Stations	$ = 1.0 * 64,661 * Pump HP^0.6652
Turbine Generator Stations	$ = 1.7 * 400,510 * Q^0.7461, Q in cfs
Electrical Service	$570,000 per Station.
Power Transmission Lines	$340,000 per Mile.
Water Quality Treatment Facility Costs:	
Clearing & Grubbing	$4,400 per acre
Earthwork	$16,000 per acre
Liner	$47,500 per acre
Plants & Planting	$7,600 per acre
Control Structures	$35,000 per acre
Plumbing & Fencing	$15,000 per acre
Distributive Costs	25%
Contingencies	25%

Pipeline Base Unit Costs

The estimated Pipeline Base Unit Costs presented in **Table 1** above are based on average construction costs for large diameter pipeline projects in the southwestern U.S. for Class 150 pipe with average trench depth of 15 to 20 feet and site conditions characteristic of a Rural Road location category (described below). The estimated Pipeline Base Unit Costs include typical appurtenances for large diameter pipelines such as fittings, cathodic corrosion protection, air relief valves, and blow-offs.

Pipe pressure classes greater than Class 150 were used for those portions of the proposed IEI for which the hydraulic analyses indicate that system operating pressures would exceed 100 psi. These portions typically occur immediately downstream of pump stations and immediately upstream of turbine generator stations. The estimated unit costs for pipe pressure classes other than Class 150 were determined using available relative pipe materials costs.

Pipeline Location Cost Adjustment Factors

Pipeline Cost Adjustment Factors are applied to the estimated Pipeline Base Unit Costs to address conditions along various segments of the alignments that vary from the assumed typical Rural Road site conditions described above and may significantly influence construction costs. These Pipeline Cost Adjustment Factors were used in the ***Desert Aqueduct Project Development Plan Phase 1 Report (Draft)*** [7] and are based on the “cultural modifiers” or difficulty factors developed by the Environmental Protection Agency (EPA) as part of the sanitary sewer needs assessment in the 1970s to address anticipated terrain and installation conditions. The Pipeline Cost Adjustment Factors used in this TM 3.4 are presented in **Table 1** above.

Site conditions associated with the Rural Road category are characteristic of a two-lane rural highway or street with low traffic volumes and minor existing utilities congestion. As noted above, this category represents baseline conditions. Site conditions associated with the Open Country category include minimal existing utilities congestion and surface restoration requirements. The Commercial / Residential category is characteristic of somewhat congested urban business and residential areas and is typically applied to arterial streets. The Busy City Street category is characteristic of dense urban areas typical of town centers, downtown areas, business districts and congested commercial areas with significant existing utilities congestion and surface restoration requirements.

Additional Pipeline Costs

Certain aspects of construction are not necessarily accounted for in the estimated Pipeline Base Unit Costs or in the Pipeline Cost Adjustment Factors described above. These include manholes on the gravity portions of the proposed IEI, tunneling or jacking & boring at crossings of other existing major facilities (such as freeways and railroads), and mitigation for possible adverse environmental impacts along the alignments. These are included in the estimated costs presented in this TM 3.4 for specific segments of the various alignments, as applicable. The estimated unit costs for these Additional Pipeline Costs used in this TM 3.4 are presented in **Table 1**.

Existing Pipeline Abandonment Costs

The existing Brine Line system includes 21 miles of pipeline that convey the flows from the point of convergence in the vicinity of Prado Dam to Orange County Sanitation District (OCSD) treatment facilities. The ***Phase 2 Technical Memorandum*** [2] reported that this portion of the system is owned and operated by OCSD. Implementation of the proposed IEI would involve abandonment of this system outfall pipeline or conversion to some other beneficial use. The estimated unit cost used in this TM 3.4 for abandonment of the existing pipeline is presented in **Table 1**.

Land Costs

The Land Costs presented in this TM 3.4 are included among the estimated costs for the various major components of the project. The pipeline alignments considered in this Appraisal Analysis are generally proposed to be located in or adjoining existing transportation, drainage and/or (public or private) utility corridors wherever possible in an effort to minimize the costs of acquisition of easements or rights-of-way. However, it is likely that some portions of the IEI would be located outside those existing easements and rights-of-way and that acquisition of additional easements and/or rights-of-way would be necessary.

Land costs for acquisition of easements and rights-of-way necessary for the pipeline are based on a typical easement (or right-of-way) width of 100 feet at a cost of approximately $25,000 per acre, or approximately $57.00 per linear foot (LF). These costs were based on information presented in ***Desert Aqueduct Project Development Plan Phase 1 Report (Draft)*** [7], indexed to Year 2010. These costs were applied to segments for which existence of easements and/or rights-of-way was not readily indicated by available mapping and acquisition of easement rights may be necessary.

It would also be necessary to acquire land on which to locate the planned IEI Pump Stations, Turbine Generator Stations (Energy Recovery Facilities), and

Water Quality Treatment Facility. Similarly, if the Evaporation Pond Facility were necessary for implementation of the proposed IEI, then it would also be necessary to acquire land on which to locate that facility. The cost of acquisition of parcels necessary for the Pump Stations and Turbine Generator Stations are based on a typical parcel size of approximately three (3) acres at a cost of approximately $56,000 per acre, or approximately $168,000 per station.

It is likely that the Water Quality Treatment Facility (TF) and the Evaporation Pond Facility (EPF) would be located in rural areas near the shore of the Salton Sea. It is also likely that the land costs (per acre) for these facilities would be lower than those for Pump Stations and Turbine Generator Stations. However, due to the limited information readily available regarding land costs in the vicinity of the Salton Sea, the unit cost used to calculate the estimated land cost for the TF and EPF is the same as that used for Pump Stations and Turbine Generator Stations, approximately $56,000 per acre.

Pump Station and Turbine Generator Station Costs

The estimated costs presented in this TM 3.4 for Pump Stations are based on a trend analysis of the estimated costs for Pump Stations included in the draft ***Inland Empire Brine Line Disposal Option Concept Investigation*** [3] for which estimated costs were based on Year 2010. The estimated costs presented for Turbine Generator Stations (Energy Recovery Facilities) are based on a trend analysis of the costs for similar facilities presented in ***Desert Aqueduct Project Development Plan Phase 1 Report (Draft)*** [7], indexed to Year 2010.

The estimated cost of electrical service to each of the Pump Stations and Turbine Generator Stations includes a base capital cost of $570,000 per station. The estimated cost of electrical service to the stations would also vary with proximity to existing electrical transmission and distribution facilities. A unit cost of $340,000 per mile was used to calculate the cost of the estimated length of new electric transmission line necessary for each station.

Water Quality Treatment Facility Costs

Conceptual designs are presented in TM 3.3 of this Appraisal Analysis for the proposed Inland Empire Interceptor Water Quality Treatment Facility (TF) to reduce Total Suspended Solids (TSS) and Biochemical Oxygen Demand (BOD) concentrations in the proposed IEI flows. Among the alternative designs considered, the two alternatives that would require the least land area for a given design flow (TF Alternatives 3 and 5) both use wastewater treatment ponds followed by constructed wetlands in the treatment process. It is anticipated for this analysis that the TF would be located in a rural area near the shore of the Salton Sea with relatively low land costs.

The EPA publications ***Manual: Constructed Wetlands Treatment of Municipal Wastewaters*** [4] and ***Principles of Design and Operations of Wastewater Treatment Pond Systems for Plant Operators, Engineers and Managers*** [5] were used to develop the conceptual designs described in TM 3.3. Similarly, the cost data presented in ***Constructed Wetlands Treatment of Municipal Wastewaters*** [4], indexed to Year 2010, were used to develop the estimated costs for the TF presented in this TM 3.4.

Distributive Costs

Distributive Costs are described in ***Reclamation Manual, Directives and Standards, FAC 09-01: Cost Estimating & 09-02: Construction Cost Estimates and Project Cost Estimates*** [9]. FAC 09-01 describes Distributive Costs as costs "of such a broad non-specific nature that they can only be attributed to the project as a whole." FAC 09-02 lists examples of Distributive Costs, which include, but are not limited to, such costs as administrative and facilitating services, planning (investigations), design and specifications, construction management, environmental compliance, archeological considerations, operation and maintenance (O&M) during construction, and project start-up and training.

The estimated Distributive Costs presented in this TM 3.4 were calculated as a percentage of the estimated construction costs for the proposed IEI. The component parts of the estimated Distributive Costs used in this TM 3.4 are presented in **Table 2** below.

Table 2 – Estimated Distributive Costs

COMPONENT	ESTIMATED RANGE	PERCENTAGE USED
Administrative, Planning & Design	8% to 17% of Est. Const. Cost	13.0%
Permits & Fees	1% to 2% of Est. Const. Cost	1.5%
Legal & Financial	1.5% to 3% of Est. Const. Cost	2.5%
Construction Management	5.5% to 9% of Est. Const. Cost	7.0%
Start-up and Training	0.5% to 1% of Est. Const. Cost	1.0%
Total Distributive Costs		25.0%

Contingencies

Contingencies are described in ***Reclamation Manual, Directives and Standards, FAC 09-01: Cost Estimating & 09-02: Construction Cost Estimates and Project Cost Estimates*** [9]. This category in a project cost estimate is an allowance to cover "uncertainties inherent as a project advances from the planning stage through construction that may directly affect the estimated cost of a project." The allowances for Contingencies are typically calculated as a percentage of the estimated costs for the project.

FAC 09-01 lists categories of Design Contingencies, including unlisted items, design and scope changes, and cost estimating refinements. FAC 09-01 lists examples of Construction Contingencies including an allowance “to cover minor differences in actual and estimated quantities, unforeseeable difficulties at the site, changed site conditions, possible minor changes in plans and other uncertainties.” The allowance is intended to take into consideration such factors as “reliability of the data, adequacy of the estimated quantities and general knowledge of the site conditions.”

The allowance for Contingencies presented in this TM 3.4 was calculated as 25% of the estimated construction costs for the proposed IEI, and includes both Design Contingencies and Construction Contingencies.

Operation and Maintenance Costs

The estimated annual Operation and Maintenance (O&M) Costs presented in this TM 3.4 were calculated as a percentage of the estimated construction costs for the related components of the project. The percentages used in this TM 3.4 to estimate the annual O&M Costs are presented in **Table 3** below.

Table 3 – Annual Operation and Maintenance Costs Estimating Criteria

COMPONENT	ESTIMATING CRITERIA
Pipeline	1.5% of Pipeline Estimated Construction Cost
Abandoned Pipeline	0% of Est. Pipeline Abandonment Cost
Pump Stations & Turbine Gen. Stations	2.0% of Estimated Station Construction Cost
Electrical Power Use (Cost)	$0.10 per kWh
Electrical Power Produced (Credit)	$0.04 per kWh
Water Quality Treatment Facility	1.5% of Est. Construction Cost
Evaporation Pond Facility	1.5% of Est. Construction Cost

The estimated annual cost of electrical power used by each Pump Station was added to the estimated annual O&M costs for that station. The estimated annual credit for the electrical power produced by each Turbine Generator Station was deducted from the estimated annual O&M costs for that station.

Present Worth Analysis of Estimated Costs

The ***Santa Ana Watershed Salinity Management Program, Phase 2 SARI Planning Technical Memorandum*** [2] included a Present Worth analysis of the estimated costs for each of the options considered to facilitate comparison. The increasing net present worth of each option was reported for the 30-year period from Year 2010 to Year 2040. The present worth analysis was performed for two assumed future inflation rates for purchase of capacity in the OCSD system, 4.95% and 17.6%.

The data and methodology used in the present worth analysis for the Phase 2 Technical Memorandum were reproduced for use in this Appraisal Analysis. These were used to prepare a present worth analysis for the combination of alignment alternatives with the lowest estimated cost, which can be used for comparison with the present worth analyses presented in the Phase 2 Technical Memorandum.

The present worth analyses for the combination of least-cost alternatives that would serve the proposed Expanded Service Area are presented in **Table 21** and **Table 22** in **Appendix A** of this TM 3.4. The alternatives used in the present worth analyses are Santa Ana Watershed (SAW) Alternative 2, Coachella Valley (CV) Alternative B-1, and Water Quality Treatment Facility (TF) Alternative 5-1. CV Alternative B-1 and TF Alternative 5-1 accommodate projected flows from the San Gorgonio Pass and Coachella Valley areas, as described in TM 3.3. The estimated costs for the Evaporation Pond Facility are **not** included in the present worth analyses presented in this TM 3.4.

Inland Empire Interceptor Alternatives in the Santa Ana Watershed

General Description

The SAWPA Investigation described four alternative conceptual designs for the portion of the IEI in the upper Santa Ana Watershed. Three of these (identified herein as SAW Alternatives 1, 2 and 4) were selected for consideration in TM 3.3 of this Appraisal Analysis. (SAW Alternative 3 was not selected in TM 3.3 for further consideration.) The specific alignments are generally the same as those developed for the SAWPA Investigation.

Alignments

The SAW Alternatives are based upon two primary alignments, which are identified as the Gas Main Alignment and the North Alignment. These are complemented by various combinations of secondary alignments, which are identified as the IEBL Alignment, the EMWD North Alignment, and the IEUA Alignment.

The primary alignment of SAW Alternatives 1 and 2 is the Gas Main Alignment. A portion of the IEBL Alignment (Segments IEBL-1a through IEBL-1d) and the EMWD North Alignment connect to the Gas Main Alignment to comprise SAW Alternative 1. SAW Alternative 2 is comprised of only a portion of the IEBL Alignment (Segments IEBL-1a through IEBL-1d) connected to the Gas Main Alignment.

The primary alignment SAW Alternative 4 is the North Alignment. The IEBL Alignment (Segments IEBL-1a through IEBL-2) and the IEUA Alignment connect to the North Alignment.

Alternatives Considered & Design Flows

Projections of average flows in the proposed IEI are addressed in TM 3.2 of this Appraisal Analysis. A Peak Rate Factor (PRF) of 1.16 was applied to the average flows to calculate the peak flows used to develop the conceptual design for the three SAW Alternatives presented in TM 3.3 (SAW Alternatives 1, 2 and 4). The projected average and peak flows used in this Appraisal Analysis match those developed by SAWPA staff in the ***Inland Empire Brine Line Disposal Option Concept Investigation*** [3].

The primary and secondary alignments that make up SAW Alternatives 1 and 2 are summarized in **Table 4** below, along with the associated peak flows and pipe sizes from the conceptual designs presented in TM 3.3.

Table 4 – SAW Alternatives 1 & 2 Alignments, Peak Flows & Pipe Sizes

Alignment / Segment	End Station	Segment Length (Feet)	SAW Alternative 1 Peak Flow (gpm)	SAW Alternative 1 Pipe Dia. (in)	SAW Alternative 2 Peak Flow (gpm)	SAW Alternative 2 Pipe Dia. (in)
Primary Alignment - Gas Main:						
G-1	650 + 05	52,421	15,312	42	25,937	54
G-2	947 + 74	29,769	15,312	42	25,937	54
G-3	1100 + 00	15,226	15,312	42	25,937	54
G-4a – G-4d	1750 + 80	65,080	15,312	42	25,937	54
G-4e	1911 + 42	16,062	25,937	54	25,937	54
G-5	2070 + 00	15,858	25,937	54	25,937	54
G-6	2412 + 38	34,238	25,937	54	25,937	54
Secondary Alignments:						
IEBL:						
BL-1	125 + 84	12,584	15,312	42	25,937	54
EMWD North:						
EN-1	440 + 00	44,000	8,650	30	n/a	n/a
EN-2	941 + 01	50,101	8,650	30	n/a	n/a

The primary and secondary alignments that make up SAW Alternative 4 are summarized in **Table 5** below, along with the associated peak flows and pipe sizes from the conceptual designs presented in TM 3.3.

Table 5 – SAW Alternative 4 Alignments, Peak Flows & Pipe Sizes

Alignment / Segment	End Station	Segment Length (Feet)	SAW Alternative 4 Peak Flow (gpm)	SAW Alternative 4 Pipe Dia. (in)
Primary Alignment - North:				
N-1a	54 + 34	5,434	1,736	16
N-1b	60 + 20	586	17,326	42
N-1c	580 + 00	51,980	18,715	42
N-1d – N-2a	715 + 00	13,500	20,798	42
N-2b – N-2d	1020 + 00	30,500	21,145	42
N-2e – N-3a	1424 + 00	40,400	23,437	42
N-3b – N-4a	2020 + 00	59,600	25,937	42
N-4b - N-7	2789 + 24	76,924	25,937	54
Secondary Alignments:				
IEBL:				
BL-1a	125 + 84	12,584	15,590	42
BL-1b	365 + 47	23,963	15,590	42
IEUA	89 + 99	8,999	347	16

Modifications to the Existing Brine Line System

If the proposed IEI were implemented, the existing 21 miles of pipeline that convey the Brine Line flows from the point of convergence in the vicinity of Prado Dam to Orange County Sanitation District (OCSD) facilities would need to be abandoned or converted to some other beneficial use. Any costs associated with abandonment or conversion of this outfall pipeline would be common to each of the three SAW Alternatives (SAW Alternatives 1, 2 and 4) under consideration in this Appraisal Analysis. Therefore, these costs are included in the estimate costs for each of the SAW Alternatives. The unit cost used to develop the estimate costs of abandonment is based on an assumed typical pipeline size of 54 inches.

If that pipeline could be converted to another use, the cost of abandonment may be reduced or eliminated.

Cost Estimates for SAW Alternatives 1, 2 and 4

The estimated costs for the conceptual designs developed in TM 3.3 of this Appraisal Analysis for the three SAW Alternatives under consideration (SAW Alternatives 1, 2 and 4) are summarized in **Table 10** of the section of this TM 3.4 entitled “Cost Estimate – Least Cost Alternative”. The estimated construction costs for SAW Alternative 2 are lower than the estimated construction costs for both SAW Alternative 1 and SAW Alternative 4.

Inland Empire Interceptor Alternatives in San Gorgonio Pass and Coachella Valley

General Description

Two alternative alignments are described in TM 3.3 of this Appraisal Analysis for the portion of the proposed IEI through the San Gorgonio Pass and Coachella Valley areas. TM 3.3 also describes three alternative conceptual designs developed for each of the two alignments under consideration in this Appraisal Analysis. Two of the three alternatives utilize energy recovery facilities to optimize the hydraulic characteristics of the system. The third alternative for each alignment (without flow controls) had unacceptable hydraulic characteristics. Therefore, estimated costs are presented in this TM 3.4 only for the two alternatives (for each alignment) utilizing energy recovery facilities.

Alignments

The two alignments developed for the portion of the proposed IEI through the San Gorgonio Pass and Coachella Valley areas are identified in this Appraisal Analysis as CV Alignment A and CV Alignment B. CV Alignment A generally follows an existing gas main easement through the San Gorgonio Pass area and follows Coachella Canal for a substantial portion of the length through Coachella Valley. CV Alignment B generally follows the abandoned pavement of the U.S. Highway 60 / 70 / 99 alignment through much of the San Gorgonio Pass area. This abandoned pavement is located between the I-10 and Union Pacific Railroad (UPRR) rights-of-way. CV Alignment B follows the Whitewater River / Coachella Valley Storm Water Channel (CVSC) through Coachella Valley.

Alternatives Considered & Design Flows

Projections of average flows in the proposed IEI are addressed in TM 3.2 of this Appraisal Analysis. Alternative flow projections are presented, with and without projected flows from the potential service area expansion in the San Gorgonio Pass and Coachella Valley areas. A Peak Rate Factor (PRF) of 1.16 was applied to the Average Flows tabulated above to calculate the Peak Flows used to develop the conceptual design for each of the CV Alternatives and to perform the hydraulic analysis of each. This PRF is the same as that used in the Salinity Management Program and SAWPA Investigation reports.

For purpose of comparison, conceptual designs were developed for each of the CV Alignments using both sets of peak flow projections. Energy Recovery Facilities were included in the alternative conceptual designs to maintain full pipe flow.

The peak flows and pipe sizes for the various segments of CV Alignment A from the conceptual designs presented in TM 3.3 for the two alternatives with Energy Recovery Facilities are presented in **Table 6** below.

Table 6 – CV Alignment A Segments, Peak Flows & Pipe Sizes

Segment End Station	Segment Length	CV Alternative A-1 (Flows from Expanded Service Area)		CV Alternative A-2 (Flows from Existing Service Area)	
		Peak Flow	Pipe Dia.	Peak Flow	Pipe Dia.
	(Feet)	(gpm)	(in)	(gpm)	(in)
1258 + 60	125,860	25,937	36	25,937	36
1320 + 00	6,140	25,937	48	25,937	36
1982 + 55	66,255	39,428	48	25,937	36
3193 + 17	121,062	39,428	48	25,937	42
4060 + 00	86,683	42,509	54	25,937	42
4410 + 50	35,050	54,625	54	25,937	42
4480 + 00	6,950	60,636	60	25,937	42

The peak flows and pipe sizes for the various segments of CV Alignment B from the conceptual designs presented in TM 3.3 for the two alternatives with Energy Recovery Facilities are presented in **Table 7** below.

Table 7 – CV Alignment B Segments, Peak Flows & Pipe Sizes

Segment End Station	Segment Length	CV Alternative B-1 (Flows from Expanded Service Area)		CV Alternative B-2 (Flows from Existing Service Area)	
		Peak Flow	Pipe Dia.	Peak Flow	Pipe Dia.
	(Feet)	(gpm)	(in)	(gpm)	(in)
1110 + 00	111,000	25,937	36	25,937	36
1725 + 33	61,533	39,428	48	25,937	36
2860 + 00	113,467	39,428	48	25,937	42
3380 + 50	52,050	42,509	54	25,937	42
3690 + 00	30,950	54,625	54	25,937	42
3775 + 97	8,000	60,636	60	25,937	42

Cost Estimates for CV Alignments A and B

The conceptual designs and the associated estimated costs for the two alternative CV Alignments (A and B) should be compared for the same projected flows. Therefore, CV Alternatives A-1 and B-1 should be paired for comparison and analysis, since both were designed for projected flows from the potential service area expansion in the San Gorgonio Pass and Coachella Valley areas. Similarly, CV Alternative A-2 should be paired with CV Alternative B-2, since both were designed for flows from only the existing SAWPA service area.

The estimated construction costs for CV Alternatives A-1 and B-1 are summarized in **Table 11** of the section of this TM 3.4 entitled “Cost Estimate – Least Cost Alternative”. The estimated construction costs for CV Alternative B-1 are lower than the estimated construction costs for CV Alternative A-1.

The estimated construction costs for CV Alternatives A-2 and B-2 are summarized in **Table 13** of the section of this TM 3.4 entitled “Cost Estimate – Least Cost Alternative”. The estimated construction costs for CV Alternative B-2 are lower than the estimated construction costs for CV Alternative A-2.

Energy Recovery Facilities Costs

The estimated costs of the proposed energy recovery facilities have a significant influence on the total estimated costs for all four CV Alternatives considered. The large costs associated with the proposed Turbine Generator Stations and the associated electric transmission facilities and higher pressure classes of pipe in relation to the value of the electrical energy produced annually indicate that the time period necessary to recover the investment in those facilities would be long.

As discussed in TM 3.3 of this Appraisal Analysis, these energy recovery facilities were incorporated into the conceptual designs as a means of extracting surplus energy from the flows in the proposed IEI. However, this design goal could be accomplished by other means. For example, low-head in-line turbine generators could be used to capture that surplus energy without need for higher pressure classes of pipe. This approach would eliminate the added costs of higher pressure classes of pipe necessary to accommodate the energy recovery facilities as proposed in this Appraisal Analysis, but the costs associated with these low-head in-line turbine generators and the associated electric transmission facilities would likely be similar to the costs of the proposed energy recovery facilities considered in this Appraisal Analysis.

Alternatively, the surplus energy could be dissipated using flow control devices in the pipeline, the cost of which would certainly be substantially less than the cost of either the energy recovery facilities proposed in this Appraisal Analysis or the low-head in-line turbine generator alternative. However, there would be no accompanying energy recovery or credit for electricity produced to help offset costs.

Water Quality Treatment Facility

Background

The water quality issues in the Salton Sea and the potential impacts of the proposed IEI on the Salton Sea are discussed in TM 3.3 of this Appraisal Analysis. Various combinations of wastewater treatment ponds and constructed wetlands, collectively identified herein as the Inland Empire Interceptor Treatment Facility (TF), are considered for treatment of the IEI flows for TSS and BOD. Estimated costs are presented in this section of this TM 3.4 for each of two alternative designs for the proposed TF.

The large land area necessary for the TF suggests a location in a rural area with relatively low land costs. The proposed location of the TF at the downstream end of the IEI near the shore of the Salton Sea fits this criterion and would facilitate gravity flow.

As discussed in TM 3.3 of this Appraisal Analysis, water treatment processes used to reduce TSS and BOD concentrations are not effective at significantly reducing TDS concentrations. Therefore, if removal of salt from IEI flows were deemed necessary to reduce or mitigate for accumulation of salts from the IEI in the Salton Sea, then this treatment could best be accomplished using a separate process. A conceptual design for an Evaporation Pond Facility is presented in Appendix C of TM 3.3 as an alternative approach for removal of salts from the Salton Sea attributable to the IEI flows. Estimated costs associated with an Evaporation Pond Facility sized for the projected IEI flows are addressed in **Appendix B** of this TM 3.4.

Treatment Facility Conceptual Designs

The U.S. Environmental Protection Agency (EPA) publications entitled ***Principles of Design and Operations of Wastewater Treatment Pond Systems for Plant Operators, Engineers and Managers*** [5] (WTP Manual) and ***Manual: Constructed Wetlands Treatment of Municipal Wastewaters*** [4] (CW Manual) were used for conceptual design(s) for the Inland Empire Interceptor Treatment Facility (TF) described in TM 3.3. The WTP Manual also provides information useful for development of estimated construction costs and O&M costs for constructed wetlands.

Alternatives Considered & Design Flows

Alternative conceptual designs for the TF are presented in TM 3.3. Two of these alternatives are considered in this TM 3.4.

TF Alternative 3 would provide TSS and BOD removal using a Facultative Wastewater Treatment Pond (FTP) to pre-treat flows prior to treatment in a Free Water Surface Constructed Wetland (FWS CW). TF Alternative 3 would produce discharges to the Salton Sea with TSS and BOD concentrations that meet or exceed EPA effluent standards (30 mg/L for both TSS and BOD).

TF Alternative 5 would also provide TSS and BOD removal using a Facultative Wastewater Treatment Pond (FTP) to pre-treat flows prior to treatment in a Free Water Surface Constructed Wetland (FWS CW). TF Alternative 5 would treat only a portion of the IEI flows. The effluent would then be blended with the balance of the IEI flows to produce discharges to the Salton Sea with average TSS concentration of approximately 200 mg/L.

Projections of average flows in the proposed IEI are addressed in TM 3.2 of this Appraisal Analysis. Alternative flow projections are presented, with and without projected flows from the potential service area expansion in the San Gorgonio Pass and Coachella Valley areas. Alternative conceptual designs were developed for the TF using both sets of average flow projections.

The minimum surface areas for the FTP and the FWS CW of TF Alternative 3 and the total area of the facility are summarized for both projected flows in **Table 8** below.

Table 8 – Treatment Facility Alternative 3 Average Flows and Areas

	Avg. Flow (2060)	Minimum Surface Area			Minimum Total Area
		FTP	FWS CW	Subtotal	
	(MGD)	(Acres)	(Acres)	(Acres)	(Acres)
Existing SAWPA Service Area (Alt. 3-2)	32.1	1,391	1,039	2,430	3,159
Expanded Service Area (Alt. 3-1)	75.1	2,411	1,800	4,211	5,474

The minimum surface areas for the FTP and the FWS CW of TF Alternative 5 and the total area of the facility are summarized for both projected flows in **Table 9** below.

Table 9 – Treatment Facility Alternative 5 Average Flows and Areas

	Avg. Flow (2060)	Minimum Surface Area			Minimum Total Area
		FTP	FWS CW	Subtotal	
	(MGD)	(Acres)	(Acres)	(Acres)	(Acres)
Existing SAWPA Service Area (Alt. 5-2)	32.1	927	693	1,620	2,106
Expanded Service Area (Alt. 5-1)	75.1	1,434	1,071	2,505	3,257

Treatment Facility Cost Estimates

The conceptual designs and associated estimated costs for the two alternative TF designs (TF Alternatives 3 and 5) should be compared for the same projected flows. Therefore, TF Alternatives 3-1 and 5-1 should be paired for comparison and analysis, since both were designed for projected flows from the potential service area expansion in the San Gorgonio Pass and Coachella Valley areas. Similarly, TF Alternative 3-2 should be paired with TF Alternative 5-2, since both were designed for flows from only the existing SAWPA service area.

The estimated construction costs for TF Alternatives 3-1 and 5-1 are summarized in **Table 12** of the section of this TM 3.4 entitled “Cost Estimate – Least Cost Alternative”. The estimated costs of TF Alternative 5-1 are lower than those of TF Alternative 3-1.

The estimated construction costs for TF Alternatives 3-2 and 5-2 are summarized in **Table 14** of the section of this TM 3.4 entitled “Cost Estimate – Least Cost Alternative”. The estimated costs of TF Alternative 5-2 are lower than the estimated costs of TF Alternative 3-2.

The estimated costs of the proposed Water Quality Treatment Facility represent a substantial portion of the estimated costs for the overall project. Therefore, if implementation of the proposed IEI receives further consideration, the need for the TF and the applicable design criteria warrants careful scrutiny.

For example, the item with the largest estimated construction cost for both TF Alternatives is the impermeable liner. A clay or synthetic membrane liner is recommended in the CW Manual [4] under a constructed wetland if the permeability of the soil is greater than approximately 10^{-6} cm/sec (0.0014 in/hr). Available soil survey data from the U.S. Department of Agriculture’s (USDA) Natural Resources Conservation Service (formerly the Soil Conservation Service) for the Salton Sea area indicate that the permeability of the soils in the area is much greater than this recommended maximum. Due to the permeability of the soils in the area, the cost of the liner has been included in the estimated construction costs for both TF Alternatives. The magnitude of the cost of the liner suggests that investigation of alternatives would be warranted.

Alternatives could include site-specific soil investigations to determine actual soil permeability and soil treatment with clay (e.g. bentonite) to reduce soil permeability to acceptable levels. Also, the CW Manual [4] acknowledges that a "'leaky wetland', which may take advantage of natural processes to purify wastewater as it moves downward through soil to recharge groundwater, may be a potential benefit in certain areas." Investigation of the suitability of a "leaky wetland" for this TF may also warrant investigation.

Cost Estimate – Least Cost Alternative

Summaries of Cost Estimates for Santa Ana Watershed Alternatives

The estimated costs for the three SAW Alternatives (SAW Alternatives 1, 2 and 4) are summarized in **Table 10** below. The estimated costs for the least cost SAW Alternative (SAW Alternative 2) are presented in detail in **Table 18** in **Appendix A** of this TM 3.4.

Table 10 – Summary of Costs of SAW Alternatives

Description	SAW Alternative		
	1	**2**	**4**
Construction Costs	$344,029,200	$337,680,902	$368,539,425
Distributive Costs (25%)	$86,007,300	$84,420,226	$92,134,856
Contingencies (25%)	$86,007,300	$84,420,226	$92,134,856
Total Construction Costs	**$516,043,800**	**$506,521,354**	**$552,809,138**
Annual O&M Costs	$18,069,608	$20,249,464	$21,090,154

The estimated costs for SAW Alternative 2 are lower than the estimated costs for SAW Alternatives 1 and 4. Therefore, SAW Alternative 2 is the least-cost alternative for this portion of the proposed IEI.

Summaries of Cost Estimates for Coachella Valley Alternatives

The estimated costs for the two CV Alternatives designed to serve the proposed expanded service area (CV Alternatives A-1 and B-1) are summarized in **Table 11** on the next page. The estimated costs for the least cost of these alternatives (CV Alternative B-1) are presented in detail in **Table 19** in **Appendix A** of this TM 3.4.

Table 11 – Summary of Costs of CV Alternatives (Expanded Service Area)

Description	CV Alternative	
	A-1	**B-1**
Construction Costs	$396,307,228	$309,420,966
Distributive Costs (25%)	$99,076,807	$77,355,241
Contingencies (25%)	$99,076,807	$77,355,241
Total Construction Costs	**$594,460,842**	**$464,131,449**
Annual O&M Costs	$6,536,048	$4,661,725

The estimated costs for CV Alternative B-1 are lower than the estimated costs for CV Alternative A-1. Therefore, CV Alternative B-1 is the least-cost alternative for this portion of the proposed IEI serving the proposed expanded service area.

The estimated costs for the two TF Alternatives designed to serve the proposed expanded service area (TF Alternatives 3-1 and 5-1) are summarized in **Table 12** below. The estimated costs for the least cost of these alternatives (TF Alternative 5-1) are presented in detail in **Table 20** in **Appendix A** of this TM 3.4.

Table 12 – Summary of Costs of TF Alternatives (Expanded Service Area)

Description	TF Alternative	
	3-1	**5-1**
Construction Costs	$745,972,900	$443,759,100
Distributive Costs (25%)	$186,493,225	$110,939,775
Contingencies (25%)	$186,493,225	$110,939,775
Total Construction Costs	**$1,118,959,350**	**$665,638,650**
Annual O&M Costs	$16,784,390	$9,984,580

The estimated costs for TF Alternative 5-1 are lower than the estimated costs for TF Alternative 3-1. Therefore, TF Alternative 5-1 is the least-cost alternative for this portion of the proposed IEI serving the proposed expanded service area.

The estimated costs for the two CV Alternatives designed to convey flows from only the existing SAWPA service area (CV Alternatives A-2 and B-2) are summarized in **Table 13** below.

Table 13 – Summary of Costs of CV Alternatives (Existing Service Area)

Description	CV Alternative	
	A-2	**B-2**
Construction Costs	$341,365,243	$250,100,820
Distributive Costs (25%)	$85,341,311	$62,525,205
Contingencies (25%)	$85,341,311	$62,525,205
Total Construction Costs	**$512,047,864**	**$375,151,230**
Annual O&M Costs	$6,350,856	$3,756,286

The estimated costs for CV Alternative B-2 are lower than the estimated costs for CV Alternative A-2. Therefore, CV Alternative B-2 is the least-cost alternative for this portion of the proposed IEI serving only the existing SAWPA service area.

The estimated costs for the two TF Alternatives designed to treat flows from only the existing SAWPA service area (TF Alternatives 3-2 and 5-2) are summarized in **Table 14** below.

Table 14 – Summary of Costs of TF Alternatives (Existing Service Area)

Description	TF Alternative	
	3-2	**5-2**
Construction Costs	$430,473,400	$286,984,800
Distributive Costs (25%)	$107,618,350	$71,746,200
Contingencies (25%)	$107,618,350	$71,746,200
Total Construction Costs	**$645,710,100**	**$430,477,200**
Annual O&M Costs	$9,685,652	$6,457,158

The estimated costs for TF Alternative 5-2 are lower than the estimated costs for TF Alternative 3-1. Therefore, TF Alternative 5-2 is the least-cost alternative for this portion of the proposed IEI serving the existing SAWPA service area.

Least Cost Alternatives

The total estimated cost for the proposed IEI to serve the proposed expanded service area is the combined estimated costs of SAW Alternative 2, CV

Alternative B-1 and TF Alternative 5-1, the least-cost alternatives identified above. Therefore, the total estimated cost for the proposed IEI to serve the proposed expanded service area is summarized in **Table 15** below.

Table 15 – Summary of Least Cost Alternatives (Expanded Service Area)

Description	Alternative			
	SAW Alt. 2	**CV Alt. B-1**	**TF Alt. 5-1**	**TOTALS**
Construction Costs	$337,680,902	$309,420,966	$443,759,100	$1,090,860,968
Distributive Costs (25%)	$84,420,226	$77,355,241	$110,939,775	$272,715,242
Contingencies (25%)	$84,420,226	$77,355,241	$110,939,775	$272,715,242
Total Construction Costs	**$506,521,354**	**$464,131,449**	**$665,638,650**	**$1,636,291,452**
Annual O&M Costs	$20,249,464	$4,661,725	$9,984,580	$34,895,769

The total estimated cost for the proposed IEI to serve the existing SAWPA service area is the combined estimated costs of SAW Alternative 2, CV Alternative B-2, and TF Alternative 5-2, which are the least-cost alternatives identified above. Therefore, the total estimated cost for the proposed IEI to serve the existing SAWPA service area is summarized in **Table 16** below.

Table 16 – Summary of Least Cost Alternatives (Existing SAWPA Service Area)

Description	Alternative			
	SAW Alt. 2	**CV Alt. B-2**	**TF Alt. 5-2**	**TOTALS**
Construction Costs	$337,680,902	$250,100,820	$286,984,800	$874,766,522
Distributive Costs (25%)	$84,420,226	$62,525,205	$71,746,200	$218,691,631
Contingencies (25%)	$84,420,226	$62,525,205	$71,746,200	$218,691,631
Total Construction Costs	**$506,521,354**	**$375,151,230**	**$430,477,200**	**$1,312,149,783**
Annual O&M Costs	$20,249,464	$3,756,286	$6,457,158	$30,462,908

Present Worth Analysis

Present worth analyses were presented in the ***Santa Ana Watershed Salinity Management Program Phase 2 SARI Planning Technical Memorandum*** [1] of the estimated costs for each of the options considered in that study to facilitate comparison. The methodology used in this Phase 2 Technical Memorandum present worth analyses were reproduced for use in this Appraisal Analysis to prepare a present worth analysis for the combined estimated costs of SAW Alternative 2, CV Alternative B-1, and TF Alternative 5-1, which are the least-cost alternatives identified above to serve the proposed Expanded Service Area.

The increasing net present worth of this combination of alternatives is reported for the 30-year period from Year 2010 to Year 2040. The present worth analysis was performed for the two assumed future inflation rates for purchase of capacity in the OCSD system used in the Phase 2 Technical Memorandum present worth analyses, 4.95% and 17.6%. This present worth analysis was performed to facilitate comparison of the proposed IEI with the present worth analyses of the options considered in the Technical Memorandum [1].

Present worth analyses for the combination of least cost alternatives that would serve the proposed Expanded Service Area (SAW Alternative 2, CV Alternative B-1 and TF Alternative 5-1) are presented in **Table 21** and **Table 22** in **Appendix A** of this TM 3.4.

Opportunities and Optimization Strategies

General Description

The present worth analysis presented in this TM 3.4 evaluates the combination of alignment alternatives that would serve the proposed Expanded Service Area with the lowest estimated cost. This analysis was prepared for the purpose of comparison with the present worth analyses presented in the ***Salinity Management Program Phase 2 Technical Memorandum*** [1]. A simple comparison of the results of these present worth analyses indicates that the present worth of the estimated costs of the proposed IEI are greater than the costs of other options considered in the Salinity Management Program.

However, various aspects of the proposed IEI distinguish this option from the other options considered in the Salinity Management Program. For example, as discussed in TM 3.3 of this Appraisal Analysis, the proposed IEI has great potential as a tool for economic development in the San Gorgonio Pass and Coachella Valley areas along the route, making brine management infrastructure available to prospective employers in the area. This Economic Development Opportunity is unique to the proposed IEI among all the options considered and may significantly influence the benefits associated with this option, which may help to offset the estimated costs.

Furthermore, significant Opportunities are available for refinement of the conceptual designs for the proposed IEI presented in this Appraisal Analysis. Any of these Opportunities could result in reduction or elimination of certain costs included in the estimates presented in this TM 3.4. For example, uncertainties related to appropriate water quality standards for discharges to the Salton Sea and to implementation of a restoration plan for the Sea help make the design criteria for the Water Quality Treatment Facility (TF) similarly uncertain. Reducing the scope of those uncertainties would help verify the need for the TF, determine appropriate TF design criteria, and reduce the multiplier for contingencies. The estimated costs for the TF are a substantial portion of the total estimated costs for the proposed IEI, so reducing the scope of any uncertainties could significantly influence the total estimated costs for the proposed IEI.

Evaluation of Opportunities for refinement of the scope, design, estimated costs and anticipated benefits of a project is an incremental process. Each incremental step in this process often includes identification of appropriate “next steps” in the process. For the proposed IEI, the appropriate next steps are identified in this TM

3.4 as Optimization Strategies. Suggested Optimization Strategies include performing further investigation of the Opportunities identified. Priority rankings are assigned to those Optimization Strategies, but these priority rankings are subjective and loosely based on the potential influence on the estimated project costs and/or the value of anticipated benefits.

The Opportunities and the associated Optimization Strategies identified in this Appraisal Analysis are discussed on the following pages and summarized in **Table 17** located at the end of this section of this TM 3.4. The suggested priorities for each Opportunity and for the associated Optimization Strategies are also identified in **Table 17**.

Economic Development Opportunities

As noted in TM 3.3 of this Appraisal Analysis, the economic development potential associated with the proposed IEI is significant. The history of economic development in the Santa Ana Watershed demonstrates that brine management infrastructure is a valuable tool for economic development. Industrial facilities in the upper Santa Ana Watershed are major contributors of flow to the existing Brine Line. That history suggests that the proposed IEI, if implemented, would make similar brine management infrastructure available to prospective employers located in the San Gorgonio Pass and Coachella Valley areas.

Similarly, the proposed Gas Main Alignment traverses portions of the existing SAWPA service area that are not currently served by the existing Brine Line. The Gas Main Alignment is the primary alignment for SAW Alternative 2, which is identified in this TM 3.4 as the least cost alternative for the Santa Ana Watershed portion of the proposed IEI.

Economic development in San Gorgonio Pass and Coachella Valley encouraged by availability of brine disposal infrastructure could also serve to facilitate efforts to restore the Salton Sea.

The other options considered in the Salinity Management Program would not significantly expand the SAWPA service area, nor extend infrastructure to provide service to areas within the existing SAWPA service area where it is not currently available. Nor would those other options influence efforts to restore the Salton Sea. Therefore, Economic Development Opportunities associated with the proposed IEI are unique to this option. Successful pursuit of those Economic Development Opportunities could offset some portion of the estimated costs of the proposed IEI, which could significantly alter the comparison of the IEI estimated costs with those of the other options considered in the Salinity Management Program.

The suggested Optimization Strategy for the Economic Development Opportunities is to perform an economic impact analysis for the proposed IEI.

This economic impact analysis should be used to quantify the economic development benefits of the proposed IEI and used to refine the IEI estimated costs for comparison with the estimated costs of the other options considered in the Salinity Management Program.

Net Impact

If implemented, the proposed IEI would impact the Salton Sea in various ways, some of which may be considered beneficial and others negative. For example, the projected flows in the proposed IEI could provide a reliable new source of water to the Salton Sea. Though the projected IEI flows are small in comparison to the loss of water from the Sea to evaporation, they could offset a portion of the imbalance in the Salton Sea water budget.

The beneficial impacts from the increased supply of water to the Sea may offset or exceed the detrimental impacts from the increased salt load conveyed by the IEI flows. If so, the net impact of the proposed IEI flows on Salton Sea salinity would be beneficial. Conversely, if it were determined that the proposed IEI flows would have a net detrimental impact on salinity in the Salton Sea, appropriate measures should be incorporated into the IEI design to offset or mitigate for that impact (e.g. the Evaporation Pond Facility (EPF)).

The suggested Optimization Strategy associated with the Net Impact of the proposed IEI is to perform a more detailed investigation of both beneficial and detrimental impacts of the proposed IEI on the Salton Sea. This investigation may include:

- Development or refinement of a water budget for the Salton Sea,
- Development or refinement of models for salinity and water quality in the Salton Sea,
- Modeling of the impact of the proposed IEI flows on salinity and water quality in the Salton Sea, and
- Evaluation of the influence of Salton Sea salinity and water quality regulatory requirements on the design and estimated costs of various components of the proposed IEI.

Salton Sea Restoration

As discussed in TM 3.3 of this Appraisal Analysis, the Salton Sea is a terminal water body and, as such, no outlet is available for the salts, nutrients and other contaminants conveyed by water flowing into the Sea. It is typical of such terminal water bodies in a desert environment that concentrations of these salts, nutrients and other contaminants accumulate are dynamic, increasing over time. Several plans have been proposed in recent years for restoration of the Salton Sea in response to both the deteriorating water budget imbalance and the deteriorating water quality. Implementation of any of these restoration plans has been impeded by the estimated costs, which contributes to significant uncertainties regarding salinity and water quality aspects of the proposed IEI. A clear understanding of how the low-salinity flows conveyed by the proposed IEI would influence TDS concentrations and other water quality parameters in the Salton Sea or in affected components of a Salton Sea restoration plan would help to reduce those uncertainties.

Similarly, resolution of uncertainties regarding specific components of Salton Sea restoration could facilitate design and construction of the proposed IEI in collaboration with corresponding components of the Salton Sea restoration plan. For example, the TF presented in this Appraisal Analysis for treatment of the IEI flows, if needed, could be developed in combination with the “habitat complex” included in proposed Salton Sea restoration plans as part of a hybrid facility. In this case, the proposed IEI flows could provide a reliable water supply to the habitat complex.

The suggested Optimization Strategy for the Opportunities associated with efforts to restore the Salton Sea is to investigate the likely impacts of implementation of restoration on planning and design development for the proposed IEI. This investigation would likely overlap with the Optimization Strategy for Net Impact discussed above and may include:

- Development or refinement of a water budget for the Salton Sea,
- Development or refinement of models for salinity and water quality in the Salton Sea,
- Modeling of the impact of the proposed IEI flows on salinity and water quality in the affected components of the Salton Sea restoration, and
- Evaluation of the influence of Salton Sea Restoration efforts on the design and estimated costs of various components of the proposed IEI.

Basin Plan

Similar to the uncertainties regarding Salton Sea restoration efforts, Salton Sea salinity and water quality regulatory requirements add to the uncertainties regarding the associated components of the proposed IEI. As discussed in TM 3.3 of this Appraisal Analysis, evaluation of the impacts of the proposed IEI would be based largely on standards established in the State of California’s Colorado River Basin Water Quality Control Plan (Basin Plan). Approval of a Basin Plan Amendment will be required for implementation of the proposed IEI.

The suggested Optimization Strategy associated with the Basin Plan is to perform a more detailed investigation of the process and technical requirements for the necessary Basin Plan Amendment.

As also discussed in TM 3.3 of this Appraisal Analysis, it should be noted that in an arid climate like that of the area tributary to the Salton Sea, water treated to Basin Plan standards would be a highly valued resource with many potential uses. The cost of treating water to those standards is significant, as demonstrated by the estimated costs for the TF and the EPF presented in this TM 3.4. It is difficult to justify those costs for water intended for discharge to a surface water body with much higher salinity and poor water quality from which that water cannot be recovered for some other use. Any water supplies that comply with the requirements of the Basin Plan would certainly have greater value for potential uses other than discharge to the Sea. Therefore, the water quality standards established in the Basin Plan are a deterrent to any potential new sources of water to the Salton Sea and contribute to the uncertainties noted above regarding salinity and water quality aspects of the proposed IEI and the associated costs.

If new sources of water supply to the Salton Sea are to be encouraged in support of restoration efforts, then a change to the regulatory approach to Salton Sea salinity and water quality standards warrants serious consideration. Broad-based community support would certainly be necessary for such a change.

Stakeholder Partnering

The objective of the change suggested in this Appraisal Analysis to the regulatory approach to Salton Sea salinity and water quality standards is to reduce obstacles to potential new sources of water supply to the Salton Sea in support of restoration efforts. The influence of any such change would extend well beyond the scope of any single project, and community-based support for the change would enhance the likelihood of adoption. This circumstance represents an Opportunity for SAWPA to partner with other Salton Sea stakeholders.

The suggested Optimization Strategy associated with this Stakeholder Partnering Opportunity is to identify Salton Sea stakeholders and investigate opportunities for partnerships with those stakeholders. These Partnerships could help to develop specific proposals for the suggested regulatory changes, identify the benefits of the changes, and communicate those changes and benefits to the broader community. Potential partners would likely include other organizations serving the San Gorgonio Pass, Coachella Valley areas, and/or other areas tributary to the Salton Sea, such as:

- Economic development organizations,
- Electric and other dry utilities providers,
- Irrigation districts,
- Other major water users or suppliers,
- Salton Sea stakeholders,
- Tribes, and
- Water utilities.

Salton Sea Salinity

Though the projected TDS concentrations in the IEI flows (up to 6,800 mg/L) are much lower than existing TDS concentrations in the Sea (approximately 48,000 mg/L). The salts in the IEI flows would add to the existing rate of accumulation of salts in the Sea. Whether the salts in the IEI flows would cause the TDS concentrations in the Sea to increase will depend on factors beyond the scope of this Appraisal Analysis, such as the magnitude of the Salton Sea water budget imbalance over time and progress toward implementation of a Salton Sea restoration plan.

The suggested Optimization Strategy for the Opportunities associated with Salton Sea Salinity is to investigate the likely influence of the proposed IEI flows on TDS concentrations in the Salton Sea. This investigation would likely overlap with the Optimization Strategies described for Net Impact and Salton Sea Restoration discussed above and for Salton Sea Water Quality discussed below and may include:

- Development or refinement of a water budget for the Salton Sea,
- Development or refinement of models for salinity and water quality in the Salton Sea,
- Modeling of the impact of the proposed IEI flows on salinity in the Salton Sea, and
- Evaluation of the influence of Salton Sea salinity regulatory requirements on the design and estimated costs of various components of the proposed IEI.

Salton Sea Water Quality

The Basin Plan is less specific about limitations on concentrations of TSS and BOD than it is for limits on TDS concentrations, but cites the EPA effluent standard for discharge of wastewater effluent to surface water for both TSS and BOD (30 mg/L). These parameters (TSS and BOD) correlate with or influence other water quality parameters for which specific standards are identified in the Basin Plan, including concentrations of turbidity, dissolved oxygen, and bacteria. As with TDS in the IEI flows discussed above, whether the TSS and/or BOD in in the IEI flows would cause adverse impacts on the water quality in the Sea will depend on factors beyond the scope of this Appraisal Analysis, such as the magnitude of the Salton Sea water budget imbalance over time and progress toward implementation of a Salton Sea restoration plan.

The suggested Optimization Strategy for the Opportunities associated with Salton Sea Water Quality is to investigate the likely influence of the proposed IEI flows on TSS and BOD concentrations in the Salton Sea. This investigation would likely overlap with the Optimization Strategies described for Net Impact, Salton Sea Restoration, and Salton Sea Salinity discussed above and may include:

- Development or refinement of a water budget for the Salton Sea,
- Development or refinement of models for salinity and water quality in the Salton Sea,
- Modeling of the impact of the proposed IEI flows on water quality in the Salton Sea, and
- Evaluation of the influence of Salton Sea water quality regulatory requirements on the design and estimated costs of various components of the proposed IEI.

Brine Pre-treatment and Treatment Strategies

Six strategies for managing flows in the Brine Line system were addressed by CDM in the Salinity Management Program [2]. Four of those Options (2a, 2b, 3a and 3b) involve changes to the method and/or degree of treatment of Brine Line flows, and two of those Options (3a and 3b) involve pre-treatment of brine to reduce BOD loads prior to discharge to the Brine Line system.

Potential strategies for centralized treatment of the Brine Line (IEI) flows are presented in TM 3.3 of this Appraisal Analysis as alternatives to the brine pre-treatment strategies discussed in the Salinity Management Program [2]. The Treatment Facility (TF) would use wastewater treatment ponds and constructed wetlands as a centralized treatment mechanism to reduce TSS and BOD concentrations in the flows prior to discharge to the Salton Sea.

The suggested Optimization Strategy for the Opportunities associated with Brine Pre-treatment and Treatment is to develop and evaluate alternative strategies for treatment of the IEI flows, based on results of Optimization Strategy for other Opportunities discussed above. This Optimization Strategy may include development of hybrid conceptual designs incorporating Salinity Management Program brine pre-treatment strategies in combination with alternative configurations of the wastewater treatment ponds and/or constructed wetlands that comprise the TF considered in this Appraisal Analysis.

Management of Surplus Energy

As discussed previously in this TM 3.4, the estimated costs of the proposed energy recovery facilities have a significant influence on the estimated costs for all four CV Alternatives considered. The large costs associated with the proposed Turbine Generator Stations and the associated electric transmission facilities and higher pressure classes of pipe suggest that the time period necessary to recover the investment in those facilities would be long. The costs associated with removal of surplus energy from the flows in the proposed IEI could be reduced using an alternative approach (e.g. low-head in-line turbine generators or flow control devices). However, the benefits of the accompanying energy recovery or credit for the value of electricity produced would also be reduced or eliminated.

The suggested Optimization Strategy for the Opportunities associated with Management of Surplus Energy is to develop alternative conceptual designs using alternative approaches. This Optimization Strategy should include evaluation of estimated costs and associated credits and/or benefits (if any) of these alternative conceptual designs.

Other Opportunities

Other Opportunities exist to refine, reduce and/or eliminate costs identified in this TM 3.4 for the proposed IEI. Examples of Other Opportunities and the suggested Optimization Strategy for each example include but are not limited to the following:

- **Synthetic Membrane Liners:** The synthetic membrane liner at the Water Quality Treatment Facility (and at the Evaporation Pond Facility) represents an Opportunity to reduce costs through investigation of alternatives as discussed in the section of this TM 3.4 entitled "Water Quality Treatment Facility".
- **Tunneling:** Alternative approaches to pipeline design and construction in selected areas (e.g. tunneling in lieu of direct bury through the Badlands west of the City of Beaumont along the Gas Main Alignment) represents an Opportunity to refine costs through investigation of those alternatives. Tunneling in lieu of direct bury in an area like the Badlands could add construction cost but may reduce impacts associated with the project.
- **Phasing:** Phasing of project components (e.g. use of dual pipelines in Coachella Valley) represents an Opportunity to defer costs until warranted by the flows in the system. Identification of opportunities for phasing of project components and Present Worth analyses of the phased costs may lead to reduced total costs for the project.

Summary

As noted in the discussions on the pages above, some of the suggested Optimization Strategies overlap among some of the Opportunities identified. Therefore, the Opportunities and associated Optimization Strategies are summarized in **Table 17** on the next page.

Table 17 – Summary of Opportunities and Optimization Strategies

		OPTIMIZATION STRATEGIES													
OPPORTUNITIES		**Economic Impact Analysis**	**Salton Sea Water Budget**	**Salton Sea Salinity & Water Quality Model**	**IEI Influence on Salton Sea Salinity**	**IEI Influence on Salton Sea Water Quality**	**Influence on of Salton Sea on IEI Design**	**Basin Plan Amendment Process**	**Salton Sea Regulatory Approach**	**Identify, Investigate, & Initiate Partnerships**	**Hybrid Strategies for Brine Treatment**	**Alternative Conceptual Designs & Est. Costs**	**Investigate Alternative Liner Materials**	**Investigate Tunneling in Lieu of Direct Bury**	**Investigate Phasing of Improvements**
	PRIORITY	**1**	**2**	**2**	**2**	**2**	**2**	**3**	**3**	**4**	**5**	**6**	**7a**	**7b**	**7c**
Economic Development Opportunities	**1**	**X**													
Net Impact	**2**		**X**	**X**	**X**	**X**	**X**								
Salton Sea Restoration	**2**		**X**	**X**	**X**	**X**	**X**								
Basin Plan	**3**							**X**	**X**						
Stakeholder Partnering	**4**									**X**					
Salton Sea Salinity	**2**		**X**	**X**	**X**		**X**								
Salton Sea Water Quality	**2**		**X**	**X**		**X**	**X**								
Brine Pre-treatment and Treatment	**5**										**X**				
Management of Surplus Energy	**6**											**X**			
Other Opportunities	**7**												**X**	**X**	**X**

References

[1] ***Santa Ana Watershed Salinity Management Program, Phase 2 SARI Planning Technical Memorandum***, Camp, Dresser & McKee (CDM), et al for Santa Ana Watershed Project Authority, May 2010.

[2] ***Santa Ana Watershed Salinity Management Program, Summary Report***, CDM, et al for Santa Ana Watershed Project Authority, July 2010.

[3] ***Inland Empire Brine Line Disposal Option Concept Investigation*** (Draft), Santa Ana Watershed Project Authority, October 2011.

[4] ***Manual: Constructed Wetlands Treatment of Municipal Wastewaters***, U.S. Environmental Protection Agency, 1999.

[5] ***Principles of Design and Operations of Wastewater Treatment Pond Systems for Plant Operators, Engineers and Managers***, U.S. Environmental Protection Agency, 2001.

[6] ***Evaporation Pond Sizing with Water Balance and Make-up Water Calculations***, Idaho National Engineering and Environmental Laboratory, Engineering Design File, 2001.

[7] ***Desert Aqueduct Project Development Plan Phase 1 Report (Draft)***, GEI/Bookman-Edmonston, et al for Coachella Valley Water District, et al, August 2007.

[8] ***RSMeans Facilities Construction Cost Data, 2011, 26th Annual Edition***, RSMeans, a division of Reed Construction Data, 2010.

[9] ***Reclamation Manual, Directives and Standards, FAC 09-01: Cost Estimating & 09-02: Construction Cost Estimates and Project Cost Estimates***, Bureau of Reclamation, October 2007.

[10] ***Water Quality Control Plan: Colorado River Basin - Region 7***, Colorado River Basin Regional Water Quality Control Board, 2006.

Appendix A – Cost Estimates

Santa Ana Watershed Alternatives

As discussed in the "Inland Empire Interceptor Alternatives in Santa Ana Watershed" section of this TM 3.4, the estimated costs for each of the SAW Alternatives considered in this Appraisal Analysis are presented in **Table 18** on the pages that follow in this **Appendix A**.

Table 18 – Cost Estimate for Santa Ana Watershed Alternative 2 (Sheet 1 of 4)

Description	Quantity	Units	Pipeline Base Unit Cost	Weighted Location Cost Adj. Factor	Adjusted Unit Cost /Unit Price	Estimated Cost
PIPELINE BASE COST:						
Class 150 Pipe						
54" Diameter Conc Pipe Class 150 Pipe	186,874	LF	$648.00	1.13	$735.39	$137,425,118
Subtotal, Class 150 Pipe	**186,874**	**LF**				**$137,425,118**
Class 200 Pipe						
54" Diameter Conc Pipe Class 200 Pipe	33,800	LF	$702.00	1.13	$796.67	$26,927,315
Subtotal, Class 200 Pipe	**33,800**	**LF**				**$26,927,315**
Class 250 Pipe						
54" Diameter Conc Pipe Class 250 Pipe	16,818	LF	$756.00	1.13	$857.95	$14,429,478
Subtotal, Class 250 Pipe	**16,818**	**LF**				**$14,429,478**
Class 400 Pipe						
54" Diameter Conc Pipe Class 400 Pipe	3,746	LF	$864.00	1.13	$980.52	$3,672,951
Subtotal, Class 400 Pipe	**3,746**	**LF**				**$3,672,951**
SUBTOTAL, PIPELINE BASE COST	**241,238**	**LF**				**$182,454,862**
ADDITIONAL PIPELINE COSTS:						
Easements & Rights-of-Way Acquisition						
Per LF of 100' Esmnt.	35,451	LF			$57.00	**$2,020,707**
Tunneling / Jack & Bore						
Jack and Bore 78" Diameter Steel Casing (54" Carrier Pipe)	2,900	LF			$1,365.00	$3,958,500
Subtotal, Micro-Tunneling / Jack & Bore	**2,900**	**LF**				**$3,958,500.00**
Environmental Mitigation Areas						
Pipeline	14,100	LF			$14.00	$197,400
Parcels		Ac			$6,000	$0
Subtotal, Environmental Mitigation Areas						**$197,400.00**
SUBTOTAL, ADDITIONAL PIPELINE COSTS						**$6,176,607**
EXISTING PIPELINE ABANDONMENT COSTS:						
Existing 54-inch Pipeline Abandonment	110,880	LF			$486.00	**$53,887,680**

Table 18 – Cost Estimate for Santa Ana Watershed Alternative 2 (Sheet 2 of 4)

Description	Quantity	Units	Pipeline Base Unit Cost	Weighted Location Cost Adj. Factor	Adjusted Unit Cost /Unit Price	Estimated Cost
PUMP STATIONS:						
Pump Station 1-BL @ 1228 HP						
Pump Station	1,228	HP			$7,337,991	$7,337,991
Electrical Service	1	Ea			$570,000	$570,000
Transmission Line	1	Mi			$340,000	$340,000
Pump Station Parcel	3.0	Ac			$56,000	$168,000
Subtotal, Pump Station 1-BL						**$8,415,991**
Pump Station 1-G @ 1228 HP						
Pump Station	1,228	HP			$7,337,991	$7,337,991
Electrical Service	1	Ea			$570,000	$570,000
Transmission Line	1	Mi			$340,000	$340,000
Pump Station Parcel	3.0	Ac			$56,000	$168,000
Subtotal, Pump Station 1-G						**$8,415,991**
Pump Station 2-G @ 3193 HP						
Pump Station	3,193	HP			$13,855,925	$13,855,925
Electrical Service	1	Ea			$570,000	$570,000
Transmission Line	1	Mi			$340,000	$340,000
Pump Station Parcel	3.0	Ac			$56,000	$168,000
Subtotal, Pump Station 2-G						**$14,933,925**
Pump Station 3-G @ 2292 HP						
Pump Station	2,292	HP			$11,113,662	$11,113,662
Electrical Service	1	Ea			$570,000	$570,000
Transmission Line	2	Mi			$340,000	$680,000
Pump Station Parcel	3.0	Ac			$56,000	$168,000
Subtotal, Pump Station 3-G						**$12,531,662**
Pump Station 4-G @ 3029 HP						
Pump Station	3,029	HP			$13,378,354	$13,378,354
Electrical Service	1	Ea			$570,000	$570,000
Transmission Line	5	Mi			$340,000	$1,700,000
Pump Station Parcel	3.0	Ac			$56,000	$168,000
Subtotal, Pump Station 4-G						**$15,816,354**

Table 18 – Cost Estimate for Santa Ana Watershed Alternative 2 (Sheet 3 of 4)

Description	Quantity	Units	Pipeline Base Unit Cost	Weighted Location Cost Adj. Factor	Adjusted Unit Cost /Unit Price	Estimated Cost
Pump Station 5-G @ 2784 HP						
Pump Station	2,784	HP			$12,648,423	$12,648,423
Electrical Service	1	Ea			$570,000	$570,000
Transmission Line	2	Mi			$340,000	$680,000
Pump Station Parcel	3.0	Ac			$56,000	$168,000
Subtotal, Pump Station 5-G						**$14,066,423**
Pump Station 6-G @ 5363 HP						
Pump Station	5,363	HP			$19,563,407	$19,563,407
Electrical Service	1	Ea			$570,000	$570,000
Transmission Line	2	Mi			$340,000	$680,000
Pump Station Parcel	3.0	Ac			$56,000	$168,000
Subtotal, Pump Station 6-G						**$20,981,407**
SUBTOTAL, PUMP STATIONS	**7**	**Ea**				**$95,161,753**
SUMMARY OF CONSTRUCTION COSTS:						
SUBTOTAL, PIPELINE BASE UNIT COST	241,238	LF				$182,454,862
SUBTOTAL, ADDITIONAL PIPELINE COSTS						$6,176,607
SUBTOTAL, EXISTING PIPELINE ABANDONMENT COSTS:	110,880	LF				$53,887,680
SUBTOTAL, PUMP STATIONS	7	Ea				$95,161,753
SUBTOTAL						**$337,680,902**
DISTRIBUTIVE COSTS:					25%	$84,420,226
CONTINGENCIES:					25%	$84,420,226
TOTAL CONSTRUCTION COSTS						**$506,521,354**

Table 18 – Cost Estimate for Santa Ana Watershed Alternative 2 (Sheet 4 of 4)

Description	Quantity	Units	Pipeline Base Unit Cost	Weighted Location Cost Adj. Factor	Adjusted Unit Cost /Unit Price	Estimated Cost
ANNUAL OPERATION & MAINTENANCE COSTS:						
Annual Pipeline O & M					1.50%	$4,244,208
Annual Pump Station O & M					2.00%	$2,854,853
Annual Pumping Power Cost						
Power Cost (per kWh)					$0.10	
Motor Efficiency (typ.)					0.95	
Pump Station 1-BL @ 1228 HP						$844,730
Pump Station 1-G @ 1228 HP						$844,730
Pump Station 2-G @ 3193 HP						$2,196,434
Pump Station 3-G @ 2292 HP						$1,576,645
Pump Station 4-G @ 3029 HP						$2,083,620
Pump Station 5-G @ 2784 HP						$1,915,087
Pump Station 6-G @ 5363 HP						$3,689,157
Subtotal						$13,150,403
TOTAL OPERATION & MAINTENANCE COSTS						**$20,249,464**

Coachella Valley Alternatives

As discussed in the "Inland Empire Interceptor Alternatives in San Gorgonio Pass & Coachella Valley" section of this TM 3.4, the estimated costs for the CV Alternative B-1, which would serve the Expanded Service Area, are presented in **Table 19** on the pages that follow in this **Appendix A**.

Table 19 – Cost Estimate for CV Alternative B-1 (Expanded Service Area) (Sheet 1 of 5)

Description	Quantity	Units	Pipeline Base Unit Cost	Weighted Location Cost Adj. Factor	Adjusted Unit Cost /Unit Price	Estimated Cost
PIPELINE BASE COSTS:						
Class 150 Pipe						
36" Diameter Conc Pipe Class 150 Pipe	77,021	LF	$432.00	1.10	$477.27	$36,760,342
48" Diameter Conc Pipe Class 150 Pipe	165,640	LF	$504.00	0.97	$487.13	$80,688,524
54" Diameter Conc Pipe Class 150 Pipe	83,000	LF	$648.00	0.74	$479.52	$39,800,160
60" Diameter Conc Pipe Class 150 Pipe	8,597	LF	$720.00	0.74	$532.80	$4,580,482
Subtotal, Class 150 Pipe	**334,259**	**LF**				**$161,829,507**
Class 200 Pipe						
36" Diameter Conc Pipe Class 200 Pipe	9,376	LF	$468.00	1.10	$517.05	$4,847,851
48" Diameter Conc Pipe Class 200 Pipe	9,360	LF	$546.00	0.97	$527.72	$4,939,297
54" Diameter Conc Pipe Class 200 Pipe	0	LF	$702.00	0.74	$519.48	$0
60" Diameter Conc Pipe Class 200 Pipe	0	LF	$780.00	0.74	$577.20	$0
Subtotal, Class 200 Pipe	**18,736**	**LF**				**$9,787,148**
Class 250 Pipe						
36" Diameter Conc Pipe Class 250 Pipe	9,376	LF	$504.00	1.10	$556.82	$5,220,762
48" Diameter Conc Pipe Class 250 Pipe	0	LF	$588.00	0.97	$568.32	$0
54" Diameter Conc Pipe Class 250 Pipe	0	LF	$756.00	0.74	$559.44	$0
60" Diameter Conc Pipe Class 250 Pipe	0	LF	$840.00	0.74	$621.60	$0
Subtotal, Class 250 Pipe	**9,376**	**LF**				**$5,220,762**
Class 400 Pipe						
36" Diameter Conc Pipe Class 400 Pipe	15,227	LF	$576.00	1.10	$636.37	$9,689,735
48" Diameter Conc Pipe Class 400 Pipe	0	LF	$672.00	0.97	$649.51	$0
54" Diameter Conc Pipe Class 400 Pipe	0	LF	$864.00	0.74	$639.36	$0
60" Diameter Conc Pipe Class 400 Pipe	0	LF	$960.00	0.74	$710.40	$0
Subtotal, Class 400 Pipe	**15,227**	**LF**				**$9,689,735**
SUBTOTAL, PIPELINE BASE COST	**377,597**	**LF**				**$186,527,152**
ADDITIONAL PIPELINE COSTS:						
Easements & Rights-of-Way Acquisition						
Per LF of 100' Esmnt.	78,309	LF			$57.00	**$4,463,613**

Table 19 – Cost Estimate for CV Alternative B-1 (Expanded Service Area) (Sheet 2 of 5)

Description	Quantity	Units	Pipeline Base Unit Cost	Weighted Location Cost Adj. Factor	Adjusted Unit Cost /Unit Price	Estimated Cost
Manholes						
60 in. Sq. Manhole for 36" Diameter Pipe	155	Ea			$14,000	$2,170,000
60 in. Sq. Manhole for 48" Diameter Pipe	333	Ea			$14,000	$4,662,000
60 in. Sq. Manhole for 54" Diameter Pipe	166	Ea			$14,000	$2,324,000
72 in. Sq. Manhole for 60" Diameter Pipe	17	Ea			$17,000	$289,000
	671	**Ea**				**$9,445,000**
Tunneling / Jack & Bore						
Jack and Bore 60" Diameter Steel Casing (36" Carrier Pipe)	700	LF			$1,050.00	$735,000
Jack and Bore 72" Diameter Steel Casing (48" Carrier Pipe)	0	LF			$1,155.00	$0
Jack and Bore 78" Diameter Steel Casing (54" Carrier Pipe)	0	LF			$1,365.00	$0
Jack and Bore 84" Diameter Steel Casing (60" Carrier Pipe)	0	LF			$1,470.00	$0
Subtotal, Micro-Tunneling / Jack & Bore	**700**	**LF**				**$735,000**
Environmental Mitigation Areas						
Pipeline	95,397	LF			$14.00	$1,335,558
Parcels		Ac			$6,000	$0
Subtotal, Environmental Mitigation Areas						**$1,335,558**
SUBTOTAL, ADDITIONAL PIPELINE COSTS						**$15,979,171**
TURBINE GENERATOR STATIONS:						
Turbine Generator Station 1-B @ 57.8 CFS & 70 FT of Head						
Turbine Generator Station	70	Ft			$14,007,397	$14,007,397
Electrical Service	1	Ea			$570,000	$570,000
Transmission Line	1	Mi			$340,000	$340,000
Turbine Generator Station Parcel	3.0	Ac			$56,000	$168,000
Subtotal						**$15,085,397**

Table 19 – Cost Estimate for CV Alternative B-1 (Expanded Service Area) (Sheet 3 of 5)

Description	Quantity	Units	Pipeline Base Unit Cost	Weighted Location Cost Adj. Factor	Adjusted Unit Cost /Unit Price	Estimated Cost
Turbine Generator Station 2-B @ 57.8 CFS & 640 FT of Head						
Turbine Generator Station	640	Ft			$14,007,397	$14,007,397
Electrical Service	1	Ea			$570,000	$570,000
Transmission Line	1	Mi			$340,000	$340,000
Turbine Generator Station Parcel	3.0	Ac			$56,000	$168,000
Subtotal						**$15,085,397**
Turbine Generator Station 3-B @ 57.8 CFS & 220 FT of Head						
Turbine Generator Station	220	Ft			$14,007,397	$14,007,397
Electrical Service	1	Ea			$570,000	$570,000
Transmission Line	2	Mi			$340,000	$680,000
Turbine Generator Station Parcel	3.0	Ac			$56,000	$168,000
Subtotal						**$15,425,397**
Turbine Generator Station 4-B @ 87.8 CFS & 355 FT of Head						
Turbine Generator Station	355	Ft			$19,134,818	$19,134,818
Electrical Service	1	Ea			$570,000	$570,000
Transmission Line	1	Mi			$340,000	$340,000
Turbine Generator Station Parcel	3.0	Ac			$56,000	$168,000
Subtotal						**$20,212,818**
Turbine Generator Station 5-B @ 87.8 CFS & 140 FT of Head						
Turbine Generator Station	140	Ft			$19,134,818	$19,134,818
Electrical Service	1	Ea			$570,000	$570,000
Transmission Line	1	Mi			$340,000	$340,000
Turbine Generator Station Parcel	3.0	Ac			$56,000	$168,000
Subtotal						**$20,212,818**

Table 19 – Cost Estimate for CV Alternative B-1 (Expanded Service Area) (Sheet 4 of 5)

Description	Quantity	Units	Pipeline Base Unit Cost	Weighted Location Cost Adj. Factor	Adjusted Unit Cost /Unit Price	Estimated Cost
Turbine Generator Station 6-B @ 87.8 CFS & 145 FT of Head						
Turbine Generator Station	145	Ft			$19,134,818	$19,134,818
Electrical Service	1	Ea			$570,000	$570,000
Transmission Line	3	Mi			$340,000	$1,020,000
Turbine Generator Station Parcel	3.0	Ac			$56,000	$168,000
Subtotal						**$20,892,818**
SUBTOTAL, TURBINE GENERATOR STATIONS	**6**	**Ea**				**$106,914,643**
SUMMARY OF CONSTRUCTION COSTS:						
SUBTOTAL, PIPELINE BASE UNIT COST	377,597	LF				$186,527,152
SUBTOTAL, ADDITIONAL PIPELINE COSTS						$15,979,171
SUBTOTAL, TURBINE GENERATOR STATIONS	6	Ea				$106,914,643
SUBTOTAL						**$309,420,966**
DISTRIBUTIVE COSTS:					25%	$77,355,241
CONTINGENCIES:					25%	$77,355,241
TOTAL CONSTRUCTION COSTS						**$464,131,449**

Table 19 – Cost Estimate for CV Alternative B-1 (Expanded Service Area) (Sheet 5 of 5)

Description	Quantity	Units	Pipeline Base Unit Cost	Weighted Location Cost Adj. Factor	Adjusted Unit Cost /Unit Price	Estimated Cost
ANNUAL OPERATION & MAINTENANCE COSTS:						
Annual Pipeline O & M					1.50%	$4,556,392
Annual Turbine Generator Station O & M					2.00%	$3,207,439
Annual Power Generation Credit						
Power Generation Credit (per kWh)					$0.04	
Motor Efficiency (typ.)					0.95	
Turbine Generator Station 1-B @ 57.8 CFS & 70 FT of Head	70	Ft				$114,114
Turbine Generator Station 2-B @ 57.8 CFS & 640 FT of Head	640	Ft				$1,043,332
Turbine Generator Station 3-B @ 57.8 CFS & 220 FT of Head	220	Ft				$358,645
Turbine Generator Station 4-B @ 87.8 CFS & 355 FT of Head	355	Ft				$879,743
Turbine Generator Station 5-B @ 87.8 CFS & 140 FT of Head	140	Ft				$346,941
Turbine Generator Station 6-B @ 87.8 CFS & 145 FT of Head	145	Ft				$359,332
Subtotal						$3,102,107
TOTAL O&M COSTS						**$4,661,725**

Water Quality Treatment Facility Alternatives

As discussed in the “Water Quality Treatment Facility” section of this TM 3.4, the estimated costs for TF Alternative 5-1, which would serve the Expanded Service Area, are presented in **Table 20** on the next page in this **Appendix A**.

Table 20 – Cost Estimate for Treatment Facility Alternative 5-1 (Expanded Service Area)

Description	Quantity	Units	Adjusted Unit Cost /Unit Price	Estimated Cost
WATER QUALITY TREATMENT FACILITY COSTS:				
Facultative Treatment Ponds				
Clear & Grub	1,434	Ac	$4,400	$6,309,600
Earthwork	1,434	Ac	$16,000	$22,944,000
50 mil Liner	1,434	Ac	$47,500	$68,115,000
Control Structures	1,434	Ac	$35,000	$50,190,000
Plumbing & Fencing	1,434	Ac	$15,000	$21,510,000
Water Quality Treatment Facility Land Cost	1,434	Ac	$56,000	$80,304,000
Subtotal, Facultative Treatment Ponds	**1,434**	**Ac**		**$249,372,600**
Constructed Wetlands				
Clear & Grub	1,071	Ac	$4,400	$4,712,400
Earthwork	1,071	Ac	$16,000	$17,136,000
50 mil Liner	1,071	Ac	$47,500	$50,872,500
Plants & Planting	1,071	Ac	$7,600	$8,139,600
Control Structures	1,071	Ac	$35,000	$37,485,000
Plumbing & Fencing	1,071	Ac	$15,000	$16,065,000
Water Quality Treatment Facility Land Cost	1,071	Ac	$56,000	$59,976,000
Subtotal, Constructed Wetlands	**1,071**	**Ac**		**$194,386,500**
SUMMARY OF CONSTRUCTION COSTS:				
Subtotal, Facultative Treatment Ponds	1,434	Ac		$249,372,600
Subtotal, Constructed Wetlands	1,071	Ac		$194,386,500
SUBTOTAL				**$443,759,100**
DISTRIBUTIVE COSTS:			25%	$110,939,775
CONTINGENCIES:			25%	$110,939,775
TOTAL CONSTRUCTION COSTS				**$665,638,650**
ANNUAL OPERATION & MAINTENANCE COSTS:				
Water Quality Treatment Facility O & M			1.50%	$9,984,580
TOTAL OPERATION & MAINTENANCE COSTS				**$9,984,580**

Present Worth Analysis

Present worth analyses for the combination of least cost alternatives that would serve the Expanded Service Area (Santa Ana Watershed (SAW) Alternative 2, Coachella Valley (CV) Alternative B-1 and TF Alternative 5-1) are presented in **Table 21** and **Table 22**, respectively, on the pages that follow in this **Appendix A**.

Table 21 – Present Worth Analysis for Least Cost Alternative (4.95% Inflation Rate)
(Part 1 of 2, Sheet 1 of 4)

OCSD Rates (per SAW Salinity Management Plan)			
Description	**Rate**	**Description**	**Rate**
O&M Inflation Rate 1 (IR1):		O&M Inflation Rate 2 (IR2):	6.00%
Rate up to 2013 (IR12013)	10.00%	O&M Inflation Rate 3 (IR3):	3.00%
Rate at 2014(IR12014)	8.00%	Capital Inflation Rate 1 (CIR1):	4.95%
Rate at 2015(IR12015)	7.00%	Capital Inflation Rate 2 (CIR2):	10.00%
Rate up to 2020(IR12020)	5.40%	Interest Rate 1 (INTR1):	6.00%
Costs unchanged after 2020	0.00%	Interest Rate 2 (INTR2, est'd.):	6.25%

				OCSD Treatment Capacity Cost			OCSD O&M Treatment Cost			OCSD O&M Maintenance Cost					
Calen-dar Year	2010 (n)	Flow (mgd)	OCSD CIP Sinking Fund	2010 Dollars	Inflated Cost (F/P, CIR1, n)	2010 Present Worth (P/F, INTR1, n)	2010 Dollars	Inflated Cost (F/P, IR1, n)	2010 Present Worth (P/F, INTR1, n)	2010 Dollars	Inflated Cost (F/P, IR2, n)	2010 Present Worth (P/F, INTR1, n)	Capital + O&M Costs Per Year	2010 Capital + O&M Present Worth	2010 Cumulative Present Worth
2010	0	14.74	$1,696,607	$0	$0	$0	$7,914,842	$7,914,800	$7,914,800	$140,290	$140,290	$140,290	$9,751,697	$9,751,697	$9,751,697
2011	1	15.09	$1,696,607	$0	$0	$0	$8,103,853	$8,914,200	$8,409,623	$140,290	$148,707	$140,290	$10,759,514	$10,246,520	$19,998,217
2012	2	15.44	$1,696,607	$0	$0	$0	$8,292,864	$10,034,400	$8,930,580	$140,290	$157,630	$140,290	$11,888,637	$10,767,477	$30,765,694
2013	3	15.80	$1,696,607	$0	$0	$0	$8,481,875	$11,289,400	$9,478,798	$140,290	$167,088	$140,290	$13,153,095	$11,315,695	$42,081,389
2014	4	16.15	$1,696,607	$0	$0	$0	$8,670,887	$11,796,600	$9,344,012	$140,290	$177,113	$140,290	$13,670,320	$11,180,909	$53,262,298
2015	5	16.50	$1,696,607	$0	$0	$0	$8,859,898	$12,426,500	$9,285,804	$140,290	$187,740	$140,290	$14,310,847	$11,122,701	$64,384,999
2016	6	18.12	$1,696,607	$18,346,508	$24,515,913	$17,282,751	$9,729,242	$13,339,000	$9,403,469	$140,290	$199,004	$140,290	$39,750,524	$28,523,117	$92,908,116
2017	7	19.74	$1,696,607	$18,346,508	$25,729,451	$17,111,554	$10,598,586	$15,315,500	$10,185,682	$140,290	$210,944	$140,290	$42,952,502	$29,134,133	$122,042,249
2018	8	21.36	$1,696,607	$18,346,508	$27,003,059	$16,942,053	$11,467,929	$17,466,700	$10,958,824	$140,290	$223,601	$140,290	$46,389,966	$29,737,774	$151,780,023
2019	9	22.98	$1,696,607	$18,346,508	$28,339,710	$16,774,231	$12,337,273	$19,805,400	$11,722,786	$140,290	$237,017	$140,290	$50,078,734	$30,333,914	$182,113,936
2020	10	24.60	$1,696,607	$18,346,508	$29,742,526	$16,608,071	$13,206,617	$22,345,900	$12,477,834	$140,290	$251,238	$140,290	$54,036,271	$30,922,802	$213,036,738
2021	11	26.21	$1,696,607	$18,346,508	$31,214,781	$16,443,557	$14,075,961	$22,345,900	$11,771,541	$140,290	$266,312	$140,290	$55,523,600	$30,051,995	$243,088,733
2022	12	27.83	$1,696,607	$18,346,508	$32,759,912	$16,280,673	$14,945,305	$23,816,800	$11,836,220	$140,290	$282,291	$140,290	$58,555,610	$29,953,790	$273,042,523
2023	13	29.45	$1,696,607	$18,346,508	$34,381,528	$16,119,402	$15,814,649	$25,287,800	$11,855,907	$140,290	$299,229	$140,290	$61,665,163	$29,812,206	$302,854,730
2024	14	31.07	$1,696,607	$18,346,508	$36,083,414	$15,959,729	$16,683,993	$26,758,700	$11,835,399	$140,290	$317,182	$140,290	$64,855,903	$29,632,024	$332,486,754
2025	15	32.69	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$332,486,754
2026	16	32.81	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$332,486,754
2027	17	32.93	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$332,486,754
2028	18	33.05	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$332,486,754
2029	19	33.17	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$332,486,754

Table 21 – Present Worth Analysis for Least Cost Alternative (4.95% Inflation Rate)
(Part 1 of 2, Sheet 2 of 4)

Calen-dar Year	2010 (n)	Flow (mgd)	OCSD CIP Sinking Fund	OCSD Treatment Capacity Cost		2010 Present Worth (P/F, INTR1, n)	OCSD O&M Treatment Cost		2010 Present Worth (P/F, INTR1, n)	OCSD O&M Maintenance Cost		2010 Present Worth (P/F, INTR1, n)	Capital + O&M Costs Per Year	2010 Capital + O&M Present Worth	2010 Cumulative Present Worth
				2010 Dollars	Inflated Cost (F/P, CIR1, n)		2010 Dollars	Inflated Cost (F/P, IR1, n)		2010 Dollars	Inflated Cost (F/P, IR2, n)				
2030	20	33.28	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$332,486,754
2031	21	33.40	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$332,486,754
2032	22	33.52	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$332,486,754
2033	23	33.64	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$332,486,754
2034	24	33.76	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$332,486,754
2035	25	33.88	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$332,486,754
2036	26	34.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$332,486,754
2037	27	34.12	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$332,486,754
2038	28	34.24	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$332,486,754
2039	29	34.35	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$332,486,754
2040	30	34.47	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$332,486,754
2041	31	34.59	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$332,486,754
2042	32	34.71	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$332,486,754
2043	33	34.83	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$332,486,754
2044	34	34.95	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$332,486,754
2045	35	35.07	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$332,486,754
2046	36	35.19	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$332,486,754
2047	37	35.30	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$332,486,754
2048	38	35.42	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$332,486,754
2049	39	35.54	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$332,486,754
2050	40	35.66	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$332,486,754
2051	41	35.78	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$332,486,754
2052	42	35.90	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$332,486,754
2053	43	36.02	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$332,486,754
2054	44	36.14	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$332,486,754
2055	45	36.26	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$332,486,754
2056	46	36.37	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$332,486,754
2057	47	36.49	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$332,486,754
2058	48	36.61	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$332,486,754
2059	49	36.73	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$332,486,754
2060	50	36.85	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$332,486,754

Table 21 – Present Worth Analysis for Least Cost Alternative (4.95% Inflation Rate)
(Part 2 of 2, Sheet 3 of 4)

IEI Construction Cost Estimate =	$1,636,291,452
Annual Const. Cost over 5 years =	$327,258,290
O&M Cost Estimate =	$34,895,769

One-time Sellback	Salton Sea Discharge
2010	$370,443,080
2013	$542,365,713
2014	$585,754,971
2015	$626,757,818
2020	$815,272,540
2025	$815,272,540

Average Flow	32.69 MGD
2010 Dollars	$370,443,080
Inflation at 2025	$815,272,540
2010 Present Worth	$360,595,800

Calen-dar Year	2010 (n)	Capital Cost of IEI			IEI O&M Costs			Baseline Analysis Capital + O&M 2010 Present Worth	Capital + O&M 2010 Present Worth	Capital + O&M Cumulative Present Worth
		2010 Dollars	Inflated Cost (F/P, CIR2, n)	2010 Present Worth (P/F, INTR1, n)	2.0% of Const. Cost in 2010 Dollars	Inflated Cost (F/P, IR2, n)	2010 Present Worth (P/F, INTR2, n)			
2010	0	$0	$0	$0	$0	$0	$0	$9,751,697	$9,751,697	$9,751,697
2011	1	$0	$0	$0	$0	$0	$0	$10,246,520	$10,246,520	$19,998,217
2012	2	$0	$0	$0	$0	$0	$0	$10,767,477	$10,767,477	$30,765,694
2013	3	$0	$0	$0	$0	$0	$0	$11,315,695	$11,315,695	$42,081,389
2014	4	$0	$0	$0	$0	$0	$0	$11,180,909	$11,180,909	$53,262,298
2015	5	$0	$0	$0	$0	$0	$0	$11,122,701	$11,122,701	$64,384,999
2016	6	$0	$0	$0	$0	$0	$0	$28,523,117	$28,523,117	$92,908,116
2017	7	$0	$0	$0	$0	$0	$0	$29,134,133	$29,134,133	$122,042,249
2018	8	$0	$0	$0	$0	$0	$0	$29,737,774	$29,737,774	$151,780,023
2019	9	$0	$0	$0	$0	$0	$0	$30,333,914	$30,333,914	$182,113,936
2020	10	$327,258,290	$848,823,723	$473,978,734	$0	$0	$0	$30,922,802	$504,901,535	$687,015,472
2021	11	$327,258,290	$933,706,096	$491,864,724	$0	$0	$0	$30,051,995	$521,916,719	$1,208,932,191
2022	12	$327,258,290	$1,027,076,705	$510,425,657	$0	$0	$0	$29,953,790	$540,379,446	$1,749,311,637
2023	13	$327,258,290	$1,129,784,376	$529,687,002	$0	$0	$0	$29,812,206	$559,499,208	$2,308,810,845
2024	14	$327,258,290	$1,242,762,813	$549,675,191	$0	$0	$0	$29,632,024	$579,307,215	$2,888,118,061
2025	15	$0	$0	$0	$34,895,769	$54,366,470	$21,897,627	$0	($338,698,173)	$2,549,419,888
2026	16	$0	$0	$0	$34,895,769	$55,997,464	$21,227,817	$0	$21,227,817	$2,570,647,705
2027	17	$0	$0	$0	$34,895,769	$57,677,388	$20,578,496	$0	$20,578,496	$2,591,226,201
2028	18	$0	$0	$0	$34,895,769	$59,407,710	$19,949,036	$0	$19,949,036	$2,611,175,237
2029	19	$0	$0	$0	$34,895,769	$61,189,941	$19,338,830	$0	$19,338,830	$2,630,514,068

Table 21 – Present Worth Analysis for Least Cost Alternative (4.95% Inflation Rate) (Part 2 of 2, Sheet 4 of 4)

Calen-dar Year	2010 (n)	Capital Cost of IEI			IEI O&M Costs			Baseline Analysis Capital + O&M 2010 Present Worth	Capital + O&M 2010 Present Worth	Capital + O&M Cumulative Present Worth
		2010 Dollars	Inflated Cost (F/P, CIR2, n)	2010 Present Worth (P/F, INTR1, n)	2.0% of Const. Cost in 2010 Dollars	Inflated Cost (F/P, IR2, n)	2010 Present Worth (P/F, INTR2, n)			
2030	20	$0	$0	$0	$34,895,769	$63,025,640	$18,747,290	$0	$18,747,290	$2,649,261,357
2031	21	$0	$0	$0	$34,895,769	$64,916,409	$18,173,843	$0	$18,173,843	$2,667,435,200
2032	22	$0	$0	$0	$34,895,769	$66,863,901	$17,617,937	$0	$17,617,937	$2,685,053,138
2033	23	$0	$0	$0	$34,895,769	$68,869,818	$17,079,036	$0	$17,079,036	$2,702,132,173
2034	24	$0	$0	$0	$34,895,769	$70,935,913	$16,556,618	$0	$16,556,618	$2,718,688,791
2035	25	$0	$0	$0	$34,895,769	$73,063,990	$16,050,180	$0	$16,050,180	$2,734,738,972
2036	26	$0	$0	$0	$34,895,769	$75,255,910	$15,559,234	$0	$15,559,234	$2,750,298,205
2037	27	$0	$0	$0	$34,895,769	$77,513,587	$15,083,304	$0	$15,083,304	$2,765,381,510
2038	28	$0	$0	$0	$34,895,769	$79,838,995	$14,621,933	$0	$14,621,933	$2,780,003,442
2039	29	$0	$0	$0	$34,895,769	$82,234,164	$14,174,673	$0	$14,174,673	$2,794,178,115
2040	30	$0	$0	$0	$34,895,769	$84,701,189	$13,741,095	$0	$13,741,095	$2,807,919,211
2041	31	$0	$0	$0	$34,895,769	$87,242,225	$13,320,779	$0	$13,320,779	$2,821,239,990
2042	32	$0	$0	$0	$34,895,769	$89,859,492	$12,913,320	$0	$12,913,320	$2,834,153,310
2043	33	$0	$0	$0	$34,895,769	$92,555,277	$12,518,325	$0	$12,518,325	$2,846,671,635
2044	34	$0	$0	$0	$34,895,769	$95,331,935	$12,135,411	$0	$12,135,411	$2,858,807,046
2045	35	$0	$0	$0	$34,895,769	$98,191,893	$11,764,210	$0	$11,764,210	$2,870,571,256
2046	36	$0	$0	$0	$34,895,769	$101,137,650	$11,404,364	$0	$11,404,364	$2,881,975,620
2047	37	$0	$0	$0	$34,895,769	$104,171,779	$11,055,524	$0	$11,055,524	$2,893,031,144
2048	38	$0	$0	$0	$34,895,769	$107,296,933	$10,717,355	$0	$10,717,355	$2,903,748,500
2049	39	$0	$0	$0	$34,895,769	$110,515,841	$10,389,530	$0	$10,389,530	$2,914,138,030
2050	40	$0	$0	$0	$34,895,769	$113,831,316	$10,071,733	$0	$10,071,733	$2,924,209,763
2051	41	$0	$0	$0	$34,895,769	$117,246,255	$9,763,657	$0	$9,763,657	$2,933,973,420
2052	42	$0	$0	$0	$34,895,769	$120,763,643	$9,465,004	$0	$9,465,004	$2,943,438,423
2053	43	$0	$0	$0	$34,895,769	$124,386,552	$9,175,486	$0	$9,175,486	$2,952,613,909
2054	44	$0	$0	$0	$34,895,769	$128,118,149	$8,894,824	$0	$8,894,824	$2,961,508,733
2055	45	$0	$0	$0	$34,895,769	$131,961,693	$8,622,747	$0	$8,622,747	$2,970,131,480
2056	46	$0	$0	$0	$34,895,769	$135,920,544	$8,358,992	$0	$8,358,992	$2,978,490,472
2057	47	$0	$0	$0	$34,895,769	$139,998,160	$8,103,305	$0	$8,103,305	$2,986,593,777
2058	48	$0	$0	$0	$34,895,769	$144,198,105	$7,855,440	$0	$7,855,440	$2,994,449,217
2059	49	$0	$0	$0	$34,895,769	$148,524,048	$7,615,156	$0	$7,615,156	$3,002,064,373
2060	50	$0	$0	$0	$34,895,769	$152,979,770	$7,382,221	$0	$7,382,221	$3,009,446,594

Table 22 – Present Worth Analysis for Least Cost Alternative (17.6% Inflation Rate)
(Part 1 of 2, Sheet 1 of 4)

OCSD Rates (per SAW Salinity Management Plan)			
Description	**Rate**	**Description**	**Rate**
O&M Inflation Rate 1 (IR1):		O&M Inflation Rate 2 (IR2):	6.00%
Rate up to 2013 (IR12013)	10.00%	O&M Inflation Rate 3 (IR3):	3.00%
Rate at 2014(IR12014)	8.00%	Capital Inflation Rate 1 (CIR1):	17.6%
Rate at 2015(IR12015)	7.00%	Capital Inflation Rate 2 (CIR2):	10.00%
Rate up to 2020(IR12020)	5.40%	Interest Rate 1 (INTR1):	6.00%
Costs unchanged after 2020	0.00%	Interest Rate 2 (INTR2, est'd.):	6.25%

Calen-dar Year	2010 (n)	Flow (mgd)	OCSD CIP Sinking Fund	OCSD Treatment Capacity Cost		2010 Present Worth (P/F, INTR1, n)	OCSD O&M Treatment Cost		2010 Present Worth (P/F, INTR1, n)	OCSD O&M Maintenance Cost		2010 Present Worth (P/F, INTR1, n)	Capital + O&M Costs Per Year	2010 Capital + O&M Present Worth	2010 Cumulative Present Worth
				2010 Dollars	Inflated Cost (F/P, CIR1, n)		2010 Dollars	Inflated Cost (F/P, IR1, n)		2010 Dollars	Inflated Cost (F/P, IR2, n)				
2010	0	14.74	$1,696,607	$0	$0	$0	$7,914,842	$7,914,800	$7,914,800	$140,290	$140,290	$140,290	$9,751,697	$9,751,697	$9,751,697
2011	1	15.09	$1,696,607	$0	$0	$0	$8,103,853	$8,914,200	$8,409,623	$140,290	$148,707	$140,290	$10,759,514	$10,246,520	$19,998,217
2012	2	15.44	$1,696,607	$0	$0	$0	$8,292,864	$10,034,400	$8,930,580	$140,290	$157,630	$140,290	$11,888,637	$10,767,477	$30,765,694
2013	3	15.80	$1,696,607	$0	$0	$0	$8,481,875	$11,289,400	$9,478,798	$140,290	$167,088	$140,290	$13,153,095	$11,315,695	$42,081,389
2014	4	16.15	$1,696,607	$0	$0	$0	$8,670,887	$11,796,600	$9,344,012	$140,290	$177,113	$140,290	$13,670,320	$11,180,909	$53,262,298
2015	5	16.50	$1,696,607	$0	$0	$0	$8,859,898	$12,426,500	$9,285,804	$140,290	$187,740	$140,290	$14,310,847	$11,122,701	$64,384,999
2016	6	18.12	$1,696,607	$18,346,508	$48,528,553	$34,210,715	$9,729,242	$13,339,000	$9,403,469	$140,290	$199,004	$140,290	$63,763,164	$45,451,081	$109,836,079
2017	7	19.74	$1,696,607	$18,346,508	$57,069,579	$37,954,529	$10,598,586	$15,315,500	$10,185,682	$140,290	$210,944	$140,290	$74,292,630	$49,977,109	$159,813,188
2018	8	21.36	$1,696,607	$18,346,508	$67,113,825	$42,108,044	$11,467,929	$17,466,700	$10,958,824	$140,290	$223,601	$140,290	$86,500,733	$54,903,765	$214,716,953
2019	9	22.98	$1,696,607	$18,346,508	$78,925,858	$46,716,094	$12,337,273	$19,805,400	$11,722,786	$140,290	$237,017	$140,290	$100,664,882	$60,275,777	$274,992,729
2020	10	24.60	$1,696,607	$18,346,508	$92,816,809	$51,828,421	$13,206,617	$22,345,900	$12,477,834	$140,290	$251,238	$140,290	$117,110,554	$66,143,152	$341,135,881
2021	11	26.21	$1,696,607	$18,346,508	$109,152,567	$57,500,211	$14,075,961	$22,345,900	$11,771,541	$140,290	$266,312	$140,290	$133,461,386	$71,108,649	$412,244,530
2022	12	27.83	$1,696,607	$18,346,508	$128,363,419	$63,792,687	$14,945,305	$23,816,800	$11,836,220	$140,290	$282,291	$140,290	$154,159,117	$77,465,803	$489,710,334
2023	13	29.45	$1,696,607	$18,346,508	$150,955,381	$70,773,773	$15,814,649	$25,287,800	$11,855,907	$140,290	$299,229	$140,290	$178,239,016	$84,466,577	$574,176,911
2024	14	31.07	$1,696,607	$18,346,508	$177,523,527	$78,518,827	$16,683,993	$26,758,700	$11,835,399	$140,290	$317,182	$140,290	$206,296,017	$92,191,123	$666,368,034
2025	15	32.69	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$666,368,034
2026	16	32.81	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$666,368,034
2027	17	32.93	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$666,368,034
2028	18	33.05	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$666,368,034
2029	19	33.17	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$666,368,034

Table 22 – Present Worth Analysis for Least Cost Alternative (17.6% Inflation Rate) (Part 1 of 2, Sheet 2 of 4)

				OCSD Treatment Capacity Cost			OCSD O&M Treatment Cost			OCSD O&M Maintenance Cost					
Calen-dar Year	2010 (n)	Flow (mgd)	OCSD CIP Sinking Fund	2010 Dollars	Inflated Cost (F/P, CIR1, n)	2010 Present Worth (P/F, INTR1, n)	2010 Dollars	Inflated Cost (F/P, IR1, n)	2010 Present Worth (P/F, INTR1, n)	2010 Dollars	Inflated Cost (F/P, IR2, n)	2010 Present Worth (P/F, INTR1, n)	Capital + O&M Costs Per Year	2010 Capital + O&M Present Worth	2010 Cumulative Present Worth
2030	20	33.28	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$666,368,034
2031	21	33.40	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$666,368,034
2032	22	33.52	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$666,368,034
2033	23	33.64	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$666,368,034
2034	24	33.76	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$666,368,034
2035	25	33.88	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$666,368,034
2036	26	34.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$666,368,034
2037	27	34.12	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$666,368,034
2038	28	34.24	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$666,368,034
2039	29	34.35	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$666,368,034
2040	30	34.47	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$666,368,034
2041	31	34.59	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$666,368,034
2042	32	34.71	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$666,368,034
2043	33	34.83	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$666,368,034
2044	34	34.95	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$666,368,034
2045	35	35.07	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$666,368,034
2046	36	35.19	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$666,368,034
2047	37	35.30	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$666,368,034
2048	38	35.42	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$666,368,034
2049	39	35.54	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$666,368,034
2050	40	35.66	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$666,368,034
2051	41	35.78	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$666,368,034
2052	42	35.90	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$666,368,034
2053	43	36.02	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$666,368,034
2054	44	36.14	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$666,368,034
2055	45	36.26	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$666,368,034
2056	46	36.37	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$666,368,034
2057	47	36.49	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$666,368,034
2058	48	36.61	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$666,368,034
2059	49	36.73	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$666,368,034
2060	50	36.85	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$666,368,034

**Table 22 – Present Worth Analysis for Least Cost Alternative (17.6% Inflation Rate)
(Part 2 of 2, Sheet 3 of 4)**

One-time Sellback	Salton Sea Discharge
2010	$370,443,080
2013	$542,365,713
2014	$585,754,971
2015	$626,757,818
2020	$815,272,540
2025	$815,272,540

IEI Construction Cost Estimate =	$1,636,291,452
Annual Const. Cost over 5 years =	$327,258,290
O&M Cost Estimate =	$34,895,769

Average Flow	32.69 MGD
2010 Dollars	$370,443,080
Inflation at 2025	$815,272,540
2010 Present Worth	$360,595,800

Calen-dar Year	2010 (n)	Capital Cost of IEI			IEI O&M Costs			Baseline Analysis Capital + O&M 2010 Present Worth	Capital + O&M 2010 Present Worth	Capital + O&M Cumulative Present Worth
		2010 Dollars	Inflated Cost (F/P, CIR2, n)	2010 Present Worth (P/F, INTR1, n)	2.0% of Const. Cost in 2010 Dollars	Inflated Cost (F/P, IR2, n)	2010 Present Worth (P/F, INTR2, n)			
2010	0	$0	$0	$0	$0	$0	$0	$9,751,697	$9,751,697	$9,751,697
2011	1	$0	$0	$0	$0	$0	$0	$10,246,520	$10,246,520	$19,998,217
2012	2	$0	$0	$0	$0	$0	$0	$10,767,477	$10,767,477	$30,765,694
2013	3	$0	$0	$0	$0	$0	$0	$11,315,695	$11,315,695	$42,081,389
2014	4	$0	$0	$0	$0	$0	$0	$11,180,909	$11,180,909	$53,262,298
2015	5	$0	$0	$0	$0	$0	$0	$11,122,701	$11,122,701	$64,384,999
2016	6	$0	$0	$0	$0	$0	$0	$45,451,081	$45,451,081	$109,836,079
2017	7	$0	$0	$0	$0	$0	$0	$49,977,109	$49,977,109	$159,813,188
2018	8	$0	$0	$0	$0	$0	$0	$54,903,765	$54,903,765	$214,716,953
2019	9	$0	$0	$0	$0	$0	$0	$60,275,777	$60,275,777	$274,992,729
2020	10	$327,258,290	$848,823,723	$473,978,734	$0	$0	$0	$66,143,152	$540,121,886	$815,114,615
2021	11	$327,258,290	$933,706,096	$491,864,724	$0	$0	$0	$71,108,649	$562,973,373	$1,378,087,988
2022	12	$327,258,290	$1,027,076,705	$510,425,657	$0	$0	$0	$77,465,803	$587,891,460	$1,965,979,448
2023	13	$327,258,290	$1,129,784,376	$529,687,002	$0	$0	$0	$84,466,577	$614,153,580	$2,580,133,027
2024	14	$327,258,290	$1,242,762,813	$549,675,191	$0	$0	$0	$92,191,123	$641,866,314	$3,221,999,341
2025	15	$0	$0	$0	$34,895,769	$54,366,470	$21,897,627	$0	($338,698,173)	$2,883,301,168
2026	16	$0	$0	$0	$34,895,769	$55,997,464	$21,227,817	$0	$21,227,817	$2,904,528,986
2027	17	$0	$0	$0	$34,895,769	$57,677,388	$20,578,496	$0	$20,578,496	$2,925,107,482
2028	18	$0	$0	$0	$34,895,769	$59,407,710	$19,949,036	$0	$19,949,036	$2,945,056,518
2029	19	$0	$0	$0	$34,895,769	$61,189,941	$19,338,830	$0	$19,338,830	$2,964,395,348

Table 22 – Present Worth Analysis for Least Cost Alternative (17.6% Inflation Rate) (Part 2 of 2, Sheet 4 of 4)

		Capital Cost of IEI			IEI O&M Costs					
Calen-dar Year	2010 (n)	2010 Dollars	Inflated Cost (F/P, CIR2, n)	2010 Present Worth (P/F, INTR1, n)	2.0% of Const. Cost in 2010 Dollars	Inflated Cost (F/P, IR2, n)	2010 Present Worth (P/F, INTR2, n)	Baseline Analysis Capital + O&M 2010 Present Worth	Capital + O&M 2010 Present Worth	Capital + O&M Cumulative Present Worth
2030	20	$0	$0	$0	$34,895,769	$63,025,640	$18,747,290	$0	$18,747,290	$2,983,142,638
2031	21	$0	$0	$0	$34,895,769	$64,916,409	$18,173,843	$0	$18,173,843	$3,001,316,481
2032	22	$0	$0	$0	$34,895,769	$66,863,901	$17,617,937	$0	$17,617,937	$3,018,934,418
2033	23	$0	$0	$0	$34,895,769	$68,869,818	$17,079,036	$0	$17,079,036	$3,036,013,454
2034	24	$0	$0	$0	$34,895,769	$70,935,913	$16,556,618	$0	$16,556,618	$3,052,570,072
2035	25	$0	$0	$0	$34,895,769	$73,063,990	$16,050,180	$0	$16,050,180	$3,068,620,252
2036	26	$0	$0	$0	$34,895,769	$75,255,910	$15,559,234	$0	$15,559,234	$3,084,179,486
2037	27	$0	$0	$0	$34,895,769	$77,513,587	$15,083,304	$0	$15,083,304	$3,099,262,790
2038	28	$0	$0	$0	$34,895,769	$79,838,995	$14,621,933	$0	$14,621,933	$3,113,884,723
2039	29	$0	$0	$0	$34,895,769	$82,234,164	$14,174,673	$0	$14,174,673	$3,128,059,396
2040	30	$0	$0	$0	$34,895,769	$84,701,189	$13,741,095	$0	$13,741,095	$3,141,800,491
2041	31	$0	$0	$0	$34,895,769	$87,242,225	$13,320,779	$0	$13,320,779	$3,155,121,270
2042	32	$0	$0	$0	$34,895,769	$89,859,492	$12,913,320	$0	$12,913,320	$3,168,034,591
2043	33	$0	$0	$0	$34,895,769	$92,555,277	$12,518,325	$0	$12,518,325	$3,180,552,915
2044	34	$0	$0	$0	$34,895,769	$95,331,935	$12,135,411	$0	$12,135,411	$3,192,688,326
2045	35	$0	$0	$0	$34,895,769	$98,191,893	$11,764,210	$0	$11,764,210	$3,204,452,536
2046	36	$0	$0	$0	$34,895,769	$101,137,650	$11,404,364	$0	$11,404,364	$3,215,856,900
2047	37	$0	$0	$0	$34,895,769	$104,171,779	$11,055,524	$0	$11,055,524	$3,226,912,425
2048	38	$0	$0	$0	$34,895,769	$107,296,933	$10,717,355	$0	$10,717,355	$3,237,629,780
2049	39	$0	$0	$0	$34,895,769	$110,515,841	$10,389,530	$0	$10,389,530	$3,248,019,311
2050	40	$0	$0	$0	$34,895,769	$113,831,316	$10,071,733	$0	$10,071,733	$3,258,091,044
2051	41	$0	$0	$0	$34,895,769	$117,246,255	$9,763,657	$0	$9,763,657	$3,267,854,700
2052	42	$0	$0	$0	$34,895,769	$120,763,643	$9,465,004	$0	$9,465,004	$3,277,319,704
2053	43	$0	$0	$0	$34,895,769	$124,386,552	$9,175,486	$0	$9,175,486	$3,286,495,189
2054	44	$0	$0	$0	$34,895,769	$128,118,149	$8,894,824	$0	$8,894,824	$3,295,390,013
2055	45	$0	$0	$0	$34,895,769	$131,961,693	$8,622,747	$0	$8,622,747	$3,304,012,760
2056	46	$0	$0	$0	$34,895,769	$135,920,544	$8,358,992	$0	$8,358,992	$3,312,371,752
2057	47	$0	$0	$0	$34,895,769	$139,998,160	$8,103,305	$0	$8,103,305	$3,320,475,058
2058	48	$0	$0	$0	$34,895,769	$144,198,105	$7,855,440	$0	$7,855,440	$3,328,330,497
2059	49	$0	$0	$0	$34,895,769	$148,524,048	$7,615,156	$0	$7,615,156	$3,335,945,653
2060	50	$0	$0	$0	$34,895,769	$152,979,770	$7,382,221	$0	$7,382,221	$3,343,327,874

Appendix B – Salt Removal (Evaporation Ponds)

Background

The Water Quality Treatment Facility (TF) described in TM 3.3 of this Appraisal Analysis would not be effective at removing TDS (salt) from the flows. If implementation of the Brine Pool proposed in the various Salton Sea restoration plans discussed in TM 3.3 does not occur, and if removal of salt associated with the proposed IEI flows were deemed necessary, then a separate process would be necessary. Therefore, a conceptual design for a Salt Evaporation Pond Facility (EPF) is presented in Appendix C of TM 3.3 as an alternative to the Brine Pool.

The large land area necessary for the Salt Evaporation Pond Facility (EPF) and the associated pumping costs suggest a location near the shore of the Salton Sea in an area with low land costs. The costs of acquisition of land necessary for the proposed EPF are not included in the estimated costs presented in this TM 3.4.

Evaporation Pond Facility Conceptual Design

The publication entitled ***Evaporation Pond Sizing with Water Balance and Make-up Water Calculations*** [6] (EP Manual) from the Idaho National Engineering and Environmental Laboratory was used for conceptual design for this Salt Evaporation Pond Facility (EPF) as discussed in TM 3.3. This manual also addresses estimated costs for construction and for operation and maintenance for evaporation ponds.

Alternatives Considered & Design Flows

Projections of average flows in the proposed IEI are addressed in TM 3.2 of this Appraisal Analysis. Alternative flow projections are presented, both with and without projected flows from the potential service area expansion in the San Gorgonio Pass and Coachella Valley areas. The conceptual design for the EPF was developed using both sets of average flow projections.

A multiplier of 1.30 was applied to the calculated EPF surface areas to account for necessary buffers, containment berms, access roads, etc. This multiplier was not developed to include extra trains that could provide EPF capacity greater than the design flows.

The minimum surface area and the total area of the EPF are summarized for the average flow projection for the existing service area and the expanded service area in **Table 23** below.

Table 23 – Evaporation Pond Facility Area

	Avg. Flow (2060)	Process Water (48,000 mg/L)	Minimum EPF Surface Area	Minimum Total Area
	(MGD)	(AFY)	(Acres)	(Acres)
Existing SAWPA Service Area	32.1	5,091	920	1,196
Expanded Service Area	75.1	9,915	1,792	2,330

Evaporation Pond Facility Estimated Costs

As discussed in TM 3.3 of this Appraisal Analysis, the proposed IEI flows would add to the existing rate of accumulation of salts in the Sea. A brine pool has been proposed as part of various Salton Sea restoration plans, which if implemented, would offer a reasonable solution for the accumulation of salts in the Salton Sea. However, implementation of a Salton Sea restoration plan with a brine pool has been impeded by the estimated costs, so an Evaporation Pond Facility (EPF) was described in the Appendix of TM 3.3. If needed, the EPF could serve in lieu of the brine pool to remove salts attributable to the IEI flows from the Salton Sea. It would likely be located in a rural area with relatively low land costs near the shore of the Salton Sea.

The estimated costs presented in this TM 3.4 for the EPF are based on the criteria described in the Idaho National Engineering and Environmental Laboratory publication ***Evaporation Pond Sizing with Water Balance and Make-up Water Calculations*** [6], which was used in TM 3.3 for conceptual design, and (for consistency) on the EPA publications used for the TF: ***Manual: Constructed Wetlands Treatment of Municipal Wastewaters*** [4] and ***Principles of Design and Operations of Wastewater Treatment Pond Systems for Plant Operators, Engineers and Managers*** [5]. The estimated cost for the pump station at the EPF is based on the cost estimating criteria for Pump Stations described above. The estimated EPF land cost is based on the Land Cost estimating criteria described above. Like the other estimated costs presented in this TM 3.4, these costs have been indexed to Year 2010.

The criteria used for developing the estimated costs for the various EPF alternatives under consideration in this Appraisal Analysis are summarized in **Table 24** below.

Table 24 – Evaporation Pond Facility Construction Costs Estimating Criteria

COMPONENT	ESTIMATING CRITERIA
Evaporation Pond Facility:	
Clearing & Grubbing	$4,400 per acre
Earthwork	$16,000 per acre
Liner	$47,500 per acre
Control Structures	$35,000 per acre
Plumbing & Fencing	$15,000 per acre

Cost Estimates

The estimated costs for the EPF designed to treat flows from the proposed expanded service area (EPF Alternative 1) and from only the existing SAWPA service area (EPF Alternative 2) are summarized in **Table 25** below.

Table 25 – Summary of Costs of EPF

Description	EPF Alternative	
	1 (Expanded S.A.)	2 (Existing S.A.)
Construction Costs	$330,034,208	$170,912,613
Distributive Costs (25%)	$82,508,552	$42,728,153
Contingencies (25%)	$82,508,552	$42,728,153
Total Construction Costs	**$495,051,312**	**$256,368,919**
Annual O&M Costs	$7,829,388	$4,050,666

The estimated costs for the conceptual design developed in TM 3.3 of this Appraisal Analysis for the EPF designed to treat flows from the proposed expanded service area (EPF Alternative 1) are presented in detail in **Table 26** on the next page.

Table 26 – Cost Estimate - Evaporation Pond Facility (Expanded Service Area)

Description	Quantity	Units	Adjusted Unit Cost /Unit Price	Estimated Cost
EVAPORATION POND FACILITY COSTS:				
Evaporation Ponds:				
Clear & Grub	2,330	Ac	$4,400	$10,252,000
Earthwork	2,330	Ac	$16,000	$37,280,000
50 mil Liner	2,330	Ac	$47,500	$110,675,000
Plumbing & Fencing	2,330	Ac	$15,000	$34,950,000
Evaporation Pond Facility Land Cost	2,330	Ac	$56,000	$130,480,000
E.P.F. Pump Station @ 517 HP:				
Pump Station Q	54,625	GPM		
Pump Station Head	30	Ft		
Pump Station Size	517	HP		
Pump Station Cost	517	HP	$4,127,208	
Electrical Service	1	Ea	$570,000	
Transmission Line	5	Mi	$1,700,000	
Subtotal, E.P.F. Pump Station			$6,397,208	$6,397,208
Subtotal, Evaporation Pond Facility	**2,330**	**Ac**		**$330,034,208**
SUMMARY OF CONSTRUCTION COSTS:				
Subtotal,Evaporation Ponds	2,330	Ac		$323,637,000
Subtotal, E.P.F. Pump Station	517	HP		$6,397,208
SUBTOTAL				**$330,034,208**
DISTRIBUTIVE COSTS:			25%	$82,508,552
CONTINGENCIES:			25%	$82,508,552
TOTAL CONSTRUCTION COSTS				**$495,051,312**
ANNUAL OPERATION & MAINTENANCE COSTS:				
Evaporation Pond Facility O & M			1.50%	$7,281,833
Annual Pump Station O & M			2.00%	$191,916
Annual Pumping Power Cost				
Power Cost (per kWh)			$0.10	
Motor Efficiency (typ.)			0.95	
E.P.F. Pump Station @ 517 HP:				$355,639
TOTAL OPERATION & MAINTENANCE COSTS				**$7,829,388**