CHOWCHILLA SUBBASIN

Sustainable Groundwater Management Act (SGMA)

Groundwater Sustainability Plan

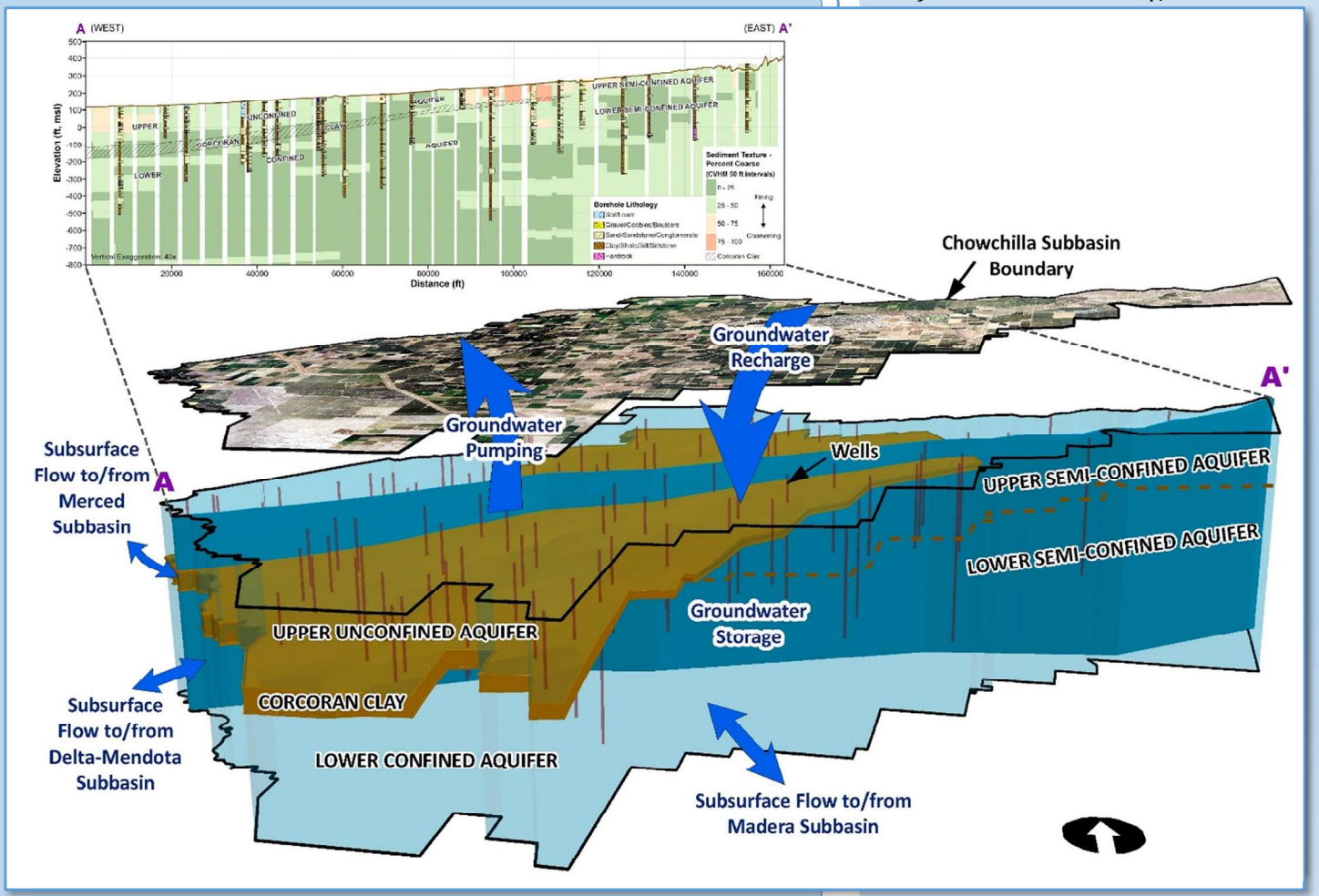
APPENDIX 4. Projects and Management Actions to Achieve Sustainability Goal

Technical Appendices 4.A. through 4.D.

January 2020,
Revised May 2023

Prepared by

Davids Engineering, Inc (Revised GSP Team)
Luhdorff & Scalmanini (Revised GSP Team)
ERA Economics
Stillwater Sciences and
California State University, Sacramento



Chowchilla Subbasin

Sustainable Groundwater Management Act

Groundwater Sustainability Plan

Technical Appendices 4.A. through 4.D.

January 2020,
Revised May 2023

Prepared For

Chowchilla Subbasin GSP Advisory Committee

Prepared By

Davids Engineering, Inc. (Revised GSP Team)
Luhdorff & Scalmanini (Revised GSP Team)
ERA Economics
Stillwater Sciences and
California State University, Sacramento

APPENDIX 4. PROJECTS AND MANAGEMENT ACTIONS TO ACHIEVE SUSTAINABILITY GOAL

4.A. Chowchilla Water District GSA: Groundwater Recharge Basins Project Supporting Details

4.B. Chowchilla Water District GSA: Chowchilla-Merced Intertie Project Supporting Details

4.C. Chowchilla Water District GSA: Buchanan Dam Capacity Increase Project Supporting Details

4.D. Madera County GSA: Groundwater Recharge Basins Project Supporting Details

APPENDIX 4.A. CHOWCHILLA WATER DISTRICT GSA
Groundwater Recharge Basins Project Supporting Details

Prepared as part of the

Groundwater Sustainability Plan
Chowchilla Subbasin

January 2020

GSP Team:

Davids Engineering, Inc
Luhdorff & Scalmanini
ERA Economics
Stillwater Sciences and
California State University, Sacramento

TABLE OF CONTENTS

LIST OF TABLES

1 PROJECT OVERVIEW

CWD plans to construct approximately 1,000 acres of groundwater recharge basins that would be distributed throughout its service area. The locations and sizes of basins will be selected based on land uses, access to delivery facilities, and the presence of soils with appropriate percolation rates suitable for recharge. Sites will be selected to maximize recharge efficiency and net benefits to the Subbasin groundwater system.

As part of project development, CWD has developed project costs for a typical 80-acre recharge basin. While actual costs for each basin will vary based on unique site characteristics and market conditions affecting land, construction, and material costs at that time, these costs are anticipated to scale, on average, with construction of the 1,000 acres of recharge basins district-wide.

The assumptions used in development and the preliminary capital cost estimates for the 80-acre recharge basin are provided below.

2 ASSUMPTIONS

The total infiltration provided by the proposed 80-acre recharge based is based on the anticipated availability of flood flows, or the flood frequency, and infiltration rates of soils in the CWD service area. These assumptions are summarized in Table A4.A-1.

The availability of flood flows in the CWD service area was based on the annual historical flood releases from Buchanan Dam and Madera Canal along Chowchilla River, Ash Slough, and Berenda Slough within the CWD service area. Flood frequency was calculated as the proportion of years with available flood flows, which generally occur during water years characterized as wet or above normal.

Infiltration rates in CWD are assumed based on seepage analyses by CWD, and seepage rates reported by Summers (2014), Bachand et al. (2015), and Dalkhe et al. (2015). These infiltration rates may be refined through further soils and groundwater analyses as specific locations are selected for the recharge basins.

Table A4.A-1. Flood Frequency and 80-acre Recharge Basin Infiltration Assumptions.

Parameter	Value
Flood frequency (% of total years)	48.5%
Recharge basin area (acres)	80
Infiltration rate (in/day)	3
Recharge duration (days/year)	140
Total infiltration per year with flood flows (AF/year)	**2,800**
Annual expected infiltration, all years (AF/year)	**1,360**

Assumptions regarding the capital cost estimates for the 80-acre recharge basin are summarized by item in Table A4.A-2. All costs are reported in current 2019 dollars.

These cost estimates are based on actual costs reported by CWD for a recently constructed 40-acre recharge basin and typical rates for materials, construction, and related services. Notably, the capital costs include higher CWD estimated requirements for:

- Installation of a 20 cfs lift pump to the basin: $30,000 total
- Shoring, sheeting & bracing: $12,000 total
- PG&E power (bringing to the site, 1/4 mile run): $35,200 total
- Construction of a 1/4 mile gravel road to the site: $47,520 total
- Soils report and testing: $35,000 total

Assumptions for all survey, design, legal, administration, and other contingency costs include:

- Field Survey: 1.5% of construction cost
- Project Design: 7% of construction cost
- Legal: 2% of construction cost
- CEQA: 5% of construction cost
- CWD Administration: 5% of construction cost

3 ESTIMATED PROJECT COSTS

The total estimated capital costs of a single 80-acre groundwater recharge basin are summarized below in Table A4.A-2. In total, an 80-acre recharge basin is expected to cost approximately $3,060,000.

Table A4.A-2. Detailed Construction Cost Estimate.

PROBABLE CONSTRUCTION COST ESTIMATE
Chowchilla Water District
Recharge basin - 80 acre site
Civil Improvements

ITEM	QUANTITY	UNIT	DESCRIPTION	UNIT PRICE	AMOUNT
			OFF-SITE IMPROVEMENTS		
1	1	LS	Mobilization	$5,000.00	$5,000
2	1	LS	Clear & Grub	$6,000.00	$6,000
4	1	LS	Pump Structure inlet and outlet	$36,000.00	$36,000
5	125,000	CY	Earthwork	$6.50	$812,500
6	1	EA	15 cfs structure	$18,000.00	$18,000
7	1	EA	10 cfs structure	$16,000.00	$16,000
8	1	EA	5 cfs structure	$15,000.00	$15,000
9	2	EA	Monitoring well	$4,800.00	$9,600
10	1	LS	20 cfs lift pump to basin	$30,000.00	$30,000
11	7,800	LF	Chain Link Fence	$18.50	$144,300
12	1	LS	Shoring, Sheeting & Bracing	$12,000.00	$12,000
13	1	LS	PG&E Power to site 1/4 mile run	$35,200.00	$35,200
14	1	LS	1/4 mile gravel road	$47,520.00	$47,520
			SUBTOTAL COST OF IMPROVEMENTS		$1,182,120.00
			Land Purchase 80 acres @ $20,000 per acre	$1,600,000.00	$1,600,000.00
			Soils report and testing	$35,000.00	$35,000.00
			Field Survey 1.5% of construction cost		$ 17,731.80
			Project Design: 7% of construction cost		$ 82,748.40
			Legal: 2% of construction cost		$ 23,642.40
			CEQA: 5% of construction cost		$ 59,106.00
			CWD Administration: 5% of construction cost		$ 59,106.00
			Total of Improvements		$3,060,000

APPENDIX 4.B. CHOWCHILLA WATER DISTRICT GSA
Chowchilla-Merced Intertie Project Supporting Details

Prepared as part of the

Groundwater Sustainability Plan
Chowchilla Subbasin

January 2020

GSP Team:

Davids Engineering, Inc
Luhdorff & Scalmanini
ERA Economics
Stillwater Sciences and
California State University, Sacramento

TABLE OF CONTENTS

1 PROJECT OVERVIEW

In 2000, Chowchilla Water District (CWD) conducted a preliminary investigation of the feasibility of a water transfer project with Merced Irrigation District (Merced) via the Chowchilla-Merced Intertie.[1] This project was revisited again during a preliminary reconnaissance-level feasibility assessment developed as part of San Joaquin River Restoration Program (SJRRP) planning efforts. The Chowchilla-Merced Intertie project would benefit the Chowchilla Subbasin by allowing CWD to purchase and deliver excess surface water supplies from Merced during years in which excess supplies are available.

The project would include construction of a pipeline connection between CWD and Merced and negotiation of short- and long-term transfer arrangements between CWD and water management entities in Merced.

In total, water conveyance facilities consisting of a canal, pipeline and appurtenant facilities would be constructed to convey water from Merced to CWD. CWD would then use that water within its service area in-lieu of groundwater pumping, or for recharge (basins or Flood-MAR), depending on conditions at the time water is available. The most likely option is that water would be acquired from Merced ID by short-term or long-term contract and delivered to CWD for direct irrigation use, thereby reducing groundwater demand within CWD's service area

This project would provide a benefit to the subbasin, allowing CWD to deliver additional surface water to growers to reduce groundwater pumping within the CWD service area.

2 COST ESTIMATES

Preliminary construction cost estimates for the Chowchilla-Merced Intertie project are based on the Water Transfer Feasibility Study prepared by Tolladay, Fremming and Parson for Reclamation in 2000. The analysis considered different alternatives for construction of new facilities and expansion of existing facilities. For GSP development, costs for alternative 6 from this study were considered. Indexed to 2019 dollars, the estimated construction cost is approximately $6.7 million, which would be incurred at the start of the project. It should be noted that the study completed in 2000 assumes lower land acquisition costs and does not include environmental permitting or Right-of-Way costs.

Details regarding the development of these costs are summarized below from SJRRP planning efforts in January 2014 (in 2013 dollars). Building on the preliminary reconnaissance-level feasibility assessment, CWD will perform additional studies of the project to refine costs and explore partnership opportunities during the GSP implementation period.

Operating costs of the project include costs to operate the system and move water from Merced. Weighted-average annual operations and maintenance (O&M) costs are summarized in Section 4.1.3 of the GSP.

[1] Water Transfer Feasibility Study: Merced Irrigation District to Chowchilla Water District. Prepared by Tolladay, Fremming and Parson for the U.S. Bureau of Reclamation. Summer 2000.

3 PROJECT DETAILS (SAN JOAQUIN RIVER RESTORATION PROGRAM, 2014)

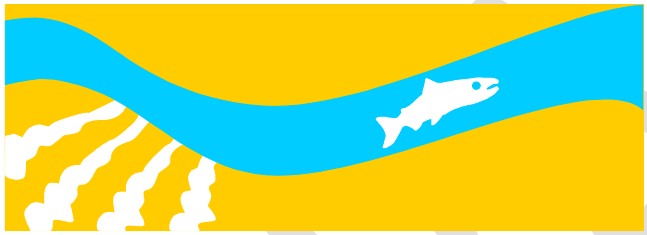
Details regarding the development of the Chowchilla-Merced Intertie project are provided below in the documentation of *Project 101: Chowchilla-Merced Intertie* from SJRRP planning efforts in January 2014. Project cost estimates are provided in 2013 dollars.

Project 101

Chowchilla-Merced Intertie

Working Administrative Draft
Water Management Goal – Investment Strategy

SAN JOAQUIN RIVER
RESTORATION PROGRAM



1.0 Project 101 Evaluation Summary

BUREAU OF RECLAMATION

SAN JOAQUIN RIVER RESTORATION PROGRAM

WATER MANAGEMENT GOAL - INVESTMENT STRATEGY

Project Evaluation Summary

ID: **101** Type: **LI**

Project Name: **Chowchilla-Merced Intertie** Proponent: **Chowchilla WD & Madera ID**

CRITERIA	METRICS	ASSESSMENT/ VALUE	SCORE	NOTES
Performance & Cost	Yield - Long-term Average (TAF/year)	6		*Refer to Yield Analysis Summary*
	Water Supply Source	Merced River Flow	MRF	
	RWA Balance Reduction Benefit (TAF/year)	6		*Assumes Yield would result in RWA Balance Reduction either directly or through exchanges*
	Duration of Benefits/ Project Useful Life	Long-Term	2	*30-year project life*
	Total Cost ($)	$ 10,000,000		*Refer to Cost Estimates Summary*
	Non-Federal Cost Share ($)			
	Overall Cost-effectiveness ($/AF) (Total Cost / Yield)	$ 121		*Annualized Total Cost / Yield, 6% discount rate over project life*
	Federal Cost of RWA Benefit ($/AF)	$ 121		*Annualized Reclamation Cost Share / RWA Credit, 6% discount rate over project life*
Implementation Factors	Environmental Compliance Requirements	Complex: Likely EIS/EIR	1	*Refer to Environmental Considerations Summary*
	Permitting Requirements	Complex: Likely Individual Permit, Formal Section 7 Consultation	1	*Refer to Environmental Considerations Summary*
	Water Rights/Contract	High: Likely New Water Right	1	*New supply for Chowchilla WD*
	Institutional Requirements	High: Partnerships Needed, Likely New Agreement	1	*Agreement with Merced ID*
	Land Acquisition	High: No Willing Seller Identified	1	*Need lands for new conveyance*
	Timeframe for Implementation	Moderate: Between 3 and 10 Years	2	
Completeness of Project Definition	Facilities & Costs	High: Plans/Studies Available	3	*Feasibility level plans*
	Yield & RWA Reduction Approach	Low: Unconfirmed Yield/Water Source and/or RWA Reduction Approach	1	*Source is confirmed only when agreement is in place with MID. Project yield and RWA reduction approach is uncertain*
	Finance	Low: Non-Federal Cost-Share is not Identified	1	
Other Related Benefits	Groundwater Overdraft Reduction	Low Potential	1	*Project delivers more surface water into an area suffering from GW over-draft*
	Hydropower	None	0	
	Flood Damage Reduction	None	0	
	Recreation	None	0	
	Ecosystem	None	0	
	Water Quality	None	0	

RELATIVE RANKING		RELATIVE SCORES		
B	Scenario 1 - Cost-Effectivenss Only	Overall Cost-Effectiveness Rank	16.5	*Relative cost-effectiveness rank compared to all other projects*
B	Scenario 2 - Cost-Effectiveness & Implementation Complexity	Overall Implementation Factors Score	0.08	*0 to 1 score - sum of six Implementation Factors scores minus six and divided by 12.*
B	Scenario 3 - Cost-Effectiveness & Completeness of Project Definition	Overall Project Definition Score	0.33	*0 to 1 score - sum of three Project Definition scores minus three and divided by six.*
B	Scenario 4 - Composite Weighted Score (for all Four Criteria)	Composite Weighted Score	1.62	*Composite weighted score for all four criteria and their specific metrics (refer to Lookup for details)*

Key:

AF = acre-feet, EA = Environmental Assessment, EIS/EIR = Environmental Impact Statement/Report, ID = Irrigation District, MND = Mitigated Negative Declaration, N/A = Not Applicable, ROW = Right of Way, RWA = Recovered Water Account, TAF = 1,000 acre-feet

Type: GW = Groundwater, LI = Local Improvement, NS = Non-Structural, RC = Regional Conveyance, RE = Recapture, RW = Recycled Water, SS = Surface Storage

This page left blank intentionally.

2.0 Project 101 Overview

Project Name: Chowchilla-Merced Intertie

ID: 101

Proponent:
Chowchilla Water District

Synopsis:
Construct intertie to deliver Merced River water to the Chowchilla Water District.

Description:
This project proposes improvements to existing Merced Irrigation District (MID) facilities, and construction of a new intertie to the Chowchilla Water District (CWD) distribution system. Two transfer sizes have been considered: 7,500 acre-feet per year and 15,000 acre-feet per year, both between June 1st and August 31st. Water transfers from MID to CWD would occur at a rate of 41 to 83 cfs from the Merced River into the MID Main Canal, at a point just east of the community of Snelling, CA. The MID Main Canal from the Merced River to Lake Yosemite would require minor grading, shaping and increased bank height to contain the additional water flow. From Lake Yosemite, water would flow for about 12 miles before diverted into the Planada Canal. After 3 miles in the Planada Canal the water would be lifted through new canals and pipelines and discharge into the Chowchilla River. Water would flow in the river until the CWD Main Canal Diversion and travel west in the CWD Main Canal for about 0.75 miles until being diverted south into a new canal. The new canal would be 1.75 miles in length and have siphons under both the Chowchilla River and Ash Slough. At the end of this new canal water would be diverted into either the Bethel Canal or the Ash Main Canal. In total this project would require about 6 miles of new canal, 1 mile of pipeline, 8 siphons, and 2 pumping plants.

This project allows CWD to take delivery of additional Merced River water. The proposed diversion enters CWD's system in a location that allows them to better manage flows and allows CWD to take delivery of additional Merced River water.

Category & Descriptor:
RC - Merced River to CWD

Water Source(s):
Merced River Supply

References:
U.S. Department of the Interior, Bureau of Reclamation. 2011. San Joaquin River Restoration Program Draft Program Environmental Impact Report. April.

Merced Irrigation District. 2013 Agricultural Water Management Plan. September.

Tolladay, Fremming, & Parson. 2000. Merced Irrigation District to Chowchilla Water District Water Transfer Feasibility Study. September.

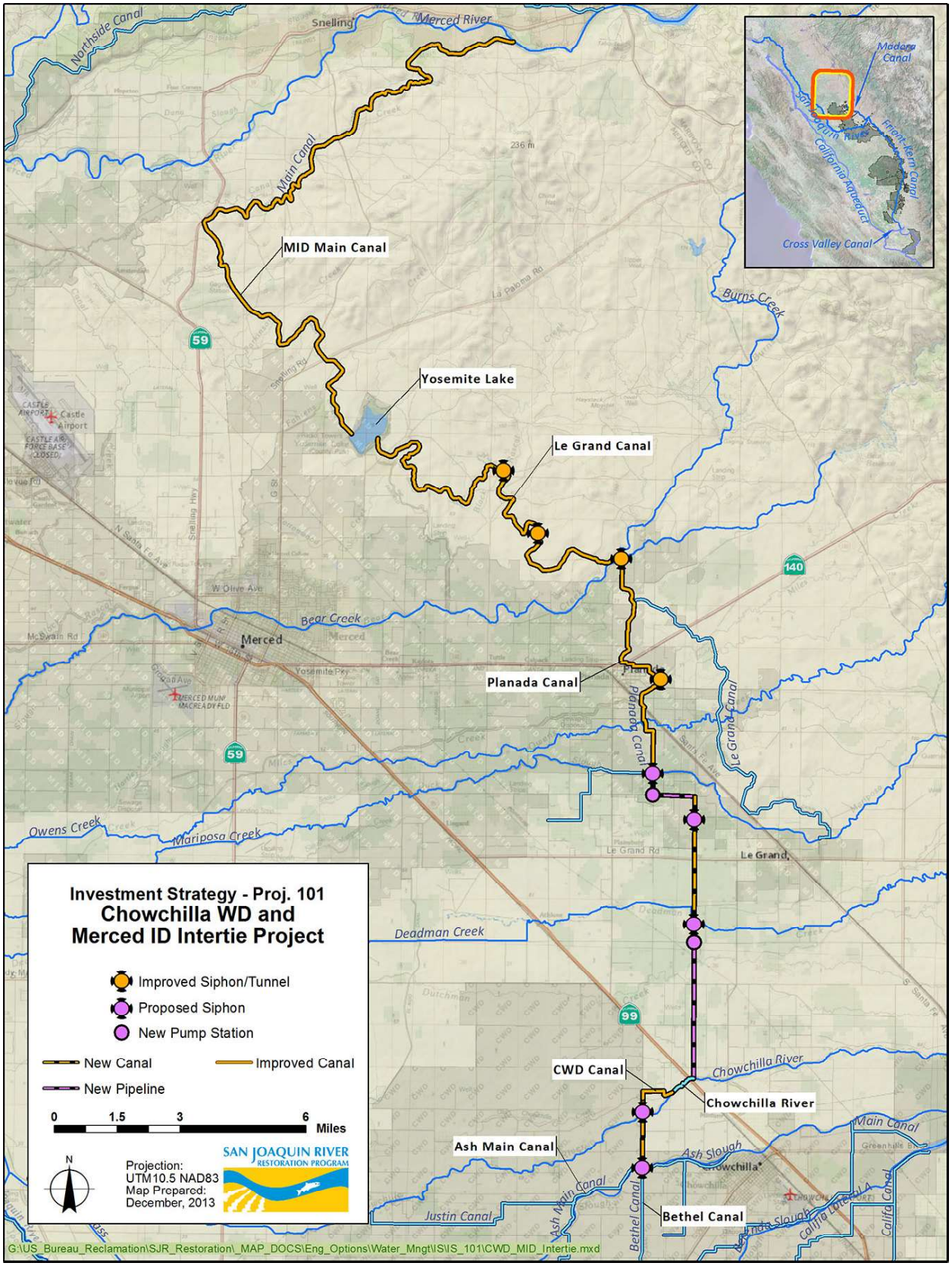


Figure 2-1.
Project Location Map

3.0 Project 101 Yield Analysis

3.1 Operational Description

This project is proposed by the Chowchilla Water District (CWD) and includes upgrades to existing conveyance facilities and construction of a new canal and siphons to annually convey 7,500 acre-feet to 15,000 acre-feet of water from the Merced Irrigation District (MID) main canal to CWD. From June 1st through August 31st, Merced River water would be conveyed through an upgraded MID main canal to Lake Yosemite, then through an upgraded Le Grand Canal, then through an upgraded Planada Canal, then through a new canal, pumping facilities, and pipelines to the Chowchilla River (Tolladay, Fremming, & Parson 2000).

3.2 Project Schematic

The following diagram depicts how Merced River water would be conveyed to CWD.

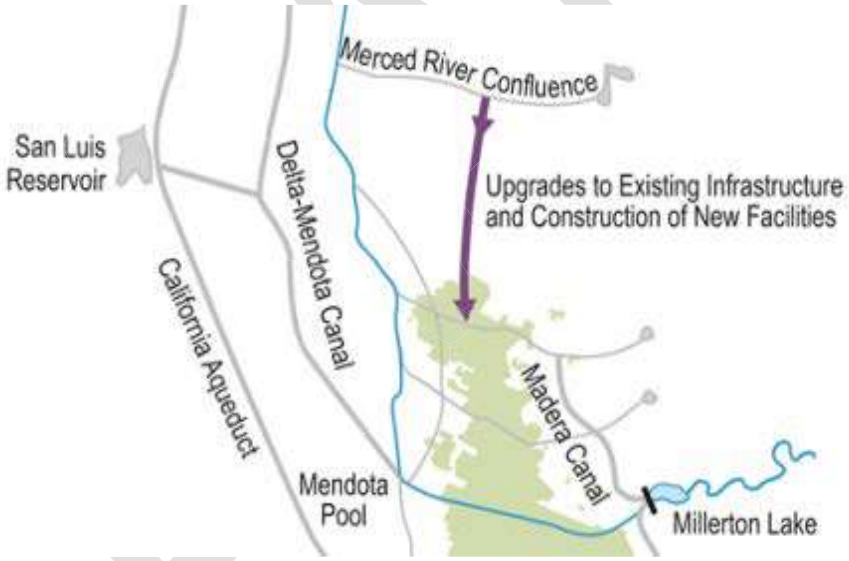


Figure 3-1.
Project Schematic

3.3 Assumptions

The following assumptions were used for this yield estimate:

- This analysis only includes an evaluation of the 7,500 acre-feet sale from MID to CWD

- MID is willing to sell 7.5 thousand acre-feet (TAF) of Merced River water to CWD each in wet, normal-wet, and normal-dry Restoration year types, split equally during June, July, and August. No sale occurs in other Restoration year types.

- The analysis period is restricted to the availability of release data from New Exchequer Dam on CDEC: 1995 through present.

3.4 Analysis Process

3.4.1 Yield

The amount of water available for irrigation purposes from June through August was determined from California Data Exchange Center (CDEC) data, available from 1995 through present. Flow requirements in the Merced River downstream from the MID main canal were subtracted from the New Exchequer Dam releases, the Crocker Agreement and the Stevinson Entitlement (Merced Irrigation District 2013). This resulted in a monthly time series of Merced River water available to MID. The quantity of Merced River flows available to MID was then compared to the flow rate required to convey 7.5 TAF to CWC from June through August. Flow rates required to deliver 7.5 TAF to CWD were determined to make up 1 to 4 percent of the Merced River water available to MID.

Since the sale of 7.5 TAF of Merced River water to CWD makes up a small percentage of total Merced River water available to MID, it was assumed that in wet, normal-wet, and normal-dry Restoration year types, MID would be willing to sell 7.5 TAF to CWD. This yield was then averaged with zero yield assumed in dry, critical high, and critical low Restoration years, to determine an annual average project yield of 6 TAF.

The certainty of the yield estimate is assumed to be low. It is unclear how much Merced River water CWD would have access to, since CWD and MID have not discussed potential terms of a transfer or sale agreement.

3.4.2 RWA Balance Reduction

CWD currently has a long-term average RWA credit of 19 TAF. Since this project directly increases delivery to CWD through a sale and not an exchange, it is expected that the entire project yield of 6 TAF a RWA reduction. The RWA balance reduction certainty is high.

3.5 Results Summary

Table 3-1 displays the long-term average annual results from the yield analysis.

Table 3-1.
Results Summary for Yield Analysis

Result	TAF/year
Annual Average Yield	6
Annual RWA Credit	18.8
Annual RWA Balance Reduction	6

Key:
RWA = Recovered Water Account
TAF = thousand acre-feet

This page left blank intentionally.

4.0 Project 101 Cost Estimates Summary

BUREAU OF RECLAMATION

FEATURE: Construct Siphons; Canal Improvements; New Canal; New Pipeline	**PROJECT:** Chowchilla-Merced Intertie Canal Preferred Alternative
	ESTIMATE LEVEL: Pre-Appraisal
	PRICE LEVEL: Dec-2013
Level of Confidence: **High: Plans/Studies Available**	ID-101

	PAY ITEM	DESCRIPTION		QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Merced ID System					
	1	Siphon - Main Canal		1	EA	$ 125,000.00	$ 125,000.00
	2	Siphon - Flume #2		1	EA	$ 230,000.00	$ 230,000.00
	3	Minor Reshaping - Le Grande Canal		12	MI	$12,650	$ 151,800.00
	4	Siphon - Bear Creek		1	EA	$ 75,000.00	$ 75,000.00
	5	Enlargement - Planada Canal		5	MI	$ 32,850.00	$ 164,250.00
	6	Siphon - Owen's Creek		1	EA	$75,000	$ 75,000.00
	7	Crossing - Santa Fe Railroad		1	EA	$50,000	$ 50,000.00
	8	Siphon - Mariposa Creek		1	EA	$75,000	$ 75,000.00
	9	New Canal		1	MI	$42,240	$ 42,240.00
	10	Pumping Plant		1	LS	$250,000	$ 250,000.00
	11	60" RCP		5,280	LF	$380	$ 2,006,400.00
	12	New Canal		3.5	MI	$42,240	$ 147,840.00
		Merced ID System					
	13	New Canal		3.25	MI	$65,706	$ 213,544.50
	14	Siphon - small creek		1	EA	$50,000	$ 50,000.00
	15	Spill Structure - Chowchilla River		1	EA	$35,000	$ 35,000.00
		Chowchilla WD System					
	16	Control Structure		1	EA	$35,000	$ 35,000.00
	17	Siphon - river		1	EA	$125,000	$ 125,000.00
	18	New Canal		1.75	MI	$65,706	$ 114,985.50
	19	Siphon - creek		1	EA	$50,000	$ 50,000.00
	20	Control Structure		1	EA	$35,000	$ 35,000.00
		Subtotal					$ 4,051,060.00
		Price Escalation (Sep/2000 to Dec/2007)		30%	pct		$ 5,266,378.00

	PAY ITEM	DESCRIPTION		QUANTITY	UNIT	UNIT PRICE	AMOUNT
	21	Mobilization		5%	LS	Lump Sum	$ 465,871.90
	22	Unlisted Items		15%	pct	Lump Sum	$ 789,956.70
		Contract Cost					$ 6,522,206.60
		Contingencies		30%	pct		$ 1,956,661.98
		Field Cost					$ 8,478,868.58
		Non-Contract Costs		25%	pct		$ 2,119,717.15
		Dec-2007 Project Cost					$ 10,598,585.73
		Dec-2013 Project Cost *Project Cost Escalated to Dec-2013 price levels using CALTRANS Construction Price Index*					$ 10,000,000.00

BY	CHECKED
Evan Perez	Checker's name here

References:

1) Tolladay, Fremming, and Parsons Water Transfer Feasibility Study: Merced Irrigation District to Chowchilla Water District, 2000

Disclaimer:

The estimates of construction costs shown, and any resulting conclusions on the project's financial requirements, economic feasibility, or funding requirements, have been prepared from the best information available at the time the estimates were performed. Additional engineering and feasibility studies would refine project information, and final project costs and resulting feasibility would depend on actual labor and material costs, competitive market conditions, and other variable factors. Accordingly, the final project cost would vary from the estimates herein. Therefore, project feasibility, benefit/cost analysis, risk, and funding would need to be carefully reviewed before making specific funding decisions and/or establishing the project budget.

5.0 Project 101 Environmental Considerations Summary

Environmental Compliance Requirements	Complex: Likely EIS/EIR
Permitting Requirements	Complex: Likely Individual or Regional Section 404 Permit, Formal Section 7 Consultation

Consideration	Yes	No	Maybe	Notes
Affect a scenic vista or scenic resources?		X		
Convert Prime Farmland, unique Farmland, Farmland of Statewide Significance; or affect Williamson Contracts?	X			Multiple sensitive soil types in project area
Violate air quality standards (large construction project vs. modification to an existing structure)?			X	Depends on size and duration of construction elements, large linear project area and new canals are proposed.
Affect endangered/threatened species, critical habitat, or other biological resources? If yes, proceed to permitting.	X			Several species/habitat are contiguous with project area. Construction of crossings at Bear and Owens Creeks and Chowchilla River could cause habitat loss in the channels and riparian areas. If additional water is to be taken from the Merced River, it could affect the water quality, fisheries, and temperature in the Merced River.
Affect historical/cultural resources? If yes, proceed to permitting:			X	Specialist or field surveys would be needed to verify.
Located on a known earthquake zone?			X	
Result in substantial soil erosion or loss of topsoil?		X		Most of project is tunnel or narrow canal construction.
Violate or degrade water quality standards?	X			During construction; multiple new siphons and and improvements to existing canals would occur. Construction of facilities may create dust or introduce additional sediment to rivers.
Substantially deplete groundwater supplies?		X		
Alter drainage patterns of site?	X			
Placement of a structure in 100-year flood hazard area?	X			
Located within residential homes (e.g. will these homes be affected by construction noise)?		X		
Affect recreational facilities?		X		
Result in a change of traffic patterns?		X		Possibly during construction.

Consideration	Yes	No	Maybe	Notes
Require work in a river, stream, or reservoir? If yes, proceed to permitting section below	X			Are canals jurisdictional? Multiple new siphons and and improvements to existing canals would occur. Existing facilities need to be kept in operation during construction, which may require some facilities to be constructed during winter months when less water is required for irrigation demands.
USFWS/NMFS Section 7 Consultation required? Formal or Informal			X	Field surveys/detailed analysis needed for formal vs. informal consultation.
USACE Section 404 Clean Water Act permit required?	X			Six miles of new canal, 1 mile of pipeline, 8 siphons, and 2 pumping plants will most likely require a CWA Section 404 Individual or Regional Permit.
USACE Section 10 Rivers and Harbors Act permit required?		X		
USACE Section 408 permission required?		X		
NHPA Section 106 Consultation required?	X			
CA RWQCB Section 402 permit required?			X	
CA DFW Incidental Take Permit required?			X	If State listed species found.
CA DFW Section 1600 permit required?	X			
CA RWQCB Section 401 Water Quality Certification Required?	X			
CVFPB levee/floodway encroachment permit required?		X		
Caltrans/local encroachments?			X	Possibly during construction.
New water right required?			X	It is using recaptured water.
Require a Change of Place of Use?			X	Water would be moved from one ID system to another for use. The intertie canal is not expected to affect the hydraulic capacity of the CWD structures, but the increased through-flow may require operation of some facilities to change. Water from the Merced River can only be used for meeting the water management goal and cannot be diverted to the San Joaquin River.
Require a Change of Point of Diversion?	X			New diversions are proposed for this project.

Key:

CA DFW = California Department of Fish and Wildlife; CA RWQCB = California Regional Water Quality Control Board; CVFPB = Central Valley Flood Protection Board; EA = Environmental Assessmnet; EIS/EIR = Environmental Impact Statement/Report; MND =Mitigated Negative Declaration; ND= Negative Declaration; NHPA = National Histroic Preservation Act; NMFS = National Marine Fisheries Service; USACE = U.S. Army Corps of Engineers; USFWS = U.S. Fish and Wildlife Service

Sources:

U.S. Department of the Interior, Bureau of Reclamation. 2011. San Joaquin River Restoration Program Draft Program Environmental Impact Report. April.

~~APPENDIX 4.C.~~ CHOWCHILLA WATER DISTRICT GSA

Buchanan Dam Capacity Increase Project Supporting Details

Prepared as part of the

Groundwater Sustainability Plan
Chowchilla Subbasin

January 2020
Revised May 2023

GSP Team:

Davids Engineering, Inc. (Revised GSP Team)
Luhdorff & Scalmanini (Revised GSP Team)
ERA Economics
Stillwater Sciences and
California State University, Sacramento

TABLE OF CONTENTS

1 PROJECT OVERVIEW

As part of the San Joaquin River Restoration Program (SJRRP), Reclamation, working with CWD, investigated the feasibility of expanding Eastman Lake by approximately 50 thousand acre-feet (TAF).[1]

The U.S. Army Corps of Engineers (USACE) owns and operates Buchanan Dam and Eastman Lake on the Chowchilla River as part of the Central Valley Project (CVP). Eastman Lake currently has a gross capacity of 150 TAF and is operated with a 45 TAF flood management reservation. CWD has a long-term contract with Reclamation for 24 TAF of CVP supplies per year from Eastman Lake. In wet years storage in Eastman Lake is carried over to subsequent drier years. In wet years, inflows that would encroach into the flood reservation space are evacuated as flood flows.

Under this project, CWD would enlarge the current 150 TAF capacity of Eastman Lake by 50 TAF to 200 TAF. The reconnaissance-level feasibility assessment conducted in 2014 estimated that the existing dam and spillway crest would be raised in place by 24 feet, and a 700-foot saddle dam would be constructed to the east of the spillway. The increase in capacity would allow USACE to maintain the flood reserve and store additional runoff for delivery to CWD.

The added capacity would allow additional deliveries to CWD and growers, helping to reduce groundwater pumping within the CWD service area. However, the additional deliveries would partially offset the availability of flood flows which are used for groundwater recharge benefits under other CWD projects (recharge basins and Flood-MAR). CWD will assess these tradeoffs under future project planning efforts.

2 COST ESTIMATES

Preliminary construction costs for the Buchanan Dam Capacity Increase project are based on the pre-appraisal level cost estimate developed by Reclamation as part of SJRRP planning efforts in January 2014. Details regarding the development of these costs are summarized below in 2013 dollars. Indexed to 2019 dollars, the estimated construction cost is approximately $49.6 million, which would be incurred at the start of the project.

The estimated average annual operations and maintenance (O&M) costs are summarized in Section 4.1.5 of the GSP and total approximately $220,000. Actual O&M costs will be assessed by CWD as the project is developed.

3 PROJECT DETAILS (SAN JOAQUIN RIVER RESTORATION PROGRAM, 2014)

Details regarding the development of the Buchanan Dam Capacity Increase project are provided below in the documentation of *Project 105: Eastman Lake Enlargement* from SJRRP planning efforts in January 2014. Project cost estimates are provided in 2013 dollars.

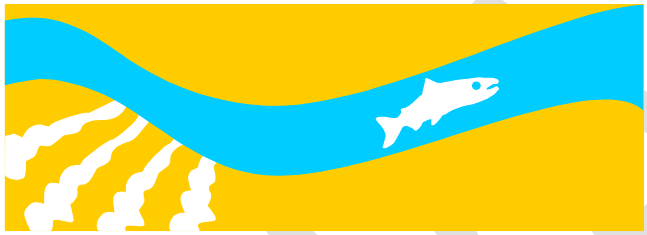
[1] Eastman Lake Enlargement. Working Administrative Draft. Water Management Goal – Investment Strategy. San Joaquin River Restoration Program. January 2014. U.S. Bureau of Reclamation.

Project 105

Eastman Lake Enlargement

Working Administrative Draft
Water Management Goal – Investment Strategy

SAN JOAQUIN RIVER
RESTORATION PROGRAM



BUREAU OF RECLAMATION

SAN JOAQUIN RIVER RESTORATION PROGRAM

WATER MANAGEMENT GOAL - INVESTMENT STRATEGY

Project Evaluation Summary

ID: **105** Type: **SS**

Project Name: **Eastman Lake Enlargement** Proponent: **Chowchilla WD**

CRITERIA	METRICS	ASSESSMENT/ VALUE	SCORE	NOTES
Performance & Cost	Yield - Long-term Average (TAF/year)	22		*Refer to Yield Analysis Summary*
	Water Supply Source	Other	Oth	*Surplus Chowchilla River Flows*
	RWA Balance Reduction Benefit (TAF/year)	22		*Assumes Yield would result in RWA Balance Reduction either directly or through exchanges*
	Duration of Benefits/ Project Useful Life	Long-Term	2	*30-year project life*
	Total Cost ($)	$ 45,000,000		*Refer to Cost Estimates Summary*
	Non-Federal Cost Share ($)	$ -		
	Overall Cost-effectiveness ($/AF) (Total Cost / Yield)	$ 149		*Annualized Total Cost/ Yield, 6% discount rate over project life*
	Federal Cost of RWA Benefit ($/AF)	$ 149		*Annualized Reclamation Cost Share / RWA Credit, 6% discount rate over project life*
Implementation Factors	Environmental Compliance Requirements	Complex: Likely EIS/EIR	1	*Refer to Environmental Considerations Summary*
	Permitting Requirements	Complex: Likely Individual Permit, Formal Section 7 Consultation	1	*Refer to Environmental Considerations Summary*
	Water Rights/Contract	Low: Likely No Change	3	*Uses existing water right*
	Institutional Requirements	Moderate: Partnerships Needed, Likely Similar to Existing Arrangement	2	*Partnership with U.S. Army Corps of Engineers (USACE) for reservoir operations*
	Land Acquisition	High: No Willing Seller Identified	1	
	Timeframe for Implementation	Long: Greater Than 10 Years	1	
Completeness of Project Definition	Facilities & Costs	Moderate: Cost Information, No Engineering Details	2	
	Yield & RWA Reduction Approach	High: Confirmed Yield/Water Source and RWA Reduction Approach	3	*Well defined project. Straight-forward RWA reduction approach. Yield is uncertain.*
	Finance	Low: Non-Federal Cost-Share is not Identified	1	
Other Related Benefits	Groundwater Overdraft Reduction	Low Potential	1	*Conjunctive use district. Method for reducing GW over-draft is not defined*
	Hydropower	None	0	
	Flood Damage Reduction	Low Potential	1	*Reduces flood flows in the Chowchilla River and Ash Slough*
	Recreation	High Potential	3	*Increased res surface area and enhanced recreational benefits*
	Ecosystem	Low Potential	1	*It is unknown how the benefits may compare to impacts*
	Water Quality	Low Potential	1	*It is unknown how the benefits may compare to impacts*

RELATIVE RANKING		RELATIVE SCORES		
B	Scenario 1 - Cost-Effectivenss Only	Overall Cost-Effectiveness Rank	22.0	*Relative cost-effectiveness rank compared to all other projects*
B	Scenario 2 - Cost-Effectiveness & Implementation Complexity	Overall Implementation Factors Score	0.25	*0 to 1 score - sum of six Implementation Factors scores minus six and divided by 12.*
A	Scenario 3 - Cost-Effectiveness & Completeness of Project Definition	Overall Project Definition Score	0.50	*0 to 1 score - sum of three Project Definition scores minus three and divided by six.*
B	Scenario 4 - Composite Weighted Score (for all Four Criteria)	Composite Weighted Score	1.88	*Composite weighted score for all four criteria and their specific metrics (refer to Lookup for details)*

Key:

AF = acre-feet, EA = Environmental Assessment, EIS/EIR = Environmental Impact Statement/Report, ID = Irrigation District, MND = Mitigated Negative Declaration, N/A = Not Applicable, ROW = Right of Way, RWA = Recovered Water Account, TAF = 1,000 acre-feet

Type: GW = Groundwater, LI = Local Improvement, NS = Non-Structural, RC = Regional Conveyance, RE = Recapture, RW = Recycled Water, SS = Surface Storage

This page left blank intentionally.

2.0 Project 105 Overview

Project Name:
Eastman Lake Enlargement

ID:
105

Proponent:
Chowchilla Water District

Synopsis:
Enlarge Eastman Lake to develop additional water supply from the Chowchilla River.

Description:
The U.S. Army Corps of Engineers (USACE) owns and operates Buchanan Dam and Eastman Lake on the Chowchilla River as part of the Central Valley Project. The 206-foot-high and 1,800-foot-long rockfill dam, with a gross pool of 150 thousand acre-feet (TAF), is operated with a 45 TAF flood management reservation (Reclamation and DWR 2005). Chowchilla Water District (WD) has a long-term contract with Reclamation for 24 TAF of Central Valley Project supplies per year from Eastman Lake (Reclamation 2001). Chowchilla WD also has appropriative water rights to divert water from the Chowchilla River. These water rights are senior to Reclamation's appropriative water rights issued for storage of water in Buchanan Dam. Eastman Lake fills during wetter years, and that storage is delivered during subsequent drier years. During periods of heavy runoff, the remaining inflows to Eastman Lake are evacuated as flood flows (CWD 2013).

This project proposes to enlarge the capacity of Eastman Lake by 50 TAF to 200 TAF. The existing dam and spillway crest would be raised in place by 24 feet and a 700 foot saddle dam would be constructed to the east of the spillway. The increase in capacity would allow USACE to store additional flood waters from the Chowchilla River for delivery to Chowchilla WD.

This project benefits Chowchilla WD by delaying the delivery of Chowchilla River supplies that would normally have to be evacuated from the reservoir due to storage limitations and flood control criteria.

Category & Descriptor:
SS - Reservoir enlargement

Water Source(s):
Surplus San Joaquin River Flows

References:

Chowchilla Water District (CWD). 2013. Water Resources. Website. Available at:< http://www.cwdwater.com/index.php/about-cwd-2/water-resources. Accessed November 12, 2013.

Reclamation and DWR. 2005. Upper San Joaquin River Basin Storage Investigation Initial Alternatives Report: Flood Damage Reduction Technical Appendix. June.

California State Water Resources Control Board (SWRCB). 1965. Decision 1365: Decision Approving Application 18714 In Part And Denying Application 18732.

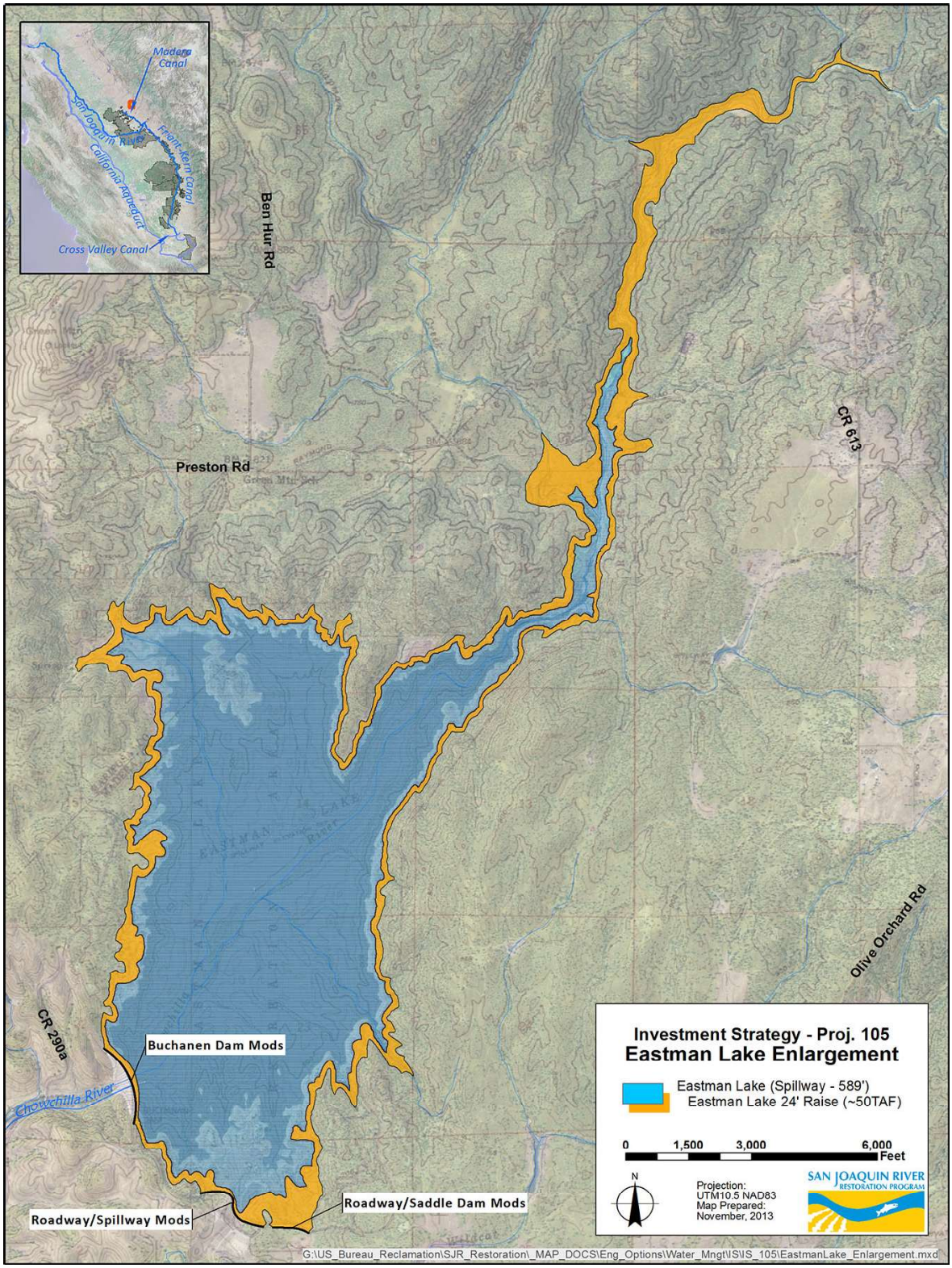


Figure 2-1.
Project Location Map

This page left blank intentionally.

3.0 Project 105 Yield Analysis

3.1 Operational Description

The project would raise Buchanan Dam on the Chowchilla River to increase storage capacity in Eastman Lake by 50 TAF. Chowchilla Water District (CWD) has a long-term contract with Reclamation for 24,000 acre-feet of CVP supplies per year from Eastman Lake, and takes deliveries from Buchanan via the Chowchilla River.

3.2 Project Schematic

The following diagram shows how Buchanan Dam and associated facilities would be modified, and how stored Chowchilla River flows would be released downstream for the yield assessment.

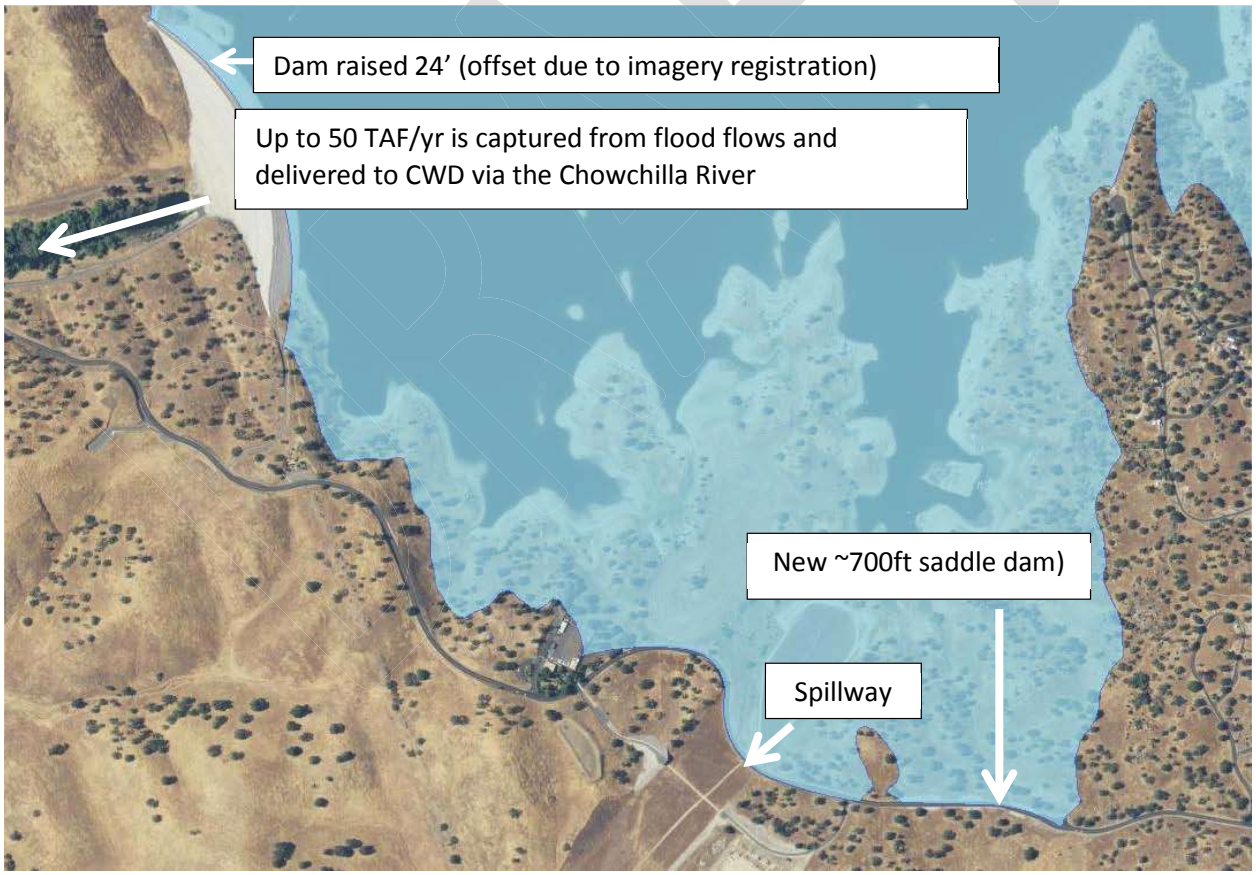


Figure 3-1.
Project Schematic

3.3 Assumptions

The following assumptions were used for this yield estimate:

- The historical ratio of long-term average deliveries and spills to inflows from 1912 to 2008, as provided by CWD, apply consistently to all months of all years, such that 61 percent of inflow in any month was delivered, and 39 percent was spilled.

- All historical inflow that would have spilled, up to 50 TAF, is stored from August 1 to July 31 and delivered August 1.

- Monthly inflows for water years 1912 – 1921 and 1924 – 1931 are correlated with gaged flow records for Fresno River near Knowles and Fresno River at Hidden Dam site in the Comprehensive Study – 2002, as reported by USACE in the Water Control Manual.

- Monthly inflows for water years 1922 – 1923, 1931 – 1990 are from the USGS; 1991 – 2005 from USACE, as reported by USACE in the Water Control Manual.

3.4 Analysis Process

3.4.1 Yield

The surplus Chowchilla River flows available at Buchanan Dam on a monthly basis were stored from August 1 through July 31 of the following year. The monthly values were converted to annual totals and an annual average new storage computed. The new amount stored annually was limited to 50 TAF per year. The computed annual average yield is 22 TAF. The yield certainty is assumed to be moderate, due to size uncertainty of the purposed Eastman Lake enlargement.

3.4.2 RWA Balance Reduction

CWD has an expected long-term annual average RWA credit of 19 TAF. The project would be operated directly for the benefit of CWD; hence, the annual average RWA balance reduction is assumed to be equal to the credit. The RWA balance reduction certainty is high.

3.5 Results Summary

Table 3-1 shows the simulated delivery of San Joaquin River flood flows to the new reservoir. The project would provide a benefit in all Restoration Year types. On a long-term basis, the yield would meet or nearly meet the entire CWD RWA credit. The majority of supplies would be diverted in January and February.

Table 3-1.
Summary of Yield Estimates

	Average Annual (TAF)
Total Supply Available	27
Total Recoverable (Yield)	22
RWA Credit	19

Key:
RWA = Recovered Water Account
TAF = thousand acre-feet

3.6 References

Chowchilla Water District (CWD). 2013. Water Resources. http://www.cwdwater.com/index.php/about-cwd-2/water-resources. Accessed November 12, 2013.

U.S. Army Corps of Engineers (USACE). 2006. Water Control Manual: Buchanan Dam and H.V. Eastman Lake, Chowchilla River, California. Appendix IX to Master Water Control Manual: San Joaquin River Basin, California. Sacramento District. June 1975, Revised January 2006.

This page left blank intentionally.

BUREAU OF RECLAMATION

FEATURE:	**PROJECT:**	
Dam Raise Spillway Raise Saddle Dam	Eastman Lake Enlagement	
	ESTIMATE LEVEL:	Pre-Appraisal
	PRICE LEVEL:	Dec-2013
Level of Confidence:	**Low: No Plans, Best Engineering Judgment Applied**	ID-105

	PAY ITEM	DESCRIPTION		QUANTITY	UNIT	UNIT PRICE	AMOUNT
	1	Dam Raise		1	LS	$7,207,620	$ 7,207,620.00
	2	Spillway Raise		1	LS	$7,774,000	$ 7,774,000.00
	3	Saddle Dam		603,750	CY	$12	$ 7,245,000.00
	4	Env. Docs/Mitigation		1	LS	$540,000	$ 540,000.00
	5	Mobilization (5%)		5%	pct		$ 1,138,331.00
	6	Unlisted Items (15%)		15%	pct		$ 3,414,993.00
		Contract Cost					$ 27,319,944.00
		Contingincies (30%)		30%	pct		$ 8,195,983.20
		Field Cost					$ 35,515,927.20
		Non-Contract Costs (25%)		25%	pct		$ 8,878,981.80
		Project Cost					$ 45,000,000.00

BY	**CHECKED**
Evan Perez	Checker's name here

References:

Disclaimer:

The estimates of construction costs shown, and any resulting conclusions on the project's financial requirements, economic feasibility, or funding requirements, have been prepared from the best information available at the time the estimates were performed. Additional engineering and feasibility studies would refine project information, and final project costs and resulting feasibility would depend on actual labor and material costs, competitive market conditions, and other variable factors. Accordingly, the final project cost would vary from the estimates herein. Therefore, project feasibility, benefit/cost analysis, risk, and funding would need to be carefully reviewed before making specific funding decisions and/or establishing the project budget.

This page left blank intentionally.

5.0 Project 105 Environmental Considerations Summary

Environmental Compliance Requirements	Complex: Likely EIS/EIR
Permitting Requirements	Complex: Likely Individual or Regional Section 404 Permit, Formal Section 7 Consultation

Consideration	Yes	No	Maybe	Notes
Affect a scenic vista or scenic resources?			X	This is in a foothill area.
Convert Prime Farmland, unique Farmland, Farmland of Statewide Significance; or affect Williamson Contracts?		X		
Violate air quality standards (large construction project vs. modification to an existing structure)?			X	Depends on size and duration of construction.new dam/spillway elements would require excavation.
Affect endangered/threatened species, critical habitat, or other biological resources? If yes, proceed to permitting.	X			Areas of critical habitat are adjacent. Inundation of the reservoir site may have impacts to species of concern.
Affect historical/cultural resources? If yes, proceed to permitting:			X	Specialist or field surveys would be needed to verify.
Located on a known earthquake zone?			X	
Result in substantial soil erosion or loss of topsoil?			X	Additional land area would be covered by a reservoir.
Violate or degrade water quality standards?			X	During construction.
Substantially deplete groundwater supplies?		X		
Alter drainage patterns of site?	X			This is a reservoir project.
Placement of a structure in 100-year flood hazard area?	X			
Located within residential homes (e.g. will these homes be affected by construction noise)?		X		
Affect recreational facilities?			X	Possibly trails or other facilities surrounding the current reservoir boundary.
Result in a change of traffic patterns?	X			Lakeshore roads would be inundated/rerouted due to new reservoir.
Require work in a river, stream, or reservoir? If yes, proceed to permitting section below	X			
USFWS/NMFS Section 7 Consultation required? Formal or Informal			X	Species or critical habitat are adjacent to project area.

Consideration	Yes	No	Maybe	Notes
USACE Section 404 Clean Water Act permit required?	X			Increasing reservoir area to 200,000 af will most likely require a CWA Section 404 Individual or Regional Permit.
USACE Section 10 Rivers and Harbors Act permit required?		X		
USACE Section 408 permission required?		X		
NHPA Section 106 Consultation required?	X			
CA RWQCB Section 402 permit required?		X		
CA DFW Incidental Take Permit required?			X	If State listed species are present
CA DFW Section 1600 permit required?	X			
CA RWQCB Section 401 Water Quality Certification Required?	X			
CVFPB levee/floodway encroachment permit required?		X		
Caltrans/local encroachments?			X	Possibly during construction.
New water right required?			X	Who uses current water reservoir doesn't store?
Require a Change of Place of Use?			X	
Require a Change of Point of Diversion?		X		

Key:

CA DFW = California Department of Fish and Wildlife; CA RWQCB = California Regional Water Quality Control Board; CVFPB = Central Valley Flood Protection Board; EA = Environmental Assessmnet; EIS/EIR = Environmental Impact Statement/Report; MND =Mitigated Negative Declaration; ND= Negative Declaration; NHPA = National Histroic Preservation Act; NMFS = National Marine Fisheries Service; USACE = U.S. Army Corps of Engineers; USFWS = U.S. Fish and Wildlife Service

APPENDIX 4.D. MADERA COUNTY GSA

Groundwater Recharge Program Supporting Details

Prepared as part of the

Groundwater Sustainability Plan
Chowchilla Subbasin

January 2020
Revised May 2023

GSP Team:

Davids Engineering, Inc. (Revised GSP Team)
Luhdorff & Scalmanini (Revised GSP Team)
ERA Economics
Stillwater Sciences and
California State University, Sacramento

TABLE OF CONTENTS

LIST OF TABLES

1 PROJECT OVERVIEW

Madera County plans to develop a groundwater recharge program to help achieve the Chowchilla Subbasin sustainability goal. Under this program, Madera County plans to construct recharge basins or work with landowners to develop a Flood Managed Aquifer Recharge (Flood-MAR) program to divert flood flows from waterways and provide percolation into the deep aquifer. The size, location, and performance of Madera County recharge sites depends on site-specific characteristics that are currently being assessed by Madera County.

Madera County GSA's recharge program includes three projects that would divert water from the Eastside Bypass and Ash Slough into recharge basins or fields during wet and above normal years when water is available.

1. Eastside Bypass diversions to recharge ponds with Clayton Water District

2. Office of Emergency Services (OES) Joint Redtop Banking Project with Triangle T Water District and Clayton Water District

3. Expanded OES Joint Redtop Banking Project with Triangle T Water District

The project would construct 14 new 20 cfs slant pump turnouts to flood recharge basins and fields. Two of the recharge projects would be implemented jointly with Triangle T Water District (TTWD) and two with Clayton Water District. Together, the projects would provide nearly 28,000 acre-feet of recharge per year, on average, across all years. In years of large available flood flow, the program would provide up to 79,000 acre-feet of recharge.

Madera County plans to construct pumping stations, delivery facilities, and/or recharge basins, as required, that are sized to accommodate this recharge rate. Preliminary capital cost estimates are provided below for these combined projects. The assumptions and methodologies used to develop the costs of the pumping stations and delivery facilities required by this program are summarized below.

2 ASSUMPTIONS AND METHODOLOGY

Estimates of capital costs for the pump stations and other infrastructure used to convey Eastside Bypass flood water for recharge were prepared based on the assumptions and methodologies outlined below.

2.1 General Assumptions

General assumptions used to develop the infrastructure cost calculations include:

- In one of every three years, pumps will be operated for 90 days during the winter period to divert Eastside Bypass flood water for recharge.
- Parcels that will receive Eastside Bypass flood water have a typical elevation relative to adjacent waterways that corresponds to a ground slope of 0.0015 ft/ft (based on ground surface elevations from Google Earth).
- Evapotranspiration loss is 5% of the diverted volume.
- Amortized total cost ($/AF) is calculated based on the assumptions in Table A4.E-1.

Table A4.D-1. Assumptions for Developing Amortized Total Cost ($/AF).

Parameter	Value	Description and Additional Notes
Borrowing cost (interest rate)	5.75%	consistent with recent municipal bonds
Term (years)	20	longer borrowing term possible
Opportunity cost of water in crop production ($/ac)	$1,334.60	$/AF applied water assumed to equal the average of annual crop applied water values (excluding irrigated pasture and wheat) in Madera County plus a 20% incentive/premium over operating costs. Assumed field prep/maintenance cost of $125/ac are included.
Annual crop / marginal orchard land values ($/ac)	$15,000	land value of productive row crop land
Share of permanent land retirement (share)	5%	% of land that is permanently retired (the remainder is idled 1 every 3 years)
Recharge "loss" (share)	10%	assumed share of non-beneficial recharge (recharge that does not contribute subbasin overdraft)

2.2 Pump Station Assumptions

Specific assumptions used to develop the size, number, and cost of pump stations required to deliver water to parcels for recharge include:

- Ground slope is estimated to be 0.0015 ft/ft (based on ground surface elevations from Google Earth; these values may vary depending on the area selected).
- 50% of all land that is able to receive water from each pump station and pipeline will be used for recharge (based on the Soil Agricultural Groundwater Banking Index (SAGBI) ratings for lands along Eastside Bypass in Madera County).
- Infiltration rate is 4 inches per day.
- Recharge infrastructure will consist of pipelines to the center of each quarter section used for recharge, enabling delivery to each 40 acre parcel, and will vary in length depending on the capacity of the pump station. Additional pipeline length is required if the recharge area is not directly adjacent to the waterway.
- Pump stations will be installed at regular intervals every half-mile along the selected waterway and sized to provide 79,000 AF of recharge over a 60 day period during years when flood flows are available.
- Pump and pipeline hydraulics estimated following the assumptions in Table A4.E-2.

Table A4.D-2. Pump and Pipeline Hydraulics Design Assumptions.

Parameter	Value	Unit	Note
Pump Hydraulics			
Motor efficiency	0.95		Estimated
Impeller efficiency	0.85		Estimated
Column pipe diameter	30	inches	Assumed
Column pipe "C" factor	120		Hazen Williams "C" Factor for steel
Column pipe length	15	feet	Assumed
Static lift	8	feet	WSE to ground surface
Factor of Safety	1.2		
Pipeline Hydraulics			
Pump Station Design Flow Capacity	*varies*	cfs	Assumed (see results)
End Line Pressure	5	psi	Assumed
Maximum Flow Velocity	5	fps	Recommended
Pipe Material	PVC		
Friction Factor	150		Hazen Williams "C" Factor
Pipeline Length	*varies*	feet	Assumed, length of pipeline to center of parcels depends on pump station capacity.
Ground Slope	0.0015	ft/ft	From Google Earth, 40 foot approximate elevation change from waterway in Madera County GSA to location about 5 miles east
Change in Elevation	*calculated*	feet	Pipeline Length x Ground Slope
Number of Isolation Valves	*calculated*		Pipeline Length / 1,320 ft

2.3 Legal, Permitting, Planning, and Professional Service Contingency Cost Assumptions

Legal, permitting, planning, and other professional service contingency costs are estimated as a percentage of estimated infrastructure costs based on the assumptions in Table A4-E-3.

3 RESULTS

The size, quantity, and associated costs of all pump stations required for the Madera County groundwater recharge program are summarized in Table A4.E-4.

Two pump station designs were considered for the three projects in this program. Design 1 would be used to transfer water to all recharge basins, providing 43 cfs each through 48 inch diameter pipelines of length 6,600 ft. Design 2 would be used to flood recharge basins and fields, providing 20 cfs through a 36 inch diameter pipeline of length 3,960 ft. The total cost per pump station, including pipeline costs and all estimated legal, permitting, planning, and contingency costs, is $7,998,000 for design 1 and $3,354,000 for design 2. Cost details per pump station are provided in Tables A4.E-5 and A4.E-6 for each design.

At minimum, a total capacity of approximately 700 cfs is required to achieve 79,000 AF of recharge within a 60 day span under the assumptions above. To meet this requirement, the project would include nine 43 cfs pump stations and eighteen 20 cfs pump stations, for a total capacity of nearly 750 cfs across

all 27 pump stations. These pump stations have a total installation cost of approximately $118,000,000 and would provide approximately 79,000 AF of recharge per year on approximately 4,300 acres of land when flood flows are available.

Of these, nine 43 cfs pump stations and fourteen 20 cfs pump stations would be implemented as part of the Eastside Bypass diversions to Madera County project ($110,000,000), while the remaining four 20 cfs pump stations would be implemented as part of the two OES Joint Redtop Banking Project with TTWD.

Table A4.D-3. Legal, Permitting, Planning, and Professional Service Contingency Cost Assumptions.

Cost Type	Cost Item	Percent	Percent Calculated Over
Site Costs	Site Work	10%	Pipeline and pump station costs (Infrastructure Costs)
	Site Safety/Security/Protection	5%	
Construction Contract Costs	Design Contingency	30%	Infrastructure + Site Costs
	Mobilization/Demobilization	3%	
	Contractor profit/markup/insurance/bonding	8%	
	Construction Management	10%	
Other Construction Costs	Construction Contingency	30%	Infrastructure + Site + Construction Contract Costs
Other Project Costs	Planning	1%	Infrastructure + Site + Construction Contract + Other Construction Costs
	Engineering/Design/Controls	10%	
	Bidding/Contracting	1%	
	Legal	2%	
	Permitting/Environmental	10%	
	Professional services contingency	5%	

Table A4.D-4. Eastside Bypass Groundwater Recharge Program: Summary of Total Estimated Pump Stations and Associated Costs.

Element	Pump Station Design		
	1	2	All
Number of Pump Stations	9	18	27
Flow Capacity (cfs/Pump Station)	43	20	-
Pipeline Length (ft/Pump Station)	6,600	3,960	-
Pipeline Diameter (in)	48	30	-
Installation Cost ($/Pump Station)	$7,998,000	$2,580,000	-
Total Installation Cost ($)	**$71,982,000**	**$46,440,000**	**$118,422,000**
Recharge Acreage Served (ac/Pump Station)	240	120	-
Recharge Acreage Served (ac)	**2,160**	**2,160**	**4,320**

Table A4.D-5. Project Component Cost Estimates Per Each Pump Station, Design 1 (43 cfs capacity, 48 inch diameter pipeline, 6,600 ft length).

Line Items	Pricing Unit	QTY	Unit Cost	Extended Cost
PVC Pipeline and Appurtenances (installed)	LF	6,600	$341.43	$2,253,451
Pump Station, Electrical Equipment, Sump	HP	256	$2,000.00	$511,540
			Subtotal	***$2,800,000***
Site Work			10%	$280,000
Site Safety/Security/Protection			5%	$140,000
			Line Item Subtotal	***$3,200,000***
Design Contingency			30%	$960,000
Mobilization/Demobilization			3%	$96,000
Contractor profit/markup/insurance/bonding			8%	$256,000
Construction Management			10%	$320,000
			Estimated Construction Contract Subtotal =	***$4,800,000***
Construction Contingency			30%	$1,440,000
			Estimated Construction Cost =	***$6,200,000***
Planning			1%	$62,000
Engineering/Design/Controls			10%	$620,000
Bidding/Contracting			1%	$62,000
Legal			2%	$124,000
Permitting/Environmental			10%	$620,000
Professional services contingency			5%	$310,000
			Estimated Total Project Cost Per Pump Station =	***$7,998,000***

Table A4.D-6. Project Component Cost Estimates Per Each Pump Station, Design 2 (20 cfs capacity, 30 inch diameter pipeline, 3,960 ft length).

Line Items	Pricing unit	QTY	Unit Cost	Extended Cost
PVC Pipeline and Appurtenances (installed)	LF	3,960	$173.88	$688,566
Pump Station, Electrical Equipment, Sump	HP	106	$2,000.00	$212,516
			Subtotal	***$900,000***
Site Work			10%	$90,000
Site Safety/Security/Protection			5%	$45,000
			Line Item Subtotal	***$1,000,000***
Design Contingency			30%	$300,000
Mobilization/Demobilization			3%	$30,000
Contractor profit/markup/insurance/bonding			8%	$80,000
Construction Management			10%	$100,000
			Estimated Construction Contract Subtotal =	***$1,500,000***
Construction Contingency			30%	$450,000
			Estimated Construction Cost =	***$2,000,000***

Line Items	Pricing unit	QTY	Unit Cost	Extended Cost
Planning			1%	$20,000
Engineering/Design/Controls			10%	$200,000
Bidding/Contracting			1%	$20,000
Legal			2%	$40,000
Permitting/Environmental			10%	$200,000
Professional services contingency			5%	$100,000
Estimated Total Project Cost Per Pump Station =				***$2,580,000***