ATTACHMENT 7. TECHNICAL JUSTIFICATION OF PROJECT PHYSICAL BENEFITS

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Physical benefits of the Calaveras River Integrated Water Management Project are as follows:

WISCONSIN AVENUE PUMPING STATION REPLACEMENT PHYSICAL BENEFITS

Flood damage reduction

The existing Wisconsin Avenue Storm Water Pump Station provides storm drainage pumping for a 700-acre area of central Stockton consisting primarily of single family residences. The area is protected from riverine flooding by levees on the Calaveras River to the north, on the San Joaquin River to the west, and on the Smith Canal to the south. The pump station is needed to pump storm water from the basin over the levees into the Calaveras River. The pump station is operated and maintained by Reclamation District 1614.

Recent and Historical Conditions. The existing Wisconsin pump station is 70 years old and consists of a sheet pile sump with a concrete slab / concrete pump house on top. The sump has no bottom and therefore is subject to groundwater infiltration. Although the pump house on top is in fair condition, the sheet pile sump itself is in failure mode. The sheet pile sump is reinforced with wood timber whalers that have rotted. The steel sheet piles themselves are bowing inward and have rotted to a point that a person can punch their hand through them. During a 2009 inspection it was quite apparent that the steel and timber sump structure was inadequate and in a failing state.

Without-Project Conditions. Any improvements and/or upsizing of the pumping capacity of the pump station would be detrimental to the structural integrity of the sump. The Wisconsin Pump Station sump's structural integrity has diminished to the point where there is now great concern the pump house is in danger of collapsing into the sump. The entire structure needs to be removed and replaced with a new sump structure. The pump station is likely to fail resulting in stormwater damage to structures and their contents, to vehicles, and to infrastructure.

The expected damages in without-project conditions is documented in an April 2011 technical memorandum developed by the consulting firm Peterson-Brustad, Inc.[15] This technical memorandum is attached as Appendix E to this grant application.

Given that functional integrity of the existing pump station has deteriorated to a point where it is essentially in failure mode, flood depths for the 100-year, 25-year, and 10-year storm events were developed assuming the existing pump station has failed and is inoperable. Flood damage

[15] Peterson-Brustad, Inc. April 21, 2011, "Flood Damage Reduction Analysis, Wisconsin Pump Station"

was estimated for land, infrastructure, automobiles, structures and structure contents for these flood events. Flood emergency response costs as well as residential displacement and shelter costs were also estimated.

The flood damages for structures and contents were developed using guidance from the USACE *Planning Guidance Notebook*, ER1105-2-100, April 2000. Land damage was estimated at 10% of the land value based on previous work done for the Sacramento Area Flood Control Agency's (SAFCA) *Engineer's Report for SAFCA Operation and Maintenance Assessment*, 1991.

"Without" project benefits are based on the total flood damages at the 100-year, 25-year, and 10-year storm events assuming the pump station is inoperable. Benefits associated with events less frequent than the 100-year event (e.g. 200-year) for both the "Without" and "With" project were assumed to be equal to the damages estimated for the 100-year event. USACE methods were then used to determine the expected annual damages for both the "Without" and "With" project scenarios.

Annual project benefits were determined from the difference between expected annual damage for the "Without" project and the "With" project scenarios. Annual project costs were developed from the project's capital construction and estimated annual maintenance cost. The construction cost of the project was evaluated over 50 years at a discount rate of 6%.

Relationship to Other Projects in the Proposal. The Wisconsin Avenue Pump Station will pump interior drainage water to the lower Calaveras River. To avoid any incremental flood damages along the river, operation will be coordinated with the operation of the SEWD Flood Detention and Groundwater Recharge Facility. The new pump station will have a pumping capacity of pumping capacity of approximately 67 cubic feet per second (cfs) in order to meet current 100-year flood standards. The Flood Detention Facility will have the capacity to move 75 cfs off the upper Calaveras River and into flood detention/groundwater percolation basins, thus mitigating any incremental flood damages along the lower river. Infiltration capacity of the ponds is estimated at 53 cfs, and the SEWD Water Treatment Plant can treat an additional 100 cfs, so capacity will always be available.

SEWD Flood Detention and Groundwater Recharge Facility Physical Benefits

Incremental flood damage mitigation

Without-Project Conditions. Without the SEWD Flood Detention and Groundwater Recharge Project, storm events greater than a 100-year event will overtop levees and cause potential widespread flood damage. The 100-year event would produce a Calaveras River flow of approximately 15,000 cfs.

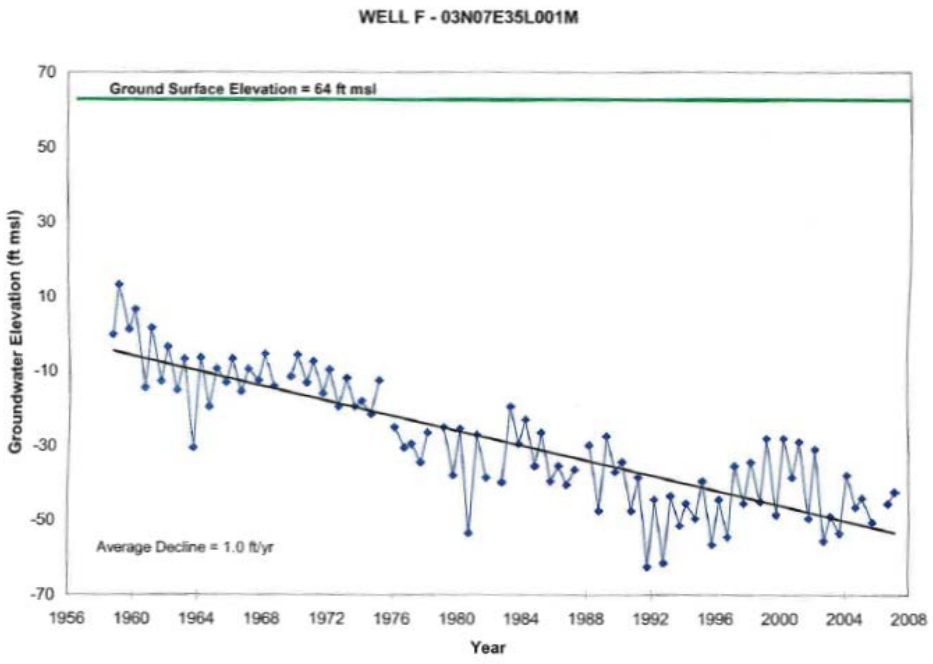
Uncertainty in Flood Damage Estimate. There are no reliable estimates of the amount of damage that might be reduced by diverting 75 cfs to the flood detention ponds. No quantified benefit is claimed in this application.

Relationship to Other Projects in the Proposal. As noted above, the Wisconsin Avenue Pump Station will pump interior drainage water to the lower Calaveras River. To avoid any incremental flood damages along the river, operation will be coordinated with the operation of the SEWD Flood Detention and Groundwater Recharge Facility. The new pump station will have a pumping capacity of pumping capacity of approximately 67 cubic feet per second (cfs) in order to meet current 100-year flood standards. The Flood Detention Facility will have the capacity to move 75 cfs off the upper Calaveras River and into flood detention/groundwater percolation basins, thus mitigating any incremental flood damages along the lower river. Infiltration capacity of the ponds is estimated at 53 cfs, and the SEWD Water Treatment Plant can treat an additional 100 cfs, so capacity will always be available.

Pump lift reduction

Without-Project Conditions. Agriculture is a $2.1 billion/year industry in San Joaquin County. The basin is in a state of critical overdraft.[16] Water table declines have averaged about one foot per year over the last 60 years. This increases pumping lift, and has induced the movement of connate saline water eastward toward the pumping depression and into the drinking water aquifer. The hydrograph of a typical well in the project area is presented as Figure 14.[17]

Figure 14 - Hydrograph of Well 3N 7E 35L, Calaveras River at SR88



[16] DWR Bulletin 118-80

[17] Northeastern San Joaquin Groundwater Banking Authority, July 2007, "Eastern San Joaquin Integrated Regional Water Management Plan", Figure 4-17

If nothing is done to control groundwater overdraft and saline intrusion, adjudication of the groundwater basin may result which could result in the automatic reduction of 20% of the agriculture of San Joaquin County and the resulting loss of irrigated acreage and the associated employment, equipment, supplies, etc.

Even without the threat of adjudication, agricultural and municipal groundwater users face increased pumping costs as groundwater levels decline. If the incremental costs of pumping are sufficiently high, pumping costs may in turn impact the viability of agriculture. Other costs associated with groundwater level decline include deepening existing wells or drilling new deeper wells, and purchase of new pumps and motor to match increased lift requirements.

Methods used to estimate physical benefits. Based on historical hydrology, up to 27,700 acre-feet of water (including stormwater) will be available for recharge in about six out of ten years (see Table 17). Existing water rights and conveyances will be used. In dry years, up to 17,400 acre-feet would be extracted to help meet demands in urban Stockton. Net groundwater storage of 10,800 acre-feet per year will accumulate, recharging the critically overdrafted aquifer, and providing a regional groundwater lift benefit that increases with time.

Table 17 - Water Balance for Flood Detention/Groundwater Recharge Project

	Capacity (af/yr)	Use Frequency	Water Balance (af/yr)
Recharge	27,700	63%	17,300
Extraction	17,400	38%	(6,500)
		100%	10,800

Total water deliveries to the SEWD Drinking Water Treatment Plan are constrained by the 166 cfs capacity of the combined Bellota and Peters Pipelines. All needed water rights and contracts have been secured. Up to 73 cfs would be diverted from the Calaveras River via the Bellota Pipeline. In years when these pipelines can be kept continuous filled, up to 120,300 af/yr could be delivered. Analyses performed for the 2008 Stockton East Water District Water Supply Plan show that annual deliveries would average about 87,200 af/yr. At 2015 levels of demand, the Stockton Area Water Suppliers would utilize about 69,900 af/yr, leaving an average 17,300 af/yr available for groundwater recharge. [18] Excerpts from the SEWD Water Management Plan are included as Appendix F.

The recharge ponds would operate for up to 335 days out of the year leaving a minimum 30-day window for annual maintenance. An average recharge rate is estimated as 0.40 feet per day over the life of the project, consistent with long-term recharge rates at the current recharge areas at the SEWD Water Treatment Plant. The annual recharge capacity is approximately

[18] Stockton Area Water Suppliers, December 2008, "Stockton East Water District Water Supply Plan", Fig.7-1

27,700 acre-feet per year. Over the 50-year life of the project, a total of 865,000 acre-feet will be recharged.

Recovery of the stored surface water will be accomplished through use of 11 wells in the vicinity of the SEWD Water Treatment Plant. Recovery of stored water is expected to take place in about four out of every 10 years when surface through existing water contracts are reduced.

The remaining banked recharge water will provide a net groundwater recharge averaging 10,800 acre-feet per year, and will total 540,000 acre-feet over the 50-year life of the project. This net recharge will reduce pumping lifts throughout the region, resulting in significant energy savings for existing groundwater pumpers.

The calculation of the pump lift reduction benefit is displayed in Table 18. The average net recharge of 10,800 acre-feet will raise water tables 1.28 feet throughout the Stockton East Water District for each year of operation. This benefit accumulates with time. Assuming an average pump efficiency of 70 percent, and an average power cost of $0.191 per kWh[19], this pump lift reduction will result in savings of $49,800 per year for area pumpers extracting a nominal 140,000 acre-feet per year.

Table 18 - Derivation of Pump Lift Reduction Benefit

Pump Lift Reduction Calculation		
Average Net Recharge	10,800	af/yr
SEWD Acreage	116,000	ac
Average Net Recharge Per Acre	0.093	ft/yr
Specific Yield	7.3%	
Average Pump Lift Benefit	1.28	ft/yr
SEWD Pumping	140,000	af/yr
Unit Power Use	1.46	kWh/af/ft lift
Power Benefit Rate	260,900	kWh/yr
Power Rate	$0.191	$/kWh
Incremental Annual Power Benefit	$49,800	$/yr

This Benefits Analysis is presented in 2012 dollars. The time stream of groundwater lift reduction benefits is presented in Table 19.

Relationship to Other Projects in the Proposal. Improvement in groundwater elevations will also reduce the rate of saline water migration, as elaborated below.

[19] PG&E Electric Schedule AG-1, Agricultural Power, effective March 30, 1012

Table 19 - Time Stream of Estimated Pump Lift Benefits

Year	Net Recharge		Pump Lift Benefit[1]		
	Annual (af/yr)	Cumulative (af)	Lift (ft)	Power (af-ft/yr)	Power[2] (kWh)
2016	10,800	10,800	1.28	178,555	260,945
2017	10,800	21,600	2.55	357,109	521,889
2018	10,800	32,400	3.83	535,664	782,834
2019	10,800	43,200	5.10	714,218	1,043,779
2020	10,800	54,000	6.38	892,773	1,304,724
2021	10,800	64,800	7.65	1,071,327	1,565,668
2022	10,800	75,600	8.93	1,249,882	1,826,613
2023	10,800	86,400	10.20	1,428,436	2,087,558
2024	10,800	97,200	11.48	1,606,991	2,348,503
2025	10,800	108,000	12.75	1,785,546	2,609,447
2026	10,800	118,800	14.03	1,964,100	2,870,392
2027	10,800	129,600	15.30	2,142,655	3,131,337
2028	10,800	140,400	16.58	2,321,209	3,392,282
2029	10,800	151,200	17.86	2,499,764	3,653,226
2030	10,800	162,000	19.13	2,678,318	3,914,171
2031	10,800	172,800	20.41	2,856,873	4,175,116
2032	10,800	183,600	21.68	3,035,427	4,436,060
2033	10,800	194,400	22.96	3,213,982	4,697,005
2034	10,800	205,200	24.23	3,392,537	4,957,950
2035	10,800	216,000	25.51	3,571,091	5,218,895
2036	10,800	226,800	26.78	3,749,646	5,479,839
2037	10,800	237,600	28.06	3,928,200	5,740,784
2038	10,800	248,400	29.33	4,106,755	6,001,729
2039	10,800	259,200	30.61	4,285,309	6,262,674
2040	10,800	270,000	31.88	4,463,864	6,523,618
2041	10,800	280,800	33.16	4,642,419	6,784,563
2042	10,800	291,600	34.44	4,820,973	7,045,508
2043	10,800	302,400	35.71	4,999,528	7,306,453
2044	10,800	313,200	36.99	5,178,082	7,567,397
2045	10,800	324,000	38.26	5,356,637	7,828,342
2046	10,800	334,800	39.54	5,535,191	8,089,287
2047	10,800	345,600	40.81	5,713,746	8,350,231
2048	10,800	356,400	42.09	5,892,300	8,611,176
2049	10,800	367,200	43.36	6,070,855	8,872,121
2050	10,800	378,000	44.64	6,249,410	9,133,066
2051	10,800	388,800	45.91	6,427,964	9,394,010
2052	10,800	399,600	47.19	6,606,519	9,654,955
2053	10,800	410,400	48.46	6,785,073	9,915,900
2054	10,800	421,200	49.74	6,963,628	10,176,845
2055	10,800	432,000	51.02	7,142,182	10,437,789
2056	10,800	442,800	52.29	7,320,737	10,698,734
2057	10,800	453,600	53.57	7,499,291	10,959,679
2058	10,800	464,400	54.84	7,677,846	11,220,624
2059	10,800	475,200	56.12	7,856,401	11,481,568
2060	10,800	486,000	57.39	8,034,955	11,742,513
2061	10,800	496,800	58.67	8,213,510	12,003,458
2062	10,800	507,600	59.94	8,392,064	12,264,402
2063	10,800	518,400	61.22	8,570,619	12,525,347
2064	10,800	529,200	62.49	8,749,173	12,786,292
2065	10,800	540,000	63.77	8,927,728	13,047,237

[1] Based on 116,000 SEWD acres and 7.3% specific yield and 140,000 af annual pumping

[2] Based on 70% pump efficiency

Saline water migration reduction

Historical and Existing Conditions. As noted above water table declines have averaged about one foot per year over the last 60 years. This has induced the movement of connate saline water eastward toward the pumping depression and into the drinking water aquifer.

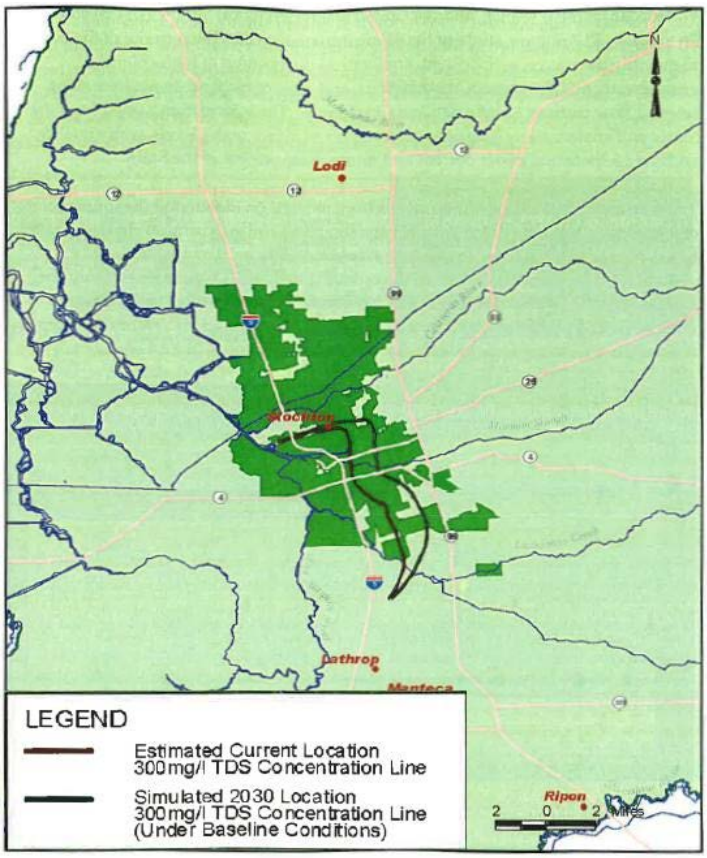
As the saline water has migrated eastward, salinity levels have increased above crop tolerance thresholds, wells have been taken out of service, and new sources have been sought.

Rising salinity levels may not allow the production of certain crops because of their sensitivity to salt and may result in accelerated equipment deterioration from corrosion. Although more salt tolerant crops could be grown, they generally produce lower revenues than many of the crops currently grown.

Without-Project Conditions. Increased salinity could require abandonment of existing wells, or construction of expensive reverse osmosis or other wellhead treatment processes. Other impacts of salinity include corrosion of wells, pumps, distribution and storage equipment within the potable water systems. All of these impacts would increase the cost of water to the M&I users and ultimately may drive certain businesses and industries from the area. The estimated location of the 300 ppm chloride saline front in year 2000 and the projected 2030 position are displayed in Figure 15.[20] The projected 2030 position is based on DynFlow modeling performed for the 2007 Eastern San Joaquin IRWMP.

[20] Northeastern San Joaquin Groundwater Banking Authority, July 2007, "Eastern San Joaquin Integrated Regional Water Management Plan", Figure 4-38

Figure 15 - Estimated 2000 and Projected 2030 Saline Front



Relationship to Other Projects in the Proposal. As noted above, improvement in groundwater elevations will also reduce pumping lifts, and thus reduce pumping costs.

Uncertainty of Benefits. There is considerable uncertainty about the rate of saline water migration, or the best ways to mitigate its advance. The USGS has suggested that the only certain way to slow or stop the saline migration is to decrease or reverse the eastward groundwater flow gradient. Benefits for slowing saline migration by raising water tables through conjunctive management of surface and groundwater have not been quantified for this grant application.