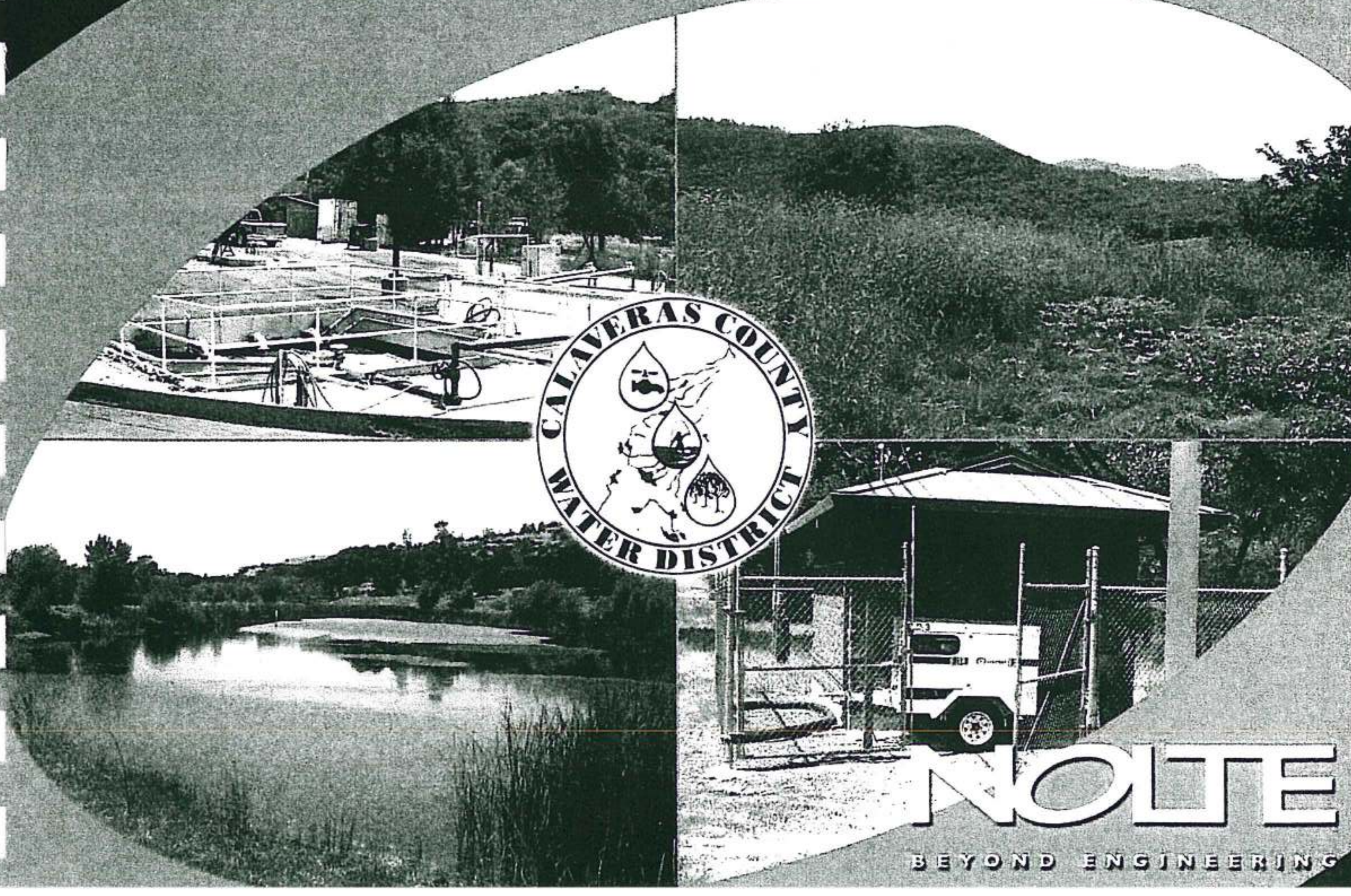
Wastewater Facilities Master Plan for Vallecito, Douglas Flat & Six-Mile Village

Calaveras County Water District

April 2005



NOLTE

BEYOND ENGINEERING

RESOLUTION NO. 2005-29

ADOPTION of
VALLECITO / DOUGLAS FLAT / SIX MILE VILLAGE
WASTEWATER SYSTEM
FACILITIES MASTER PLAN

WHEREAS, in order to better serve the current and future wastewater customers of the Vallecito / Douglas Flat / Six Mile Village service area, a wastewater facilities master plan was developed; and

WHEREAS, Nolte and Associates prepared the wastewater facilities master plan; and

WHEREAS, public meetings were held on January 25 and May 4, 2005, at which a presentation was given for the purpose of receiving public comment and concerns; and

WHEREAS, the Board of Directors of Calaveras County Water District received and filed said plan on April 27, 2005; and

WHEREAS, the Board of Directors of Calaveras County Water District recognizes that funding of the costs of facilities recommendations within said plan will be addressed separately by a comprehensive financial plan.

NOW, THEREFORE, BE IT RESOLVED that the Board of Directors of Calaveras County Water District, having received and recognized public comments, hereby adopts the facilities recommendations of the VALLECITO / DOUGLAS FLAT / SIX MILE VILLAGE WASTEWATER SYSTEM FACILITIES MASTER PLAN, attached hereto and made a part hereof by reference.

PASSED AND ADOPTED this 25th day of May, 2005, by the following vote:

AYES: Directors Davidson, Fonceca, Underhill, Hebrard
NOES: Director Deem
ABSTAIN:
ABSENT:

CALAVERAS COUNTY WATER DISTRICT

President

ATTEST:

Secretary / General Manager

CALAVERAS COUNTY WATER DISTRICT

WASTEWATER FACILITIES MASTER PLAN FOR VALLECITO, DOUGLAS FLAT, AND SIX-MILE VILLAGE

REGISTERED PROFESSIONAL ENGINEER
MICHAEL B. ANDERSON
No. 61039
EXP. 06-30-06
CIVIL
STATE OF CALIFORNIA

REGISTERED PROFESSIONAL ENGINEER
A. GRAHAM CALCIANO
No. C61456
EXP. 6-30-2005
CIVIL
STATE OF CALIFORNIA

April 2005

Submitted to:

Calaveras County Water District
423 E. St. Charles Street
San Andreas, CA 95249

Prepared by:
Nolte Associates, Inc.
1750 Creekside Oaks Drive, Suite 200
Sacramento, CA 95833
(916) 641-1500 • (916) 641-9222 (fax)

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDICES

Appendix A	Correspondence Describing Proposed Development
Appendix B	Proposed Improvements to Collection System
Appendix C	Water Balances for Growth Scenarios for Vallecito/Douglas Flat Wastewater Treatment Plant
Appendix D	Probable Construction Costs for Irrigation System
Appendix E	Preliminary Evaluation of Effluent Disposal Alternatives for the CCWD Vallecito Wastewater Treatment Plant
Appendix F	Collection, Treatment, Storage and Disposal Probable Operation and Maintenance Costs

1. INTRODUCTION

The Calaveras County Water District (CCWD) owns and operates wastewater collection, treatment, and disposal facilities for the communities of Douglas Flat and Vallecito. These communities are located along State Route (SR) 4 between the city of Angels Camp and town of Murphys (Figure 1). The Vallecito/Douglas Flat Wastewater Treatment Plant (WWTP) consists of two parallel extended aeration package plants. The Douglas Flat plant was built in the early 1970's, and the Vallecito plant was built in the early 1990's. Effluent is stored in ponds during the winter and applied to spray fields in the summer. The treatment, storage and disposal systems are at full capacity during 100-year precipitation events, due to: 1) very high peak wet weather flows through the aeration basins and clarifiers, and 2) the increase in total volume of effluent that must be stored in the ponds.

The community of Six-Mile Village is also located along SR-4. Currently, wastewater from Six-Mile Village is discharged to the Angels Camp sewer system and treated at the City of Angels Camp wastewater treatment facility. The CCWD reimburses the City of Angels Camp $50,000/year to accept wastewater from Six-Mile Village. The existing 2-inch sewer force main from Six-Mile Village to Angels Camp is in poor condition, has numerous operational problems, and requires weekly flushing. The CCWD is considering construction of a new sewer force main from Six-Mile Village to Vallecito, where it will discharge into the Vallecito sewer and the sewage will be pumped to the Vallecito/Douglas Flat WWTP. This will increase the flow received at the WWTP and impact treatment, storage, and disposal.

An important consideration in evaluating alternatives for future collection, treatment, storage and disposal facilities is the final method of effluent disposal. The CCWD can either continue to dispose of effluent entirely by land application by developing additional spray fields or, alternatively, it might be feasible to obtain a National Pollutant Discharge Elimination System (NPDES) permit to increase disposal by discharging effluent to Coyote Creek during the winter. The method of disposal will dictate significantly different treatment and storage requirements.

This Master Plan will address the following:

- Define the service areas and number of service connections.
- Characterize wastewater flow and quality.
- Summarize regulatory requirements for effluent disposal.
- Recommend a method of effluent disposal.
- Provide an assessment of existing facilities.
- Recommend future improvements to facilities (Capital Improvements).
- Provide a summary of costs for these Capital Improvements.

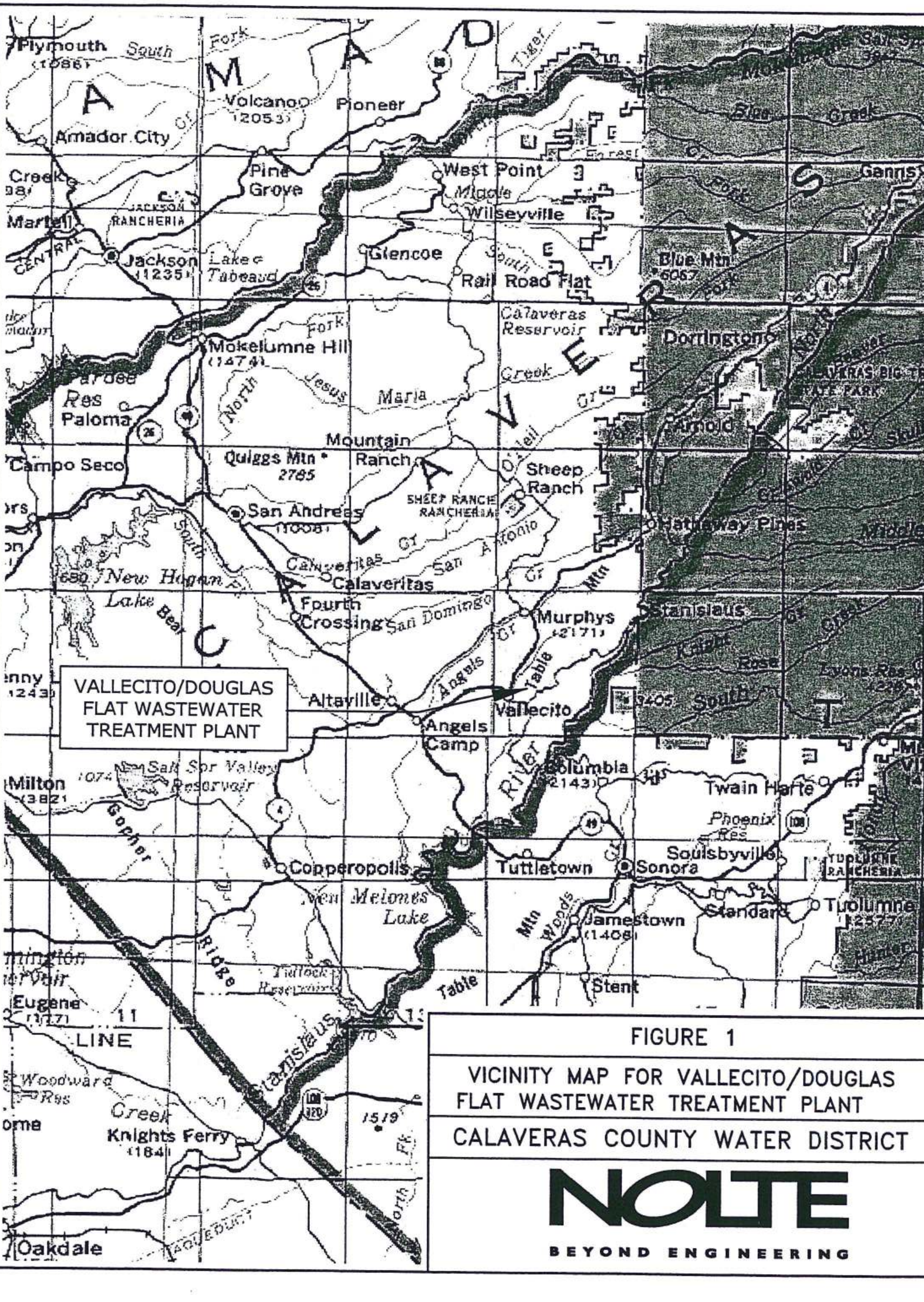


FIGURE 1

VICINITY MAP FOR VALLECITO/DOUGLAS FLAT WASTEWATER TREATMENT PLANT

CALAVERAS COUNTY WATER DISTRICT

NOLTE

BEYOND ENGINEERING

N:\SAB015000\CADD\VICINITY_MAP.DWG KCH 11/1/2004

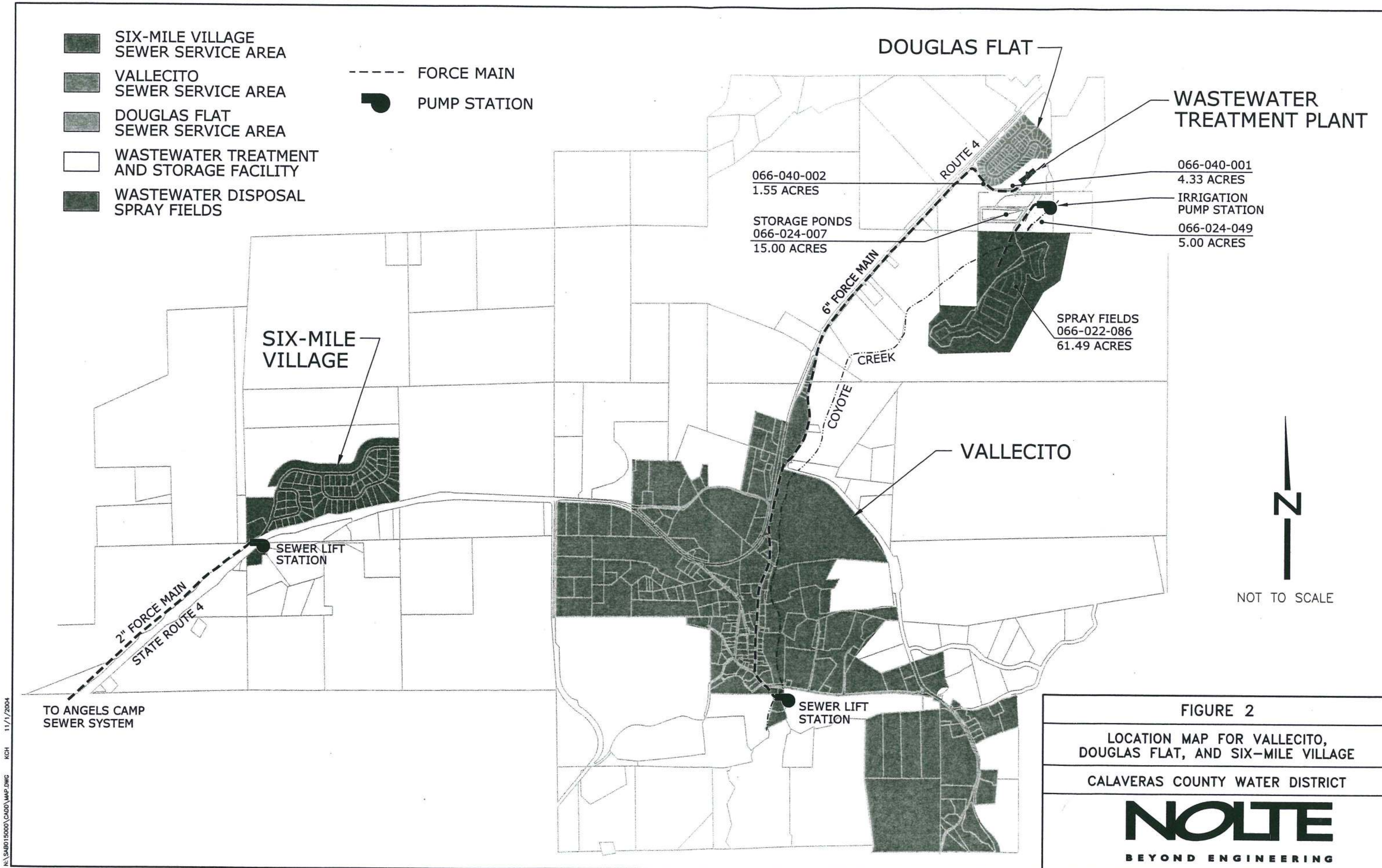


FIGURE 2

LOCATION MAP FOR VALLECITO, DOUGLAS FLAT, AND SIX-MILE VILLAGE

CALAVERAS COUNTY WATER DISTRICT

NOLTE

BEYOND ENGINEERING

2. SERVICE AREAS

A summary of service connection data for Six-Mile Village, Vallecito, and Douglas Flat is provided in Table 1. The projected number of service connections for Six-Mile Village, Vallecito, and Douglas Flat are 68, 174, and 89, respectively, for a total of 331 units. Over 95 percent of the service connections are residential, with a small number of commercial hook-ups. It is expected that future service connections from the existing communities will originate from two sources, the addition of homes to lots that are currently vacant or are not currently served, and the subdivision of existing occupied lots.

As shown in Table 1, it is estimated that a total of 58 lots are currently either vacant or unserved in Vallecito and Douglas Flat. Under build-out conditions, it is assumed that all of the unserved lots will be connected to the collection system. In addition, it is estimated that 26 subdivided lots will be added to the system from Vallecito and Douglas Flat. The number of projected subdivided lots is based on ten percent of the existing served units. As indicated in Table 1, build-out would occur in sixteen years at the assumed development rate of two percent per year.

TABLE 1
CURRENT AND FUTURE SERVICE CONNECTIONS

Service area	Existing served lots [a]			Unserved lots [a]	Subdivided lots [b]	Future total [c]
	Residential	Commercial	Total			
Six-Mile Village	66	2	68	15	7	90
Vallecito	167	7	174	38	17	229
Douglas Flat	88	1	89	20	9	118
Outside development [d]	-	-	-	-	-	80
Total	321	10	331	73	33	517

[a] Service connection data provided by CCWD.
[b] Subdivided lots equals 10 percent of existing lots.
[c] Future total equals Existing Total + Unserved Lots + Subdivided Lots. At the assumed development rate of 2 percent per year (6.6 units/yr based on Existing total), build-out in service area would occur in 16 years.
[d] Additional development outside current service area described in letter to CCWD dated 5 March 2004.

For facility planning purposes, three growth scenarios are considered: Scenarios 1, 2 and 3. Under Scenario 1, only the projected growth within the existing services areas of Vallecito and Douglas Flat is considered. Under Scenario 2, wastewater from Six-Mile Village is pumped uphill and combined with flows from the Vallecito and Douglas Flat service areas. The last scenario, Scenario 3, includes potential additional development outside the existing service areas. Specifically, a new residential community consisting of 80 homes is considered (the new development is described in correspondence to CCWD dated 5 March 2004 in Appendix A). The three scenarios are summarized below:

TABLE 2
SERVICE CONNECTIONS FOR GROWTH SCENARIOS

Service Area	Service Connections		
	Scenario 1	Scenario 2	Scenario 3
Vallecito	229	229	229
Douglas Flat	118	118	118
Six-Mile Village	-	90	90
Additional Development	-	-	80
Total	347	437	517

3. WASTEWATER FLOW AND QUALITY

This section provides a description of historical and projected future wastewater flow patterns, including average dry weather flow and inflow and infiltration (I&I). A description of wastewater quality is also provided.

A. Historical Wastewater Flows

Monthly flow and precipitation data for the Vallecito/Douglas Flat WWTP during 2002 and 2003 are shown in Table 3. The average monthly flow ranges from a low of approximately 37,000 gal/d during the summer to a high of over 63,000 gal/d during the winter. Daily wastewater flow rates are presented graphically in Figure 3 and have exceeded 120,000 gal/d on occasion.

TABLE 3
SUMMARY OF MONTHLY PRECIPITATION AND FLOW DATA

	2002		2003	
Month	Precip., in	Avg. flow, gal/d	Precip., in	Avg. flow, gal/d
Jan	3.40	52,866	1.00	48,121
Feb	3.60	50,582	3.20	45,559
Mar	5.80	56,998	2.80	41,466
Apr	1.20	40,834	9.10	55,922
May	1.50	38,646	1.30	42,927
Jun	0.00	36,991	0.00	40,945
Jul	0.00	41,847	0.00	44,345
Aug	0.00	38,297	0.40	42,865
Sep	0.00	41,119	0.00	49,671
Oct	0.00	45,128	0.00	44,883
Nov	6.60	47,586	2.40	48,769
Dec	13.40	63,411	10.45	58,980
Total	35.50	-	30.65	-
Average[a]	-	46,192	-	47,038

[a] Average dry-weather flow, occurring during non-precipitation months, is 42,600 gal/d.

FIGURE 3
HISTORICAL WASTEWATER FLOWS FOR VALLECITO/DOUGLAS FLAT WWTP (2002-2003)

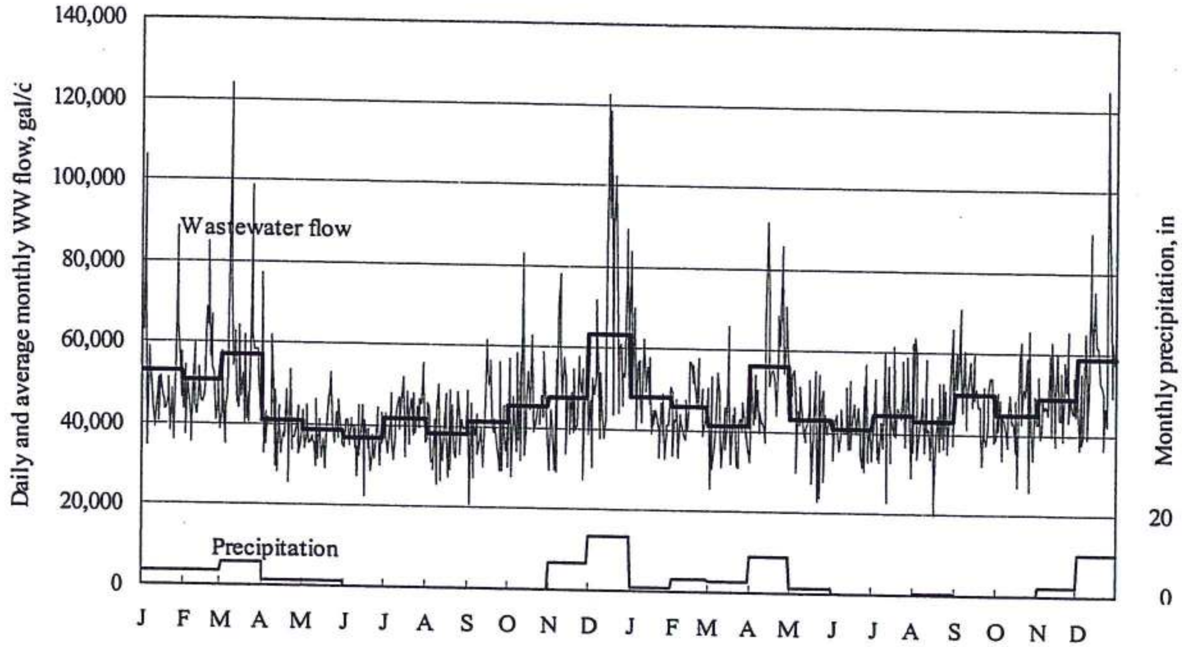
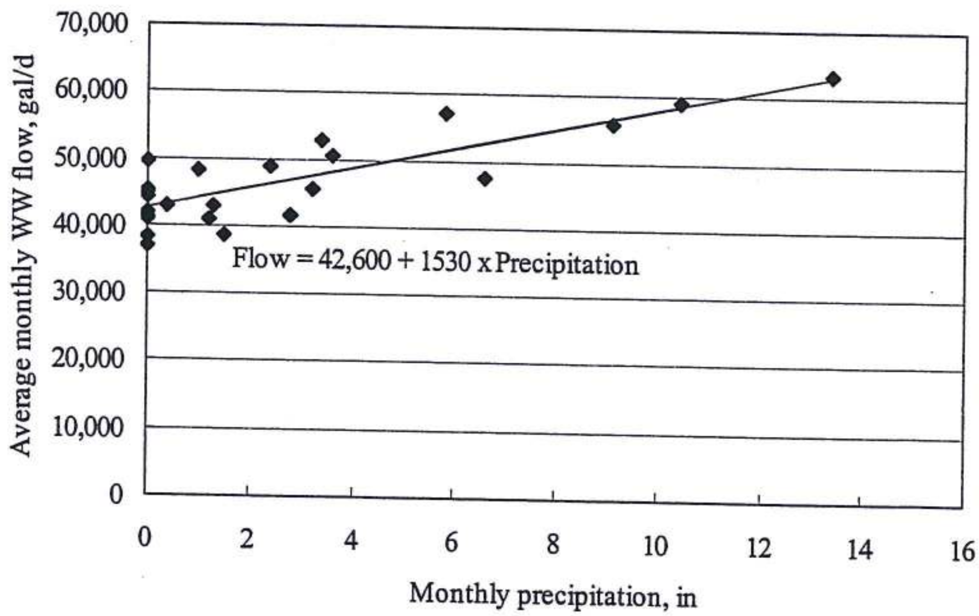


FIGURE 4
PRECIPITATION VERSUS AVERAGE WASTEWATER FLOW FOR VALLECITO/DOUGLAS FLAT WWTP (2002-2003)



B. Infiltration and Inflow

The relationship between precipitation and wastewater flow is shown in Figure 4. As expected, greater wastewater flows occur during winter months with higher rainfall due to infiltration and inflow (I&I). I&I is typically caused by high groundwater leaking into the collection system piping (infiltration) and surface drainage and runoff entering through manhole openings (inflow). The daily values for rainfall and corresponding wastewater flows indicate that I&I contribute significantly to peak wet weather flows. CCWD has indicated that the annual volume of I&I occurring during 100-year rainfall conditions is estimated to be 17.0 ac-ft/yr. As seen in Figure 3, the difference between summer flows (average near 40,000 gal/d) and winter flows (approaching 70,000 gal/d) is near 31,500 gal/d, which is estimated to be the peak monthly I&I contribution to flow.

C. Future Wastewater Flows

Projected future flow values are presented in Table 4. Flows are based on a unit generation factor of 195 gal/unit·d, as established under CCWD Improvement Standards. For each of the three growth scenarios, future wastewater flows are projected by scaling historical wastewater flows in proportion to the increase in the number of service connections. Projected flows resulting from I&I are considered, and flows for both normal-year and 100-year precipitation conditions are provided. The 100-year precipitation values are used for design purposes such as sizing of storage pond and land application areas, while the normal-year values are used to evaluate typical operating conditions. The California Regional Water Quality Control Board (Regional Board) typically requires the use of 100-year precipitation data for determining the size of wastewater storage and land-application facilities.

D. Wastewater Quality

Average monthly values for effluent Biochemical Oxygen Demand (BOD), Settleable Solids, Total Suspended Solids (TSS), Total Coliform, pH, Specific Conductivity (EC), and Total Dissolved Solids (TDS) are presented in Table 5. As seen in Table 5, monthly average values for effluent BOD are consistently below 10 mg/L, and monthly average values for TSS are below 20 mg/L. Values for TDS and EC are fairly stable (average of 284 mg/L and 546 μmho/cm, respectively), while values for TSS and Total Coliform show more variation. It is believed that the variation in effluent TSS and Total Coliform is due to solids being washed out of the treatment system during periods of high flow.

TABLE 4
PROJECTED FUTURE WASTEWATER FLOW

Month	Precipitation, in		Average monthly wastewater flow, gal/d															
			Current[c]: ADWF = 51,285 gal/d				Scenario 1[d]: ADWF = 67,665 gal/d				Scenario 2[e]: ADWF = 85,215 gal/d				Scenario 3[f]: ADWF = 100,815 gal/d			
			Inf. & Inflow		Total WW flow		Inf. & Inflow		Total WW flow		Inf. & Inflow		Total WW flow		Inf. & Inflow		Total WW flow	
	N-yr[a]	100-yr[b]	N-yr	100-yr	N-yr	100-yr	N-yr	100-yr	N-yr	100-yr	N-yr	100-yr	N-yr	100-yr	N-yr	100-yr	N-yr	100-yr
Jan	5.57	10.01	17,561	31,549	68,846	82,834	23,170	41,626	90,835	109,291	29,180	52,422	114,395	137,637	34,522	62,019	135,337	162,834
Feb	5.02	9.02	17,523	31,481	68,808	82,766	23,120	41,535	90,785	109,200	29,116	52,308	114,331	137,523	34,447	61,884	135,262	162,699
Mar	5.27	9.47	16,616	29,850	67,901	81,135	21,922	39,384	89,587	107,049	27,608	49,599	112,823	134,814	32,663	58,679	133,478	159,494
Apr	2.73	4.90	8,894	15,979	60,179	67,264	11,735	21,082	79,400	88,747	14,779	26,550	99,994	111,765	17,484	31,410	118,299	132,225
May	0.78	1.40	2,459	4,418	53,744	55,703	3,245	5,829	70,910	73,494	4,086	7,341	89,301	92,556	4,834	8,685	105,649	109,500
Jun	0.21	0.38	684	1,229	51,969	52,514	903	1,622	68,568	69,287	1,137	2,042	86,352	87,257	1,345	2,416	102,160	103,231
Jul	0.06	0.11	189	340	51,474	51,625	250	448	67,915	68,113	314	565	85,529	85,780	372	668	101,187	101,483
Aug	0.17	0.31	536	963	51,821	52,248	707	1,270	68,372	68,935	891	1,600	86,106	86,815	1,054	1,893	101,869	102,708
Sep	0.60	1.08	1,955	3,512	53,240	54,797	2,579	4,633	70,244	72,298	3,248	5,835	88,463	91,050	3,843	6,903	104,658	107,718
Oct	1.84	3.31	5,801	10,422	57,086	61,707	7,654	13,751	75,319	81,416	9,639	17,317	94,854	102,532	11,404	20,487	112,219	121,302
Nov	4.75	8.53	15,475	27,802	66,760	79,087	20,418	36,681	88,083	104,346	25,714	46,195	110,929	131,410	30,421	54,652	131,236	155,467
Dec	4.55	8.17	14,346	25,772	65,631	77,057	18,927	34,003	86,592	101,668	23,836	42,823	109,051	128,038	28,200	50,662	129,015	151,477
Total	31.55	56.68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Avg.	-	-	8,503	15,276	59,788	66,561	11,219	20,155	78,884	87,820	14,129	25,383	99,344	110,598	16,716	30,030	117,531	130,845

Current wastewater service connections:	263
Scenario 1 wastewater service connections:	347
Scenario 2 wastewater service connections:	437
Scenario 3 wastewater service connections:	517
Average dry weather flow per unit[g], gal/d:	195
100-yr I&I flow for current conditions[g], ac-ft/yr:	17.0

[a] Normal-year values collected at Sonora weather station 1961-1990 (average annual total for Angels Camp is 31.34 in).
[b] 100-year values based on annual 100-year precipitation value for Angel's Camp.
[c] Current conditions consists of present connections in Vallecito (174) and Douglas Flat (89). ADWF does not include I&I.
[d] Scenario 1 consists of projected future connections for Vallecito (229) and Douglas Flat (118). ADWF does not include I&I.
[e] Scenario 2 consists of projected future connections for Vallecito (229), Douglas Flat (118), and Six-Mile Village (90). ADWF does not include I&I.
[f] Scenario 3 consists of projected future connections for Vallecito (229), Douglas Flat (118), Six-Mile Village (90), and additional development (80). ADWF does not include I&I.
[g] Value provided by Calaveras County Water District.

TABLE 5
INFLUENT AND EFFLUENT WASTEWATER QUALITY

		Effluent wastewater quality						
Date	Influent BOD, mg/L	BOD, mg/L	Settleable Solids, mL/L	TSS, mg/L	Total Coliform[a], MPN/100 mL	pH, Standard units	Specific Conductivity, µmho/cm	TDS, mg/L
Jan 02	-	6.2	0.1	19.7	<2	6.4	489	253
Feb 02	-	7.3	0.0	12.8	<2	6.8	633	261
Mar 02	-	4.2	0.0	9.1	31.8	6.7	524	254
Apr 02	-	3.9	0.0	7.6	<2	6.6	546	243
May 02	-	2.9	0.0	9.4	<2	6.6	587	283
Jun 02	-	2.8	0.0	7.1	3.5	7.0	643	281
Jul 02	-	3.0	0.0	6.3	<2	6.9	556	241
Aug 02	-	4.4	0.0	4.6	<2	6.9	593	256
Sep 02	-	3.9	0.0	3.6	8.0	7.1	578	300
Oct 02	154	4.0	0.0	10.1	28.3	7.3	595	332
Nov 02	90	3.0	0.0	11.9	17.7	7.6	754	404
Dec 02	129	5.5	0.0	8.1	22.3	7.3	513	317
Jan 03	-	-	-	-	-	-	-	-
Feb 03	119	4.6	0.0	9.1	<2	7.2	427	290
Mar 03	52	7.2	0.0	7.2	18.5	7.0	486	317
Apr 03	76	2.0	0.0	6.4	<2	6.4	448	275
May 03	122	3.2	0.0	13.0	13.5	6.9	491	238
Jun 03	-	-	-	-	-	-	-	-
Jul 03	202	5.5	0.0	3.5	3.8	7.0	740	340
Aug 03	123	5.0	0.0	5.0	11.5	6.9	607	307
Sep 03	183	4.6	0.0	6.7	3.0	6.8	386	250
Oct 03	126	4.3	0.0	5.4	5.0	6.7	571	292
Nov 03	108	3.6	0.0	5.1	<2	7.1	471	266
Dec 03	270	4.5	0.0	6.8	<2	6.5	384	245
Average	135	4.3	0.0	8.1	8.0	6.9	546	284

[a] For calculation of average values, a value of 1 is used for Total Coliform results of <2 MPN/100 mL.

4. REGULATORY REQUIREMENTS

This section describes regulatory requirements for alternative effluent disposal methods.

A. Methods of Effluent Disposal

The three methods of effluent disposal include:

1. Land application of secondary, disinfected effluent.
2. Land application of tertiary, Title 22 reclaimed effluent.
3. NPDES permitted surface water discharge of tertiary effluent.

Regulatory requirements vary depending on the method of effluent disposal, effluent quality and other factors such as the potential for public health risk/exposure and - in the case of surface water disposal - the beneficial uses of downstream receiving waters. Currently, for the Vallecito/Douglas Flat WWTP, secondary effluent is disposed of by applying it to spray fields. However, in the near future, CCWD will have to either acquire more land to expand the spray fields or, alternatively, pursue other effluent disposal methods.

B. Effluent Quality Requirements

Table 6 lists the expected effluent quality values for discharge from the Vallecito/Douglas Flat WWTP into surface waters. Also, water quality values for the Vallecito/Douglas Flat WWTP are provided for existing spray field (restricted reuse) disposal, as well as typical values expected for public reuse (unrestricted reuse). The average BOD values for restricted land application and surface water discharge are 40 mg/L and 10 mg/L, respectively. The total coliform level is 23 MPN/100 mL for the current spray field disposal compared to 2.2 MPN/100 mL for surface water discharge. The stringent water quality limits for surface water discharge would necessitate major upgrades to the Vallecito/Douglas Flat WWTP.

TABLE 6
EXPECTED EFFLUENT QUALITY REQUIREMENTS

Constituent	Land application		River
	Restricted[a]	Unrestricted[b]	discharge[c]
Biochemical Oxygen Demand (BOD), mg/L	40/80	10	10
Settleable Solids (SS), mL/L	0.2/0.5	-	0.1
Total Suspended Solids (TSS), mg/L	-	10	10
Total Coliform (TC), MPN/100 mL	23/230	2.2/23	2.2
Total Nitrogen (TN), mg/L	-	30	13
Turbidity, NTU	-	2	2

[a] Values from current Waste Discharge Requirements (WDRs) Order No. 92-018. The first number represents the monthly average; the second number represents the daily maximum. For TC, the first number represents the monthly median, and the second number represents the daily maximum.
[b] From WDRs recently adopted for use of reclaimed water for golf course irrigation.
[c] From WDRs recently adopted for discharge into the San Joaquin River. Values refer to weekly averages.

C. Land Disposal Requirements

As indicated previously, Vallecito/Douglas Flat WWTP effluent currently is disposed by land application. Regulations for wastewater disposal operations are provided in Waste Discharge Requirements (WDRs) Order No. 92-018 adopted by the Regional Board in 1992. The WDRs include a monthly average flow limit of 65,000 gal/d, and Total Coliform limits of 23 MPN/100 mL (monthly median) and 230 MPN/100 mL (daily maximum). The discharge of effluent to surface water bodies (e.g., Coyote Creek, Little Dry Creek) is prohibited. The setback from wastewater application to surface water bodies is 100 ft where vegetation exists to limit the movement of aerosols, and 300 ft for open terrain. Offsite drainage of applied water from the land application area is also prohibited.

Because monthly average flows for the three growth scenarios described above exceed the current permit flow limit of 65,000 gal/d, new WDRs would be required for expanded operations at the Vallecito/Douglas Flat WWTP. A Report of Waste Discharge (RWD) describing proposed operations would be submitted to the Regional Board. If the disposal option involves the use of reclaimed wastewater, an Engineering Report describing the use of recycled water would also be submitted to the Regional Board and the California Department of Health Services (DHS). After the Regional Board determines the RWD to be complete, WDRs typically are adopted within six to twelve months. The WDRs would include a Monitoring and Reporting Program (MRP) with requirements for monitoring of effluent quality, pond conditions, etc. It is likely that new WDRs would include additional MRP requirements, such as the installation of monitoring wells in the land application area.

Title 22 Reclaimed Effluent

Regulations for the use of reclaimed wastewater for irrigation are found in the California Code of Regulations Title 22. Because public access to the land application area is limited, recycled water that meets a monthly median concentration of 23

MPN/100 mL can be applied to the sprayfields. However, if reclaimed effluent is applied to an area with greater potential for public contact, a higher standard (2.2 MPN/100mL) is required. As indicated above, occasional high Total Coliform concentrations occur during periods of high I&I, when solids are washed from the Vallecito/Douglas Flat WWTP clarifiers due to inadequate capacity. In addition to expanded area for wastewater disposal and increased storage volume to accommodate the increased flow, improvements to treatment equipment will be required to ensure that Title 22 standards for land application are met.

D. Surface Water Discharge Requirements

For wastewater discharges to surface water bodies (e.g., Coyote Creek, Little Dry Creek), a NPDES permit must be obtained. Effluent quality requirements are typically more stringent than for land disposal. Although the NPDES program is a federal program, it is administered by the Regional Board. However, there are several differences between the land application program and the NPDES program. The differences are summarized in Table 7.

The principal disadvantages of entering the NPDES program are:

1. Higher costs associated with preparing Forms 1, 2A, 200, the RWD, and the Feasibility Study

2. Costs associated with collecting four quarters of CTR data, groundwater data, CEQA compliance information, and possibly TMDL data

3. Increased costs for annual monitoring and permit renewal, with shorter renewal period

4. Stricter water quality requirements

5. Mandatory fines for permit violations

6. Increased exposure (liability) associated with discharging to surface waters (i.e., possible exposure to third-party lawsuits)

7. Generally unpredictable time requirement to obtain permit, due to Regional Board staff limitations and possible public opposition

TABLE 7
SUMMARY OF GENERAL NPDES PERMIT REQUIREMENTS AND CONDITIONS

Requirement	Description of Requirements and Conditions
Required Forms	Forms 1, 2A, and 200 are required. Form 1 supplies general information about the type of waste discharge, discharger contact information, and location of the facility. Form 2A is for wastewater flow and quality data, and receiving water information. In Form 200, additional information is provided about the discharger, including compliance with the California Environmental Quality Act (CEQA). In addition to the Forms 1, 2A, and 200, a RWD would be submitted to the Regional Board. For use of reclaimed wastewater, an Engineering Report would be submitted to the Regional Board and DHS.
Feasibility Study	To obtain an NPDES permit, it is necessary to demonstrate to the Regional Board that the proposed NPDES discharge is the only feasible option for disposing the wastewater. A feasibility study must be submitted demonstrating that it is infeasible to keep applied water onsite. Possible grounds for infeasibility may include lack of necessary land required for wastewater disposal. An economic analysis would be needed to demonstrate that the cost of improvements required to keep applied Title 22 recycled water from discharging to surface water bodies is unreasonable.
California Toxics Rule Data	NPDES applications are required to provide water quality data for California Toxics Rule (CTR) constituents (including pesticides, PCBs, dioxins, and about 200 other constituents). CTR data typically are required quarterly for a period of one year to prepare the NPDES permit. Samples of both the discharge water and the receiving water are required. Lab fees for each sample point are typically several thousand dollars.
Other Information Requirements	Additional information requirements include groundwater data, compliance information for CEQA, and Total Maximum Daily Load (TMDL) data if the receiving water bodies are listed on the 303(d) list maintained by the Regional Board (currently Coyote Creek and Little Dry Creek are not listed, but their status may change). Application fees for the NPDES program are typically higher than for the land application program, and the permit adoption schedule typically is longer than for land application permits. The permit adoption schedule may also be affected by limited Regional Board staff availability.
Stricter Water Quality Requirements	For land discharge, wastewater nutrients must be reduced to the point where they will match the land's capacity for assimilation and reuse of the nutrients. For surface water discharge, because sensitive aquatic species are potentially immersed by the discharge, the water quality requirements are much stricter. The improvements that would be required at the Vallecito/Douglas Flat WWTP to meet probable NPDES discharge requirements are described in Table 7.
Mandatory Fines for Non-Compliance	One of the principal disadvantages of the NPDES program for dischargers is that mandatory penalties (fines) are required for each exceedance or case of non-compliance with the permit. Depending on how the permit is structured, a single exceedance may result in multiple fines. Typically the fine is $3000 for each violation. Conversely, in the land application program, regulators may exercise discretion in assessing fines.
Public Participation	Groups and organizations interested in various uses of the receiving waters are actively involved in the NPDES permit procedure, which is a public process. Adoption of an NPDES permit can be held up indefinitely if a concerned citizen or group finds grounds to delay processing. For example, Regional Board staff concede that some Central Valley water supply agencies that use water from foothill reservoirs, such as New Melones, are opposed to the adoption of new NPDES permits for dischargers in their watersheds. Because discharges from the Vallecito/Douglas Flat WWTP would enter the New Melones reservoir, opposition to adoption of an NPDES permit for Vallecito/Douglas Flat WWTP may occur.
Third-Party Issues	Under the Clean Water Act, discharges into surface waters may result in perceived non-compliance and potential lawsuits from third parties. When Title 22 recycled water is kept onsite and offsite discharges are prevented, third-party issues under the Clean Water Act are limited. The NPDES review process includes significant public scrutiny that may result in an increased likelihood of opposition and legal action related to offsite discharges. Noncompliance with permit conditions may not only result in mandatory fines from the Regional Board, but may also result in legal actions from water purveyors who use downstream facilities for water supply.

Point of Discharge and Receiving Waters

The most likely point of discharge is Coyote Creek. The area north of the plant land application area is drained by Coyote Creek, which flows southwest. The area south of the land application area is drained by Little Dry Creek, which also flows southwest and empties into Coyote Creek less than a mile from the land application area. Coyote Creek then flows south, and about five miles south of Vallecito discharges to the Stanislaus River and eventually into the New Melones reservoir. According to the current WDRs for the Vallecito/Douglas Flat WWTP, the beneficial uses for Coyote Creek, Little Dry Creek, and the New Melones Reservoir are municipal, industrial, and agricultural supply; recreation; esthetic enjoyment; groundwater recharge; fresh water replenishment; hydropower generation; and preservation and enhancement of fish, wildlife, and other aquatic resources.

5. COLLECTION SYSTEM

The collection systems for Six-Mile Village, Douglas Flat, and Vallecito are installed in rural communities and topography consisting of rolling terrain. Douglas Flat and Vallecito are in the Coyote Creek drainage shed, and Six-Mile Village is in the Six-Mile Creek drainage shed. This section provides an assessment of and proposed improvements to the sewer collection systems for the three communities.

A. Assessment of Existing Collection System Facilities

The existing collection systems generally consist of the following:

Six-Mile Village:

1. Septic tank effluent gravity (STEG) sewer system
2. Small diameter low pressure sewer collection lines
3. Pump Station (maximum flow 45 gpm at 60 psi)
4. 2-inch to 4-inch Force Main from Six-Mile Village to Angels Camp along SR-4
5. Discharge into City of Angels Camp sewer system

Vallecito:

1. Septic tank effluent pumped (STEP) sewer system
2. Small diameter low pressure sewer lines
3. Pump Station (maximum flow 110 gpm at 107 psi)
4. 6-inch Force Main from Vallecito to Douglas Flat along SR-4

Douglas Flat:

1. Conventional gravity sewer with manholes.

Six-Mile Village Existing STEG Sewer System

The Six-Mile Village collection system was originally constructed in 1987 and collects septic tank effluent in a small diameter closed gravity sewer comprised primarily of 2-inch to 3-inch lines. The small diameter sewer lines tend to clog often and do not have enough flushing stations, isolation valves, and clean outs to facilitate maintenance. Currently, without valves to isolate individual sewer lines, the flushing water flows into neighboring branch lines and reduces the effectiveness of flushing. The system has high peak wet weather flows. Leaking septic tank lids are suspected to be contributing to I&I. CCWD replaces damaged lids with a tighter system that reduces inflow.

Six-Mile Village Existing Pump Station

The Six-Mile Village pump station is located at the northeast corner of the intersection of SR-4 and Ponderosa Drive and about 150 feet east of Six-Mile Creek. The pump station has a 1,500 gallon wet well with two pumps. Ancillary facilities include a 150 ft^2 building, discharge piping, motor controls, and SCADA. With both pumps operating, the pump station flow rate is 40-45 gpm at a discharge pressure of 60 psi.

The pump station wet well is often at risk of overflowing because peak wet weather flows exceed the pumping capacity and cannot be contained by the relatively small wet well volume. Also, the proximity of the pump station to Six-Mile Creek creates a risk that sewage overflowing the wet well may drain into Six-Mile Creek. Although CCWD staff can respond quickly to a high level alarm and – in most cases – prevent the wet well from ever overflowing, it is a persistent and common problem requiring a significant amount of staff time and attention. Adding emergency storage – five to six hours recommended – in the wet well or off stream from the wet well will significantly reduce the possibility of future overflows.

Six-Mile Village Existing Force Main

The Six-Mile Village force main starts at the pump station, paralleling the north side of SR-4 continues west for 11,800 feet and near the intersection of SR-4 and Kurt Lane discharges into a manhole within the City of Angels Camp sewer system. The force main consists of an assortment of 2-inch to 4-inch PVC piping that is in acceptable condition. However, transitions between different diameters, e.g. 2-inch PVC to 4-inch sections, cause an accumulation of solids in the line and consequently several times each year O&M staff must drain the line to break up accumulated solids. The line is periodically flushed to reduce clogging, but this still does not entirely alleviate the problem. A few portions of the force main must be flushed weekly to keep the line unobstructed and the flow rate above 40 gpm. Also, the smaller 2-inch diameter pipe sections restrict flow in the force main to approximately 43 gpm at 60 psig, which can be slightly insufficient to match the peak hour wet weather flows into the wet well.

Vallecito Existing STEP Sewer System

The existing collection system is a septic tank effluent pumped (STEP) low pressure sewer system. The septic tank effluent is pumped into a branch line and ultimately discharged though a common trunk line to the Vallecito sewage pump station. A significant problem is the large amount of I&I that enters the collection system and contributes to peak wet weather flows observed at the water treatment plant. The I&I most likely stems from a poor lid design on the existing septic tanks. CCWD has been replacing damaged lids with a tighter system that reduces inflow. Another challenge in operating the system is not having a flow meter at the pump station. Lack of a flow meter limits the ability to quantify I&I, to measure peak hourly wet weather flows, and to determine when potential washouts may occur at the treatment plant.

Douglas Flat Existing Conventional Sewer System

The Douglas Flat collection system is a conventional gravity sewer system that discharges to the Vallecito/Douglas Flat WWTP. The sewer lines were recently slip-lined and the manholes replaced in an effort to decrease I&I. A significant problem for the collection system is that the gravity line immediately upstream of the treatment plant headworks has limited fall and insufficient velocity to sweep solids into the new strainer. Solids are not being picked up by the rotary screw and remain in the channel causing odors and maintenance issues. Also, the collection system has minor issues with grease accumulation. Sewer lines are frequently cleaned and flushed, which results in a sudden increase in grease loads observed at the treatment plant.

B. Proposed Collection System Improvements

The following collection system improvements are recommended:

Six-Mile Village:

1. Add emergency storage at the pump station to mitigate wet well overflows.
2. Add permanent chemical injection at the pump station to control odors downstream.
3. Install flushing stations, clean outs and isolation valves to improve ability to flush and clear small diameter sewer lines.
4. Replace and seal septic tank lids to reduce I&I.

Vallecito:

1. Provide flow equalization at the pump station to buffer peak wet weather flows being conveyed to the WWTP.
2. Add a flow meter at the pump station.
3. Replace and seal septic tank lids to reduce I&I.

Douglas Flat:

1. Extensive improvements were made to the Douglas Flat sewer system in 2000.
2. No additional improvements are recommended.

Six-Mile Village Force Main Replacement

A new sewer force main (3-inch/7,200 feet) has been proposed historically between the Six-Mile Village pump station and Vallecito. The new force main would discharge into the Vallecito sewer system, and wastewater would eventually be conveyed by the Vallecito sewage pump station to the Vallecito/Douglas Flat WWTP. This would allow wastewater from Six-Mile Village to be treated at a CCWD-owned facility rather than continuing to pay the City of Angels Camp for treatment and disposal. This scenario, i.e. Scenario 2, is not recommended because it requires construction of the new force main and increasing the capacity of treatment, storage, and disposal facilities at the Vallecito/Douglas Flat WWTP.

Six-Mile Village Emergency Wet Well Storage Improvements

To mitigate potential wet well overflows, six hours of off-stream emergency storage are recommended at the Six-Mile Village pump station. The off-stream storage would be created by installing reinforced concrete pipe (RCP) horizontally, parallel to the pump station wet well. The storage tank will be connected to the existing wet well such that it fills in parallel with the wet well. The peak day flow of Six-Mile Village is 58,000 gal/d during 100-year precipitation conditions and approximately 15,000 gallons are required to provide six hours of emergency storage, which is equivalent to 40 feet of eight-foot diameter RCP.

Six-Mile Village Odor Control/Permanent chemical injection Improvements

Odors have been a nuisance problem with the existing force main and may be anticipated as a future problem for the new force main. Permanent chemical injection can be added to control odors, and a sodium hydroxide (NaOH) injection system is proposed at the Six-Mile Village pump station. The chemical injection system will include a chemical tank, metering pump, injection port, and ancillary piping, valves, and level gage.

Six-Mile Village New Sewer Cleanouts and Branch Isolation Valves

Sewer cleanouts, flushing stations, and isolation valves are proposed improvements to the Six-Mile Village collection system and are needed to facilitate maintenance and inspection. The isolation valves will provide a means to isolate various sewer branch lines for flushing and will improve the effectiveness of flushing by directing flushing water, allowing better flushing velocities, and keeping flushing water from backing up into neighboring branch lines. A total of ten isolation valves and cleanouts are proposed.

Six-Mile Village (and Vallecito) Replacement of Septic Tank Lids

Many of the operational difficulties with the Six-Mile Village and Vallecito collection systems are associated with I&I. Replacing septic tank lids in the system with a tighter lid is likely to reduce I&I. CCWD staff periodically replace existing septic tank lids when damaged or when tanks otherwise require maintenance. CCWD staff estimate that one third of the septic tank lids in both systems have been replaced so far. For developing costs, it was assumed that every lid in the system must be replaced once.

Vallecito Flow Equalization Improvements

During 2003, the average flow and peak day flow into the Vallecito/Douglas Flat WWTP were approximately 47,000 gal/d and 120,000 gal/d, respectively. The overflow rate of the clarifiers may be exceeded by peak hourly flows and other flow variations during peak days. The overflow rate for the clarifiers would be near to the recommended maximum rate of 600 gal/ft^2·d, assuming the peak flows are equalized/constant throughout the day. However, such flow equalization does not exist in the Vallecito collection system, and the treatment plant clarifiers are at risk of being washed out by peak flows. Providing four hours of additional storage at the Vallecito wastewater pump station can be provided to equalize peak flows in the Vallecito collection system and prevent clarifier washout at the WWTP.

The storage will be provided by installing eight-foot diameter RCP sections horizontally, parallel to the pump station wet well and connected such that the additional volume fills/drains correspondingly with the wet well level. During hundred year precipitation conditions, the peak day flow is estimated to be 150,000 gal/day. Four hours of storage for this flow will require an equalization volume of 25,000 gallons consisting of approximately 70 feet of eight-foot diameter RCP.

Vallecito Flow Meter Improvements

The peak wet weather flows occurring at the Vallecito/Douglas Flat WWTP are a significant problem. Installing a magnetic flow meter at the Vallecito pump station will provide CCWD staff with the ability to quantify I&I in the Vallecito collection system and, eventually, to better control peak flows into the treatment plant.

C. Capital Costs for Collection System Improvements

The estimated capital costs for construction of the collection system improvements are summarized in Table 8. More detailed cost tables are provided in Appendix B. For outside development, it is assumed that costs for new facilities will be paid by the developer.

TABLE 8
ESTIMATED CAPITAL COSTS FOR COLLECTION SYSTEM IMPROVEMENTS

Improvement\Scenario	Estimated Capital Cost ($) Scenario 1	Scenario 2	Scenario 3
Six-Mile Village Force Main[a]	---	$265,000	$265,000
Six-Mile Village Emergency Storage	$50,000	$50,000	$50,000
Six-Mile Village Chemical Injection	---	$40,000	$40,000
Six-Mile Village Flushing System	$35,000	$35,000	$35,000
Six-Mile Village Septic Tank Lids	$15,000	$15,000	$15,000
Vallecito Flow Equalization	$100,000	$100,000	$100,000
Vallecito Flow Meter	$5,000	$5,000	$5,000
Vallecito Septic Tank Lids	$40,000	$40,000	$40,000
Outside Development	---	---	(Developer)
Total	$245,000	$550,000	$550,000

[a] Excluding costs for right-of-way acquisition.

6. TREATMENT SYSTEM

This section provides an assessment of required treatment system improvements, assuming continued land application of effluent. In addition, a treatment plant alternative to produce higher quality effluent suitable for a surface water discharge is described in Part D of this section.

A. Assessment of Existing Treatment Facilities

The existing Vallecito/Douglas Flat WWTP receives septic tank effluent from Vallecito via a 6-inch force main, and domestic sewage from Douglas Flat via a conventional gravity sewer. At the headworks the flows are combined, screened, and again divided into two separate streams to remove solids and balance the different wastewater strengths. These streams are then diverted to the two existing, parallel extended aeration treatment plants. The first extended aeration treatment plant was built in the 1970's and originally used to treat wastewater from Douglas Flat. A second extended aeration plant was built in the 1990's to provide wastewater treatment for Vallecito. After sewage is aerated and clarified, resulting secondary effluent is disinfected, stored in ponds, and later applied to spray fields. The existing plant unit processes are further described below.

Existing Headworks

New headworks were added to the facility in 2002. The headworks contains a Rotomat microstrainer, bypass channel with bar rack, flow splitting box, V-notch weirs, and level sensors for measuring flow to each aeration basin. The splitting box allows O&M staff the ability to monitor and control flow to each aeration basin. However, the gravity line immediately upstream of the headworks has limited fall and does not have the sweeping velocity needed to carry solids into the new strainer. Solids reaching the strainer are not being picked up by the rotary screw and remain in the channel causing odors and maintenance issues. Operators have limited their use of the microstrainer and prefer to divert influent through the bypass channel and bar rack. The coarse bar rack still permits plastics and other solids to pass though the headworks, making downstream processes vulnerable to fouling. Furthermore, without the strainer much of the plastics and solids eventually become deposited in the storage ponds.

Existing Aeration Basins

The existing Vallecito and Douglas Flat extended aeration facilities are packaged treatment plants designed for 40,000 gpd and 25,000 gpd, respectively. The aeration basins generally function well under average flows and moderate peak wet weather flows. At the current average daily flow of 47,000 gal/d, the two existing aeration basins have sufficient capacity, and the hydraulic detention times are similar to the recommended value of 36 hours. The organic BOD_5 volumetric loading rates are below the recommended value of 15 BOD_5 lbs/1000 $ft^3 \cdot d$, as shown in Table 9. These low organic loading rates of 5-7 BOD_5 lbs/1000 $ft^3 \cdot d$ can potentially create challenges for sustaining sufficient cell mass in the aeration basins. Lastly, the aging condition of the Douglas Flat aeration basin – built in the 1970's – is a growing concern as it may impact future facility performance and reliability.

TABLE 9
VOLUMETRIC LOADING RATES AND DETENTION TIMES FOR THE AERATION BASINS

Condition	Volumetric Loading Rate, BOD_5 lbs/1000 $ft^3\cdot d$	Detention Time, hrs
Douglas Flat Plant		
Design	15.9	24
Range at Similar Facilities[a]	10-25	—
Recommended Value[a]	15.0	36
Average Flow (2003)	5.3	38
Vallecito Plant		
Design	15.0	24
Range at Similar Facilities[a]	10-25	18-36
Recommended Value[a]	15.0	36
Average Flow (2003)	6.6	31

[a] Values from Metcalf and Eddy[3].

Extended aeration basins are generally sized based on the average condition because the long detention times serve to absorb and resist the impact from high hydraulic peaks. However, the clarifiers that are responsible for returning cell mass back to the aeration basins are susceptible to peak hydraulic overloading, as discussed below.

Existing Clarifiers

Clarifier performance has been analyzed based on the ability to process average, peak day, and peak hour flows. As shown in Figure 3, the peak day flows can be as high as 120,000 gal/d. Although no direct data are available for the peak hour flow rate, O&M staff observe that unthrottled flow rates from the Vallecito pump station can be as high as 180 gpm. Concurrent flows from all existing sources – Vallecito, Douglas Flat and dewatering from the drying bed underdrains (see drying beds below) – may result in peak hour flows in excess of 240 gpm. For purposes of this assessment, calculations are based on a peak hour flow of 240 gpm. Also, it is assumed that two-thirds of the combined flow – average, peak day or peak hour – is diverted to the Vallecito plant and the remaining one-third to the Douglas Flat plant.

As shown in Table 10, the clarifiers have overflow rates well below the recommended rate of 200 gal/$ft^2\cdot d$ for average conditions. The successful and reliable operational history of the plants supports the assertion that clarifiers function properly at average flows. The overflow rate for the clarifiers would be close to the maximum rate of 600 gal/$ft^2\cdot d$, if the peak day flow of 120,000 gal/d was equalized and constant. Since flow equalization does not exist – neither immediately upstream of the headworks nor elsewhere in the collection system – peak hour and other hourly variations in the peak day flow can cause the clarifiers to be hydraulically overloaded. As shown in Table 11, under peak hour conditions of 240 gpm, the clarifiers weir loading rates of 11,520 gal/ft·d are above the recommended maximum of 10,000 gal/ft·d.

When the clarifiers become hydraulically overloaded, solids get flushed over the weirs and not enough cell mass gets returned to the aeration basins. Furthermore, solids collect downstream on the floor of the chlorine contact basin, and it takes a significant effort by O&M staff to remove the solids.

TABLE 10
EXISTING AND RECOMMENDED CLARIFIER OVERFLOW RATES

Condition	Year 2003 Values	Recommended Values[a]
Average Flow: Douglas Flat Plant		
Overflow Rate, gal/ft²·d	158	200
Flow Rate, gal/d	15,679	19,860
Flow Rate, gal/min	11	14
Peak Day Flow: Douglas Flat Plant		
Overflow Rate, gal/ft²·d	403	600
Flow Rate, gal/d	40,000	59,580
Flow Rate, gal/min	28	41
Average Flow: Vallecito Plant		
Overflow Rate, gal/ft² d	157	200
Flow Rate, gal/d	31,359	40,000
Flow Rate, gal/min	22	28
Peak Day Flow: Vallecito Plant		
Overflow Rate, gal/ft²·d	400	600
Flow Rate, gal/d	80,000	120,000
Flow Rate, gal/min	56	83

[a] Calculated values for Douglas Flat plant based on clarifier area of 99.3 ft². Calculated values for Vallecito plant based on clarifier area of 200 ft² [3].

TABLE 11
EXISTING AND RECOMMENDED WEIR LOADING RATES

Condition	Year 2003 Values	Recommended Values[a]
Peak Hourly Flow: Douglas Flat Plant		
Weir Loading Rate, gal/ft·d	11,520	10,000
Flow Rate, gal/d	115,200	100,000
Flow Rate, gal/min	80	69
Peak Hourly Flow: Vallecito Plant		
Weir Loading Rate, gal/ft·d	11,520	10,000
Flow Rate, gal/d	230,400	200,000
Flow Rate, gal/min	160	139

[a] Calculated values for Douglas Flat plant based on weir length of 10 ft.
Calculated values for Vallecito plant based on weir length of 20 ft [3].

Existing Chlorine Contact Basin

The chlorine contact basin is designed to maintain a 30 minute detention time at a peak flow of 150,000-gpd and has a length to width ratio of 40:1. The current permit limits the effluent total coliform to 23 MPN/100 mL with a daily maximum of 230 MPN/100 mL. The average effluent total coliform for the Vallecito/Douglas Flat WWTP was reported as 8 MPN/100 mL during the years 2002 and 2003.

Existing Septage Receiving

During recent plant modifications, a larger septage holding tank was installed to operate hydraulically in conjunction with the existing septage holding tank. A grinder pump was added at the existing tank to convey septage to the headworks. Unfortunately, the pumped septage tends to backs up into the sewer because of the inadequate fall in the sewer line immediately upstream of the headworks. The backup of the septage in the sewer line causes odors and maintenance problems and, therefore, use of the septage receiving station has been discontinued and septage disposal has been routed to alternate facilities.

Existing Drying Beds

The existing drying beds were constructed at the bottom of the original Douglas Flat storage pond. Groundwater levels rise during the winter months and water emerges above ground at the southwest corner of the drying beds. The standing water interferes with biosolids drying operations. The drying beds have an underdrain and effluent return pump station. During the winter months these pumps operate frequently and flow from the underdrain is contributing to the treatment plant wet weather flows. According to rough estimates, the pumps run 2-3 hrs/day during wet months and around 1 hrs/day during summer months. Usually the pumps are throttled down to a rate of 25-50 gpm and have a total daily flow of 3,000 to 6,000 gal/d. Although this flow by itself does not cause hydraulic overloading, it may contribute to peak flows – increasing the hydraulic loading rate on the clarifiers – and further dilutes the already dilute BOD_5 loading rate in the aeration basins.

B. Proposed Treatment System Improvements (Assuming Spray Field Disposal of Effluent)

The following improvements are proposed for upgrading the existing treatment plant:

1. Replace existing Douglas Flat aeration basin and clarifier (size depends on scenario)
2. Add odor control at headworks
3. Fix existing headworks operational problems (for Scenario 1)
4. Replace and enlarge the headworks (for Scenario 2 and 3)

Further description of these improvement and probable costs are provided below.

Replace the Aeration Basin and Clarifier

Replacement of the Douglas Flat aeration basin has the dual benefit of solving existing operational challenges while adding capacity to sustain higher flows. For Scenario 1, the required aeration volume is 102,000 gallons. For Scenarios 2 and 3, the total required aeration basin volumes are estimated to be 128,000 gallons and 151,000 gallons, respectively. Although the older Douglas Flat aeration basin will be replaced, it is assumed that the newer Vallecito aeration basin (40,000 gal) will be utilized and will count towards the total required aeration basin volume. Probable construction costs for replacing the aeration basin and clarifier are summarized in Table 12.

TABLE 12
PROBABLE CONSTRUCTION COSTS FOR NEW AERATION BASIN AND CLARIFIER

Improvement\Scenario	Probable Construction Costs, $		
	Scenario 1	Scenario 2	Scenario 3
Package treatment processes	$400,000	$600,000	$700,000
Site piping	$20,000	$30,000	$40,000
Electrical and instrumentation	$80,000	$100,000	$120,000
Installation	$100,000	$140,000	$180,000
Demolition of existing basin	$30,000	$30,000	$30,000
Total	$630,000	$900,000	$1,070,000

Add Odor Control

The community of Douglas Flat is in close proximity to the Vallecito/Douglas Flat WWTP. Odors from the treatment plant headworks can be a nuisance to nearby residences. A packaged biofilter can be installed to control odors. By covering/enclosing the headworks channels and drawing a negative pressure on the channels, foul air can be drawn into the biofilter and treated by biologically active media. Probable construction costs for the proposed biofilter are summarized in Table 13.

TABLE 13
PROBABLE CONSTRUCTION COSTS FOR ADDING ODOR CONTROL

Improvement\Scenario	Probable Construction Costs, $		
	Scenario 1	Scenario 2	Scenario 3
Package biofilter with fan and controls	$50,000	$50,000	$50,000
Enclosure for headworks	$2,000	$3,000	$3,000
Biofilter foundation	$4,000	$4,000	$4,000
Electrical and instrumentation	$10,000	$15,000	$15,000
Installation	$14,000	$15,000	$15,000
Total	$80,000	$87,000	$87,000

Modify the Existing Headworks

For Scenario 1 to mitigate many of the challenges associated with the existing headworks, approximately the final 100 feet of gravity sewer can be reconstructed at a steeper pitch and the Douglas Flat sewer could be diverted into a sump. Duplex grinder pumps would be added to lift wastewater from the sump into the existing headworks. The sump will have the additional benefit of providing a nominal amount of flow equalization for the Douglas Flat sewer system. However, to accommodate high wet weather flows or a pump failure, an overflow line will be needed to divert these flows from the sump to the headworks.

Again, these improvements will provide the following benefits:

1. Provides sufficient fall to the sewer line upstream of the plant
2. Solves operational problems with existing headworks, strainer and septage station.
3. Provides a nominal amount of flow equalization

Probable construction costs associated with equalizing flow are summarized in Table 14.

TABLE 14
PROBABLE CONSTRUCTION COSTS FOR DOUGLAS FLAT FLOW EQUALIZATION

Improvement\Scenario	Probable Construction Costs, $		
	Scenario 1	Scenario 2[a]	Scenario 3[a]
48-inch sewer/sump	$30,000	--	--
Grinder pumps	$20,000	--	--
Electrical and instrumentation	$10,000	--	--
Installation	$10,000	--	--
Total	$70,000	--	--

[a] Flow equalization is not anticipated under Scenario 2 and Scenario 3.

Replace and Enlarge the Headworks

For Scenarios 2 and 3, improvements to the headworks are needed to facilitate increased flows. A larger headworks would be provided and its elevation set correctly – with enough fall provided in the sewer line upstream of the headworks – to assure sewer backups do not occur and to assure sufficient sweeping velocity for conveyance of solids. Probable construction costs for headworks improvements are shown in Table 15.

TABLE 15
PROBABLE CONSTRUCTION COSTS FOR ENLARGING HEADWORKS

	Probable Construction Costs, $		
Improvement\ Scenario	Scenario 1[a]	Scenario 2	Scenario 3
Screening and flow splitting	--	$95,000	$105,000
Electrical and instrumentation	--	$25,000	$30,000
Total	--	$120,000	$135,000

[a] Headworks replacement is not anticipated under Scenario 1.

C. Summary of Costs for Treatment System Improvements (Assuming Spray Field Disposal of Effluent)

Selection and implementation of the final treatment system improvements will depend on the assumed growth scenario, as shown in Table 16.

TABLE 16
SUMMARY OF PROBABLE CONSTRUCTION COSTS FOR TREATMENT SYSTEM IMPROVEMENTS

	Probable Construction Cost, $		
Improvement\Scenario	Scenario 1	Scenario 2	Scenario 3
Replace Aeration Basin/Clarifier	$630,000	$900,000	$1,070,000
Biofilter Odor Control	$80,000	$90,000	$90,000
Flow Equalization	$70,000	--	--
Enlarge Headworks	--	$120,000	$135,000
Total	$780,000	$1,110,000	$1,295,000

D. Alternative MBR Treatment System (for Kautz Reuse and Seasonal NPDES Stream Discharge of Effluent)

For an NPDES surface water discharge or water reuse such as for vineyard irrigation where public contact is likely, a significantly higher level of water quality and reliability is required. An alternative MBR treatment system – an entirely new facility – is recommended to achieve tertiary treatment. The MBR system consists of a suspended growth biological reactor integrated with immersed micro-filtration membranes. The MBR process combines the unit operations of aeration, secondary clarification and filtration into a single process, simplifying operation and greatly reducing space requirements. Essentially, the micro-filtration system replaces the solids separation function of the existing package plants and produces a filtered effluent all in one process. The required steps and processes for the MBR treatment plant are shown in Figure 5.

In the MBR process, hollow fiber micro-filtration membranes are submerged in an aeration tank and in direct contact with the mixed liquor suspended solids. Suction pumps are used to create a vacuum on the downstream side of the membranes and pull wastewater through the membranes. Effluent is then discharged by the pump. In order to prevent the external surface of the membranes from clogging, a constant airflow – introduced at the base of the membrane modules – is used to produce turbulence and scour the external surface of the hollow fibers transferring rejected solids away from the membrane surface. Also, this airflow provides a large portion of the process biological oxygen demand; the remainder is provided by a diffused aeration system. Waste sludge is separately pumped and removed directly from the aeration tank.

A membrane bioreactor system is an alternative for the removal of TSS and BOD as well as nitrification/denitrification. The immersed membrane technology effectively overcomes the problems associated with poor settling of sludge in conventional activated sludge processes. The technology permits bioreactor operation with considerably higher mixed liquor solids concentrations (12,000 to 15,000 mg/L) compared to conventional activated sludge systems (2,000 to 4,000 mg/L) which are limited by sludge settling. The elevated biomass concentrations allow for highly effective removal of both soluble and particulate BOD.

Also, because immersed membrane process can operate at elevated MLSS concentrations, extended solids retention times (SRTs) are readily attainable (10-25 days). These extended SRTs ensure complete nitrification. The elevated levels of biomass become readily anoxic in the absence of aeration, ensuring high denitrification rates. An upstream anoxic zone and mixer readily accommodate denitrification. Overall effluent quality is excellent.

Required Improvements for MBR Treatment Plant

The new MBR treatment plant would require construction of the following facilities:

1. New Coarse and Fine Screens and Grit Removal.
2. New Process Controls/Control Building
3. MBR Process Equipment and Basin
4. Process Pumping (internal recycle and WAS pumping)
5. UV Disinfection
6. Effluent Pump Station
7. Coyote Creek Outfall Structure
8. Aerobic Digestion and Waste Sludge Pumping

Probable construction costs for a new MBR treatment plant are summarized in Table 17.

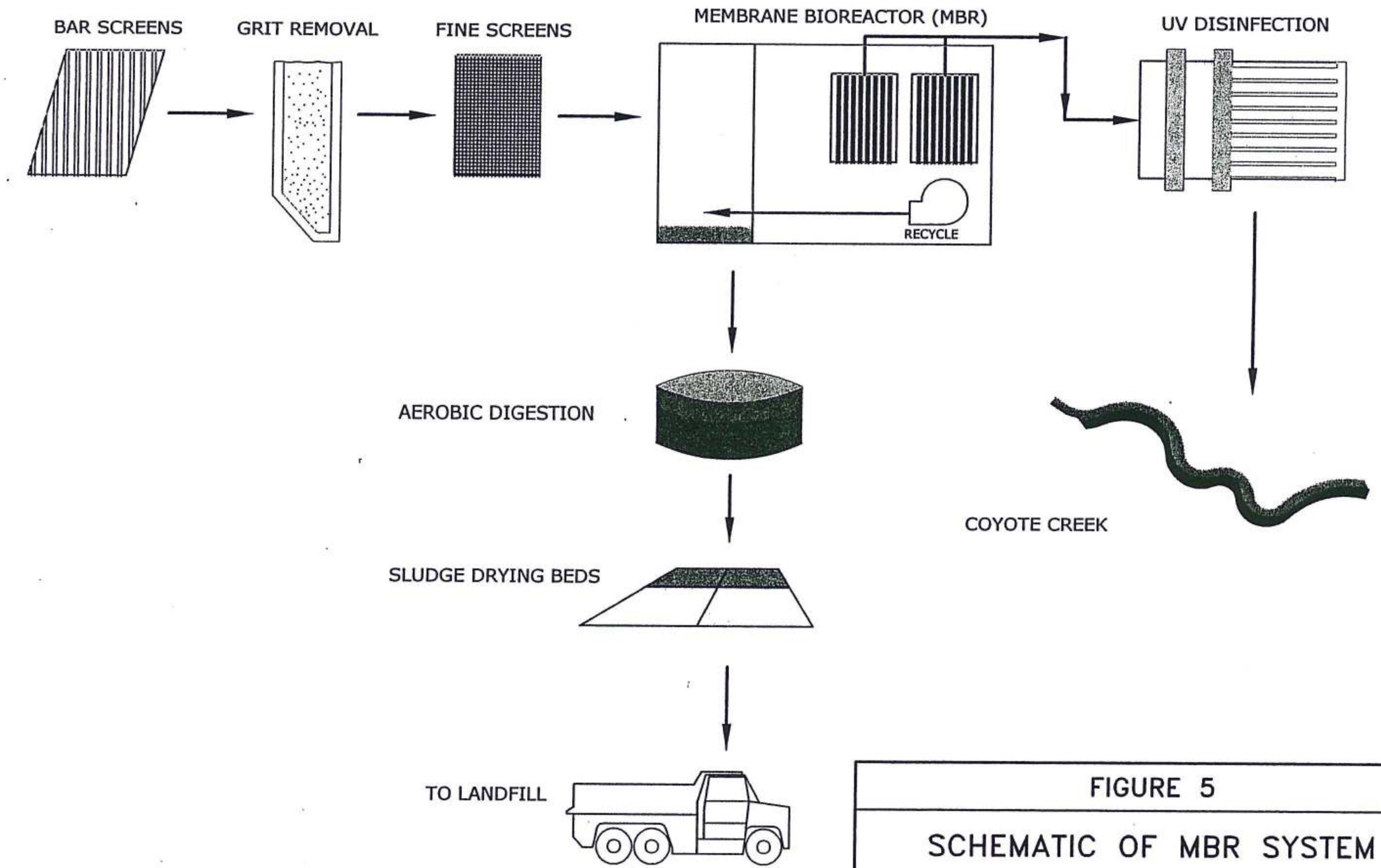


FIGURE 5

SCHEMATIC OF MBR SYSTEM

CALAVERAS COUNTY WATER DISTRICT

NOLTE

BEYOND ENGINEERING

N:\X\CADD\BIOREACTOR123004.DWG KCH/ER 10/27/2004, rev.12/30/04

TABLE 17
PROBABLE CONSTRUCTION COSTS FOR ALTERNATIVE MBR TREATMENT SYSTEM

Improvement\Scenario	Probable Construction Costs, $		
	Scenario 1	Scenario 2	Scenario 3
Bar Screens, Grit Removal, Fine Screens	$177,000	$208,000	$234,000
Control / MBR Process Building	$170,000	$200,000	$225,000
MBR Process Equipment and Basin	$384,000	$451,000	$507,000
Process Pumping (Internal Recycle & WAS Pumping)	$37,000	$43,000	$48,000
UV Disinfection	$123,000	$144,000	$162,000
Effluent Pump Station (tertiary effluent)	$129,000	$151,000	$170,000
Creek Outfall Structure	$57,000	$67,000	$75,000
Aerobic Digestion and Waste Sludge Pumping	$62,000	$73,000	$82,000
Demolition of Existing Facilities	$68,000	$80,000	$90,000
Subtotal	$1,207,000	$1,417,000	$1,593,000
Site Civil (grading, paving, etc.), 10%	$121,000	$142,000	$160,000
Yard Piping, 10%	$121,000	$142,000	$160,000
Electrical and Instrumentation, 20%	$242,000	$284,000	$319,000
Total	$1,691,000	$1,985,000	$2,232,000

7. EFFLUENT STORAGE AND DISPOSAL

This section provides an assessment of effluent storage and disposal requirements assuming continued land application. Proposed improvements for the three growth scenarios are then described. As an alternative, the impact of a surface water discharge on effluent storage requirements is also discussed.

A. Assessment

Wastewater storage at the Vallecito/Douglas Flat WWTP is provided in two ponds, each with a surface area of about 2.65 acres for a combined water surface area of 5.3 acres. Pond 1 has a maximum water depth of about 6.5 ft, with a freeboard of two feet. Pond 2 has a maximum water depth of about 10 ft, with a freeboard of two feet. The ponds are connected, so they share a common water level when there is water in both ponds. Because Pond 2 is deeper, water from Pond 1 drains to Pond 2 during periods when the stored volume is low. Using vertical sidewall simplification, the effective storage volumes for Pond 1 and Pond 2 are 5.6 Mgal and 7.3 Mgal, respectively (it is assumed that the pump inlet is located 1.5 ft above the bottom of Pond 2, giving the pond a maximum effective depth of 8.5 feet).

Pumped effluent is discharged to a dedicated land application area located adjacent to the Vallecito/Douglas Flat WWTP, where it is applied by sprinkler irrigation. Stored effluent is pumped from Pond 2 to the sprayfield area for disposal. Because the pump inlet is located above the pond bottom, it is not possible to pump Pond 2 completely dry.

To determine the storage volume and irrigation area needed to store and dispose of projected wastewater flows from the Vallecito/Douglas Flat WWTP, irrigation water balances were prepared for the three growth scenarios described above (both 100-year and normal-year precipitation conditions). In the water balances (Tables C-1 through C-8 in Appendix C), historical values for precipitation and evapotranspiration are used to estimate the crop water need, and the irrigated area is determined based on the annual volume of water available. Because water must be stored during the winter months when there is no water demand, the required effluent storage volume is also calculated.

Monthly precipitation data for the Sonora weather station (located 10 miles from the Vallecito/Douglas Flat WWTP), and 100-year precipitation values for Angels Camp provided by the California Department of Water Resources (DWR) are used in the water balance. Evapotranspiration (ET) data are for San Andreas, located 15 miles from the Vallecito/Douglas Flat WWTP. As seen in the water balances, annual 100-year precipitation is 56.68 inches, while annual normal-year precipitation is 31.55 inches. The measured ET value is 48.7 inches. To account for possible local reductions in evaporation, an ET reduction factor of 45 percent is used, resulting in a maximum applied depth of 38.0 in/yr.

In each water balance, average monthly flows for the scenario considered are added, along with precipitation, to the volume in the storage pond from the preceding month (the storage pond is assumed to be empty at the end of September, so the balance begins in October).

Outputs from the storage pond are based on the monthly evaporation rate from the pond and on the irrigation volume applied to the disposal area.

The applied wastewater depth is a function of allowable percolation and Net ET (the difference between ET and precipitation). For 100-year conditions, when more wastewater must be disposed, the annual applied depth is 38.0 inches. For normal-year conditions, the annual applied depth is 29.4 inches. For both 100-year and normal-year conditions, no wastewater would be applied from November through March.

The application area is sized so that the storage pond is empty by the end of September. The storage pond is sized so that the maximum water depth does not exceed 10 feet. The maximum water depth value of 10 feet was used because Pond 2 currently has a maximum depth of 10 feet. If site conditions (e.g., depth to bedrock, groundwater, etc.) are favorable and increased storage depths are feasible, then the pond area requirement will be decreased. However, pond depth should be kept low enough to ensure that the pond will be exempt from jurisdiction of the California Department of Water Resources (DWR) Division of Safety of Dams (typically 15 feet for wastewater ponds). It should be noted that no percolation from the ponds is assumed in the water balance. The existing ponds have never been deep-ripped, so it is believed that pond percolation rates are decreasing due to the deposition of fine particles. It is expected that the Regional Board will require a pond liner as part of future improvements to the ponds.

A summary of the water balance results for scenarios 1, 2, and 3 is provided in Table 18 (The storage volume and disposal area required for current flow conditions are also provided.). As seen in Table 18, the required pond surface areas for Scenarios 1, 2, and 3 are 8.5 acres, 10.7 acres, and 12.7 acres, respectively. The area owned by CCWD at the Vallecito/Douglas Flat WWTP consists of the following parcels (see Figure 2):

APN	Area, ac	Land Use
066-040-001	4.33	WWTP and buffer
066-040-002	1.55	WWTP and buffer
066-024-007	15.00	Wastewater ponds and buffer
066-024-049	5.00	Buffer
066-022-086	61.49	Effluent disposal area and buffer

Currently, the combined pond surface area is 5.3 acres. It can be seen that the area of the parcel where the ponds are currently located is 15 acres (see Figure 2). As seen in Table 18, the total pond area requirements (including berms, access roads, and fencing) for Scenarios 1, 2, and 3 are 21.4 acres, 25.8 acres, and 29.8 acres, respectively.

TABLE 18
SUMMARY OF RESULTS FROM WATER BALANCES
(FOR SPRAY FIELD DISPOSAL OF EFFLUENT)

Design feature	Existing	Current Flow	Scenario 1	Scenario 2	Scenario 3
Pond surface area, ac	5.3	6.5	8.5	10.7	12.7
Total pond area[a], ac	15.0	17.3	21.4	25.8	29.8
Pond depth[b], ft	7.5	10.0	10.0	10.0	10.0
Pond volume[c], Mgal	13.0	21.0	27.8	34.9	41.3
Effective irrigation area[d], ac	26.0	29.4	38.8	48.8	57.8
Required irrigation area (typical)[e], ac	61.5	69.5	91.7	115.5	136.6
Required irrigation area (ideal)[f], ac	-	35.3	46.5	58.6	69.3
Estimated berm length[g], ft	-	9,900	11,400	12,800	13,900

[a] Total pond area equals the pond surface area x 2, plus 4.4 acres.
[b] Pond depth for existing conditions equals average of depths for Douglas Flat pond (6.5 ft) and effective depth of Vallecito pond (8.5 ft).
[c] Pond volume equals surface area times depth (vertical sidewall simplification).
[d] Effective irrigation area for existing conditions based on value provided in wastewater permit. Effective irrigation area for scenarios based on required area from water balances.
[e] Required irrigation area (typical soil conditions) for existing plant based on area parcel map. Required irrigation area (typical soil conditions) for growth scenarios based on existing ratio of irrigable land.
[f] Required irrigation area (ideal soil conditions) for scenarios equals effective irrigation area x 1.2.
[g] Estimated berm length equals perimeter for square area, doubled for irregular perimeter (based on ideal soil conditions).

As indicated in Table 18, the disposal area land requirements for Scenarios 1, 2, and 3 are 46.5 acres, 58.6 acres, and 69.3 acres, respectively (the specified areas include a 20 percent increase to account for berms, roads, setbacks, and fencing). It is expected that small berms will be used where necessary to control minor runoff due to wastewater application; however, the berms are not intended to prevent rainfall runoff from draining offsite. According to the wastewater permit for the existing facility, the current irrigated area is 26 acres. However, as noted above, the dedicated parcel used for effluent disposal has an area of 61.5 acres. Much of the terrain is steep, however, limiting potential significant expansion. Therefore, it is recommended that additional land be obtained for continued land application of wastewater under Scenarios 1, 2, and 3. Irrigation area requirements for soil conditions typical of the existing site (adverse slopes, appreciable rock outcrops) are provided, in addition to the irrigation area requirements for ideal soil conditions. If additional land is required, consideration should be given to offsite disposal sites such as the Kautz Winery (discussed below).

The spray field and storage pond capacity requirements are further illustrated by the water balances shown in Table 19 and, again, are based on the assumption that effluent disposal is achieved entirely by irrigation of new and existing spray fields.

TABLE 19
SPRAY FIELD AND STORAGE POND CAPACITY REQUIREMENTS (ASSUMING SPRAY FIELD DISPOSAL OF EFFLUENT) [a]

Result		Existing condition		Scenario 1		Scenario 2		Scenario 3	
		N-year	100-year	N-year	100-year	N-year	100-year	N-year	100-year
Annual effluent total, Mgal/yr	Water in	21.8	24.3	28.8	32.0	36.2	40.3	42.9	47.7
Pond precipitation, Mgal/yr		5.5	9.9	7.3	13.1	9.2	16.5	10.9	19.5
Pond evaporation, Mgal/yr	Water out	-3.9	-3.9	-5.1	-5.1	-6.4	-6.4	-7.6	-7.6
Land applied effluent, Mgal/yr		-23.5	-30.3	-30.9	-40.0	-39.0	-50.4	-46.1	-59.6
Net water balance, Mgal/yr	Sum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total spray field requirement, Mgal/yr	Spray fields	23.5	30.3	30.9	40.0	39.0	50.4	46.1	
Existing spray field capacity, Mgal/yr		26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8
Spray field deficiency, Mgal/yr		0.0	3.5	4.1	13.2	12.1	23.5	19.3	32.8
Total storage requirement, Mgal/yr	Storage ponds	14.8	21.0	19.5	27.8	24.6	34.9	29.0	41.3
Existing pond storage, Mgal/yr		13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0
Pond storage deficiency, Mgal/yr		1.8	8.0	6.5	14.8	11.6	21.9	16.0	28.3

[a] Results indicate annual volume of water (influent, effluent, applied, stored) for each scenario.

As indicated below, the applied wastewater depth for normal-year precipitation conditions is 29.4 inches/yr, with no application from November through March. During 100-year precipitation conditions, the annual applied depth would be 38.0 inches (again, no water would be applied from November to March). Using assumed effluent concentrations for BOD and TN of 10 mg/L and 30 mg/L, respectively, organic and nutrient loading rates for the design application rate are projected. As seen in Table 20, BOD loading would be less than 1 pound/ac·d, and TN loading would be under 200 lb/ac·yr. The design BOD loading rate is well below accepted organic loading rates, and should result in conditions that will not create odors. The TN loading rate is on the order of nitrogen uptake for grasses.

TABLE 20
ESTIMATED LOADING FOR LAND APPLICATION AREA[a]

Month	Days	Applied WW, in	BOD load, lb/ac	BOD load, lb/ac·d	TN load, lb/ac
Jan	31	0.0	0.0	0.0	0.0
Feb	28	0.0	0.0	0.0	0.0
Mar	31	0.0	0.0	0.0	0.0
Apr	30	1.7	3.8	0.1	11.3
May	31	4.4	10.0	0.3	30.1
Jun	30	5.5	12.5	0.4	37.4
Jul	31	6.0	13.6	0.4	40.8
Aug	31	5.5	12.4	0.4	37.3
Sep	30	4.2	9.5	0.3	28.6
Oct	31	2.1	4.7	0.2	14.2
Nov	30	0.0	0.0	0.0	0.0
Dec	31	0.0	0.0	0.0	0.0
Total	365	29.4	66.6	2.2	199.8

Estimated effluent BOD, mg/L: 10
Estimated effluent TN, mg/L: 30
[a] Loading for normal-year conditions.

B. Proposed Storage and Disposal Improvements (Assuming Spray Field Disposal of Effluent)

For continued land application of wastewater, additional disposal area would be required for all three growth scenarios. Probable construction costs for the expanded land application area are provided in Table 21. Land acquisition costs are assumed to be $10,000/ac. Based on estimated values for the existing irrigation system (see Appendix D), the irrigation system installation cost would be $17,000/acre. As indicated above, it is assumed that small one-foot berms would be constructed around the downhill perimeter of the disposal area to assist with the control of runoff. Applied water would not be allowed to pond behind the berms (i.e., if the operator observes that applied water is ponding behind the berms, the application rate would be reduced). To prevent public exposure and possible intrusion of grazing cattle, fencing would also be required for a new site.

Based on the costs for irrigation system expansion, berms, and costs associated with expansion of pumping, the probable construction costs for expanding the land application system for Scenarios 1, 2, and 3 are $880,000, $1,283,000, and $1,643,000, respectively.

TABLE 21
PROBABLE CONSTRUCTION COSTS FOR SPRAY FIELD IMPROVEMENTS

	Probable Construction Costs, $		
Improvement	Scenario 1	Scenario 2	Scenario 3
Increase in land disposal area[a], ac	15.3	27.4	38.1
Land acquisition	$153,000	$274,000	$381,000
Irrigation system cost	$260,000	$466,000	$648,000
Berm excavation cost[b]	$103,000	$115,000	$125,000
Fencing cost	$114,000	$128,000	$139,000
Pump station and transmission line	$250,000	$300,000	$350,000
Total Cost	$880,000	$1,283,000	$1,643,000

Land costs, $/ac:	$10,000
Irrigation system cost, $/ac:	$17,000
Berm excavation cost, $/yd^3:	$3
Fencing cost, $/ft:	$10

[a] Area increase equals 1.2 x (effective irrigation area minus existing 26.0 acres).

[b] Berms assumed to be one foot high by one foot wide, with 2:1 side slopes, resulting in an excavated volume of 3 ft^2/ft.

As an alternative to off-site spray fields, irrigation with recycled water can be considered. In 1999, a study was conducted to evaluate the feasibility of applying treated effluent to the Kautz Winery, located less than two miles from the Vallecito/Douglas Flat WWTP in a northwesterly direction (a ridge separates the two sites). A copy of the evaluation is provided in Appendix E. The Kautz Winery occupies roughly 1,100 acres, and includes vineyards, apple and Christmas tree orchards, cattle pasture, and irrigation and stock ponds. As indicated in the study, implementation of this option would require installation of 9000 ft of 4-inch PVC pipe, including boring and jacking for crossing SR-4. Flow would be discharged to an existing irrigation pond at the winery. The estimated cost for constructing the force main, as detailed in the study, was $250,000. Based on ENR values, the current cost would be approximately $300,000 (7312/6039 x $250,000 = $303,000).

According to Title 22, disinfected secondary-2.2 MPN recycled water is required for irrigation of food crops "where the edible portion is produced above ground and not contacted by recycled water." However, disinfected secondary-23 MPN recycled water and even undisinfected secondary recycled water are allowed for irrigation of vineyards and orchards "with no contact between edible portion and recycled water." If applied wastewater does not contact edible portions of the crop, then current disinfection limits would probably apply for irrigation at the Kautz Winery. However, if contact is likely, then additional treatment (i.e., filtration and disinfection to meet a 2.2 MPN level, as indicated for unrestricted reuse) would be necessary. For planning purposes, it is assumed that effluent discharged to Kautz would be required to meet Title 22 requirements for unrestricted reuse.

Storage pond improvements are needed immediately and of the highest priority. Construction costs for storage improvements are provided in Table 22. Based on the estimated existing and required future pond volumes for Scenarios 1, 2, and 3, costs are provided for expanding the storage ponds. A land cost of \$10,000/ac is assumed, and an earthwork cost of \$5/yd^3 excavated is assumed. It is also assumed that the Regional Board will require that a synthetic liner be installed as part of the pond expansion project. When the liner cost is added (assumed \$1 per square foot), the pond expansion costs for Scenarios 1, 2, and 3 are \$869,000; \$1,218,000; and \$1,508,000, respectively.

TABLE 22
PROBABLE CONSTRUCTION COSTS FOR STORAGE IMPROVEMENTS

	Probable Construction Costs, \$		
Improvement	Scenario 1	Scenario 2	Scenario 3
Design Assumptions:			
Additional land required, ac	6.4	10.8	14.8
Increase in pond volume[a], yd^3	73,000	110,000	140,000
Pond liner area[b], ft^2	444,000	564,000	660,000
Land acquisition cost	\$64,000	\$108,000	\$148,000
Cost to increase pond volume	\$365,000	\$550,000	\$700,000
Cost of pond liner	\$440,000	\$560,000	\$660,000
Total of costs	\$869,000	\$1,218,000	\$1,508,000

[a] Increase in pond volume equals required volume minus existing pond volume.
[b] Pond liner area = pond surface area times 1.2.

C. Storage and Disposal Improvements (Assuming Seasonal NPDES Stream Discharge of Effluent)

For purposes of making a fair comparison of disposal alternatives, water balances were prepared to evaluate the impact of discharging tertiary-treated effluent to Coyote Creek during the rainy season. The water balances are presented as Tables C-9 through C-14 in Appendix C, and a summary of the results is presented as Table 23. It is assumed that discharge to Coyote Creek would occur only from November to March, and that effluent would still be land-applied to the spray fields during the remaining months. The impact on spray field and storage pond capacity requirements are further illustrated by the water balances shown in Table 24.

TABLE 23
SUMMARY OF RESULTS FROM WATER BALANCES
(CONTINUED LAND APPLICATION WITH SEASONAL NPDES DISCHARGE)

Design Requirement	Scenario 1	Scenario 2	Scenario 3
Required effective irrigation area[a], ac	20.3	24.3	27.9
Required total irrigation area (typical)[b], ac	48.0	57.5	65.9
Maximum pond storage, Mgal	9.7	10.6	11.4
Maximum pond depth[c], ft	5.6	6.1	6.6

[a] Required effective irrigation area based on water balances.

[b] Required irrigation area (typical soil conditions) based on existing ratio of irrigable land.

[c] Maximum pond depth for water balance based on existing pond dimensions.

As seen in Table 23, the area required for spray irrigation for Scenarios 1 and 2 is less than the area currently used (26.0 acres out of a total parcel area of 61.5 acres). Furthermore, the existing spray fields may be expanded slightly to meet the needs of Scenario 3. The required pond storage for all three growth scenarios is also less than the existing storage volume available (13.0 Mgal). Consequently, it can be seen that the existing storage and spray fields are adequate for all three scenarios, given that a winter NPDES discharge to Coyote Creek is possible. However, it is assumed that a pond liner would be required as a minimum improvement.

TABLE 24
SPRAY FIELD AND STORAGE POND CAPACITY REQUIREMENTS (LAND APPLICATION WITH SEASONAL NPDES DISCHARGE)[a]

Result		Scenario 1		Scenario 2		Scenario 3	
		N-Year	100-Year	N-Year	100-Year	N-Year	100-Year
Annual effluent total, Mgal/yr	Water in	28.8	32.0	36.2	40.3	42.9	47.7
Pond precipitation, Mgal/yr		4.5	8.2	4.5	8.2	4.5	8.2
Pond evaporation, Mgal/yr	Water out	-3.2	-3.2	-3.2	-3.2	-3.2	-3.2
Creek discharge effluent, Mgal/yr		-13.5	-16.0	-17.0	-20.2	-20.1	-23.9
Land applied effluent, Mgal/yr		-16.7	-20.9	-20.6	-25.1	-24.2	-28.8
Net water balance, Mgal/yr	Sum	0.0	0.0	0.0	0.0	0.0	0.0
Total spray field requirement, Mgal/yr	Spray fields	16.7	20.9	20.6	25.1	24.2	28.8
Existing spray field capacity, Mgal/yr		26.8	26.8	26.8	26.8	26.8	26.8
Spray field deficiency, Mgal/yr		0.0	0.0	0.0	0.0	0.0	1.9
Total pond storage requirement, Mgal/yr	Storage ponds	5.8	9.7	6.4	10.6	6.9	11.4
Existing pond storage capacity, Mgal/yr		13.0	13.0	13.0	13.0	13.0	13.0
Pond storage deficiency, Mgal/yr		0.0	0.0	0.0	0.0	0.0	0.0

[a] Results indicate annual volume of water (influent, effluent, applied, stored) for each scenario.

8. SOLIDS AND RESIDUALS

Current solids handling practices at the plant involve transferring waste activated sludge (WAS) to a 15,000 gallon aerated sludge holding tank. Solids are thickened in the tank while supernatant is decanted back to the aeration basins. From the solids holding tank, thickened solids are transferred to sludge drying beds. There is a total of 3,600 ft^2 of area divided equally into two drying beds.

The existing drying beds were built from a retired effluent storage pond. It is believed that the drying beds were generously sized because of the space available in the pond. Under current conditions the drying beds have sufficient capacity to process solids generated at this facility plus solids from nearby facilities. In the future, whether treatment is handled conventionally through extended aeration or through an MBR process, for the three growth scenarios sufficient drying bed capacity exists and no significant improvements are needed.

9. COMPARISON OF ALTERNATIVES

A summary of alternative wastewater management strategies is provided in Table 25. The strategies are divided into two categories by growth scenario: land application (L-1, L-2, and L-3), and land application with creek discharge (L/C-1, L/C-2 and L/C-3). A further distinction is made to indicate the Kautz offsite land options (L-1K, L-2K, and L-3K). For each strategy, key characteristics for treatment, storage, and disposal are provided.

A comparison of capital improvement costs associated with each of the alternative strategies is provided in Table 26. Soft costs, such as costs for administration and contingency, are not included. As indicated in Table 26, capital costs for the land/creek disposal option are comparable to costs for land disposal. However, O&M costs (discussed below) are expected to be much greater for the creek disposal option due to higher required effluent quality. In addition, costs for regulatory compliance would also be greater.

TABLE 25
SUMMARY OF ALTERNATIVE WASTEWATER MANAGEMENT STRATEGIES

		Strategies for Land Application		
Strategy	Scenario	Treatment	Storage	Disposal
L-1	1	Secondary treatment with disinfection to reach 23 MPN	Increase volume from 13.0 Mgal to 27.8 Mgal	Existing + offsite (15.3 added acres needed)
L-2	2	Secondary treatment with disinfection to reach 23 MPN	Increase volume from 13.0 Mgal to 34.9 Mgal	Existing + offsite (27.4 added acres needed)
L-3	3	Secondary treatment with disinfection to reach 23 MPN	Increase volume from 13.0 Mgal to 41.3 Mgal	Existing + offsite (38.1 added acres needed)
L-1K	1	Tertiary treatment with disinfection to reach 2.2 MPN	Increase volume from 13.0 Mgal to 27.8 Mgal	Existing + Kautz (15.3 added acres needed)
L-2K	2	Tertiary treatment with disinfection to reach 2.2 MPN	Increase volume from 13.0 Mgal to 34.9 Mgal	Existing + Kautz (27.4 added acres needed)
L-3K	3	Tertiary treatment with disinfection to reach 2.2 MPN	Increase volume from 13.0 Mgal to 41.3 Mgal	Existing + Kautz (38.1 added acres needed)
		Strategies for Land Application and Creek Discharge		
Strategy	Scenario	Treatment	Storage	Disposal
L/C-1	1	Tertiary treatment with disinfection to reach 2.2 MPN	Line existing ponds	Existing area during summer; Coyote Creek during winter
L/C-2	2	Tertiary treatment with disinfection to reach 2.2 MPN	Line existing ponds	Existing area during summer; Coyote Creek during winter
L/C-3	3	Tertiary treatment with disinfection to reach 2.2 MPN	Line existing ponds	Existing area during summer; Coyote Creek during winter

TABLE 26
COMPARISON OF CAPITAL COSTS TO IMPLEMENT ALTERNATIVE WASTEWATER MANAGEMENT STRATEGIES

Strategy	Collection	Treatment	Storage	Disposal	Total
L-1	$245,000	$780,000	$869,000	$880,000	$2,774,000
L-2	$550,000	$1,110,000	$1,218,000	$1,283,000	$4,161,000
L-3	$550,000[a]	$1,295,000	$1,508,000	$1,643,000	$4,996,000
L-1K	$245,000	$1,691,000[b]	$869,000	$300,000[c]	$3,105,000
L-2K	$550,000	$1,985,000[b]	$1,218,000	$300,000[c]	$4,053,000
L-3K	$550,000[a]	$2,232,000[b]	$1,508,000	$300,000[c]	$4,590,000
L/C-1	$245,000	$1,691,000[b]	$277,000[d]	$200,000[e]	$2,413,000
L/C-2	$550,000	$1,985,000[b]	$277,000[d]	$200,000[e]	$3,012,000
L/C-3	$550,000[a]	$2,232,000[b]	$277,000[d]	$200,000[e]	$3,259,000

[a] For Scenario 3, it is assumed that costs for improvements associated with the new collection system will be the responsibility of the developer.

[b] Treatment costs associated with MBR treatment process.

[c] Costs for Kautz land disposal option include force main, but do not include costs for land acquisition, berms, or fencing.

[d] For land/creek options the existing storage ponds would be lined (liner cost assumed to be $1/ft^2$).

[e] For land/creek options the disposal fee represents costs associated with obtaining a NPDES permit.

The comparative life cycle costs for operation and maintenance and for annualized capital costs are presented in Table 27 by disposal strategy. The annualized capital costs are based on the costs presented in Table 26. Additional detail for operation and maintenance costs can be found in Appendix F.

TABLE 27
COMPARISON OF TOTAL ANNUALIZED COSTS FOR ALTERNATIVE WASTEWATER MANAGEMENT STRATEGIES

Strategy	Capital Costs[a]	O&M Costs	Total
L-1	$222,000	$228,000	$450,000
L-2	$334,000	$284,600	$618,600
L-3	$401,000	$334,700	$735,700
L-1K	$249,000	$353,900	$602,900
L-2K	$325,000	$443,100	$768,100
L-3K	$368,000	$522,300	$890,300
L/C-1	$194,000	$427,600	$621,600
L/C-2	$242,000	$530,000	$772,000
L/C-3	$261,000	$623,100	$884,100

[a] Annualized capital costs determined using an interest rate of 5 percent and a 20-year life cycle.

When both O&M costs and annualized capital costs are considered, it becomes apparent that land disposal of wastewater is the least expensive option. For Scenario 1, the annual cost for land disposal of wastewater is $0.45 million, whereas the cost for the land/creek disposal option is $0.62 million, an increase of 38 percent. For growth Scenarios 2 and 3, the cost increase from land to land/creek is less (25 percent and 20 percent, respectively). If wastewater is discharged to the Kautz property, costs associated with improved quality of treatment (i.e., MBR treatment to meet tertiary standards) are realized, along with costs for increased storage during periods of non-irrigation. For Scenario 3, the Kautz option is the most expensive option.

10. CONCLUSIONS

The recommended scenario for wastewater collection, treatment, and disposal improvements is Scenario 1 (includes estimated build-out service connections for Vallecito and Douglas Flat). In this section, recommendations for the WWTP regarding method of effluent disposal and capital improvement projects are presented. A summary of capital costs is provided, and a schedule for phasing of capital improvements is proposed.

A. Recommended Method of Effluent Disposal

Based on total O&M costs and annualized capital costs, land disposal of treated effluent is the least expensive disposal alternative and avoids costs associated with upgrading the wastewater treatment plant for tertiary treatment and an NPDES discharge. The land disposal alternative avoids other problems such as increased exposure to third-party lawsuits associated with discharging to surface waters and mandatory fines for NPDES permit violations. By remaining in the Regional Board land disposal program, delays associated with Regional Board NPDES staff limitations and possible public opposition may be avoided.

B. Recommended Capital Improvement Projects

The required capital improvements will depend on selecting a growth scenario and a method of disposal, and several other considerations such as restrictions on grant funds, the availability of acreage for expanding the spray fields, the costs/benefits of combining Six-Mile Village with the other service areas, and local agencies – and perhaps LAFCO – resolving how sewer service is to be provided in the region. Scenario 1 with continued spray field disposal (L-1) is the recommended alternative. Scenario 1 allows for the buildout of the existing Vallecito and Douglas Flat service areas, but does not otherwise provide for any expansion or combining of these systems. Scenario 2 is not recommended at this time, and it is recommended that the Six-Mile Village area remain separate from the Vallecito and Douglas Flat service areas. There is no cost benefit to combining the Six-Mile Village service area with the Vallecito and Douglas Flat. To reconfigure the Six-Mile Village sewer system, the District would have to add capacity for treatment, storage and disposal, and also construct a new force main and upgrade the Six-Mile Village pump station. Scenario 3 – which does anticipate new development occurring – would only be considered if necessary expansion funds are identified and secured. The availability and acquisition of land for development of new storage ponds and new spray fields is a common and key consideration for all three scenarios.

For the collection system, the following capital improvements are recommended:

1. Add emergency storage at the Six-Mile Village pump station to mitigate wet well overflows.
2. Install flushing stations, clean outs and isolation valves to improve ability to flush and clear small diameter sewer lines at Six-Mile Village.
3. Replace and seal septic tank lids to reduce I&I at Six-Mile Village.

4. Provide flow equalization at the Vallecito pump station to buffer peak wet weather flows being conveyed to the WWTP.
5. Add a flow meter at the Vallecito pump station.
6. Replace and seal septic tank lids to reduce I&I at Vallecito.

For the treatment system, the following capital improvements are recommended:

1. Replace existing Douglas Flat aeration basin and clarifier (size depends on scenario)
2. Add odor control at headworks.
3. Fix existing headworks operational problems (for Scenario 1).
4. Replace and enlarge the headworks (for Scenario 2 and 3 only).

For the storage and disposal system, the following capital improvements are recommended:

1. Acquire additional land for new spray fields.
2. Install irrigation system.
3. Install berms and fencing.
4. Make improvements to irrigation pump station and transmission line.
5. Acquire additional land for new storage ponds.
6. Complete excavation/earthwork for additional storage ponds..
7. Install pond liners.

Implementation of the recommended improvements will provide long-term effluent quality. Adverse nuisance conditions will be avoided, wastewater permit requirements will be reliably met, and natural resources will be protected.

C. Summary of Costs for Capital Improvements

A summary of costs for the necessary capital improvements for the three alternative growth scenarios is provided in Table 28. The total capital improvement costs for Scenarios 1, 2, and 3 are approximately $3.3 million, $5.0 million, and $6.0 million, respectively. Again, Scenario 1 with land disposal (L-1) is the recommended alternative.

Capital costs will be allocated between new and existing consumers. Existing customers will pay capital costs for making improvements due to replacement, regulatory compliance and correcting existing system deficiencies. New customers will pay capital costs associated with expansion facilities – such as new spray fields and storage ponds and enlarging treatment and pump station capacities – to the extent that these facilities are not attributable to replacement, regulatory compliance, or correcting other deficiencies of the existing system. For Scenarios 2 and 3, it is assumed that capital costs for incorporating Six-Mile Village into the combined service area is a shared cost by all existing consumers, which may not be entirely equitable, unless part of these costs are grant funded. The allocation of capital costs between new and existing customers is presented in Table 29.

TABLE 28
SUMMARY OF COSTS FOR ALTERNATIVE CAPITAL IMPROVEMENTS, INCLUDING RECOMMENDED SCENARIO

	Estimated Capital Cost ($)		
Improvement\Scenario	Scenario 1 [a]	Scenario 2	Scenario 3
COLLECTION			
Six-Mile Village Force Main[a]	---	$265,000	$265,000
Six-Mile Village Emergency Storage	$50,000	$50,000	$50,000
Six-Mile Village Perm. Chemical Injection	---	$40,000	$40,000
Six-Mile Village Flushing System	$35,000	$35,000	$35,000
Six-Mile Village Septic Tank Lids	$15,000	$15,000	$15,000
Vallecito Flow Equalization	$100,000	$100,000	$100,000
Vallecito Flow Meter	$5,000	$5,000	$5,000
Vallecito Septic Tank Lids	$40,000	$40,000	$40,000
Outside Development	---	---	(Developer)
Subtotal for Collection	$245,000	$550,000	$550,000
TREATMENT			
Replace Aeration Basin/Clarifier	$630,000	$900,000	$1,070,000
Biofilter Odor Control	$80,000	$90,000	$90,000
Flow Equalization	$70,000	---	---
Enlarge Headworks	---	$120,000	$135,000
Subtotal for Treatment	$780,000	$1,110,000	$1,295,000
STORAGE & DISPOSAL			
Spray Field Land Acquisition	$153,000	$274,000	$381,000
Irrigation System Cost	$260,000	$466,000	$648,000
Berm Excavation Cost	$103,000	$115,000	$125,000
Fencing Costs	$114,000	$128,000	$139,000
Irrigation Pump Station and Transmission Line	$250,000	$300,000	$350,000
Storage Pond Land Acquisition	$64,000	$108,000	$148,000
Excavation/Earthwork for Ponds	$365,000	$550,000	$700,000
Cost to Install Pond Liner	$440,000	$560,000	$660,000
Subtotal for Sprayfields and Ponds	$1,749,000	$2,501,000	$3,151,000
Subtotals of Collection, Treatment, and Storage & Disposal	$2,774,000	$4,161,000	$4,996,000
Overhead/Contingency (20%)	$555,000	$832,000	$999,000
TOTAL	$3,329,000	$4,993,000	$5,995,000

[a] Recommended Scenario

TABLE 29
DIVISION OF COSTS FOR CAPITAL IMPROVEMENTS

Capital Improvement	Scenario 1[b] Existing	Scenario 1[b] New	Scenario 2 Existing	Scenario 2 New	Scenario 3 Existing	Scenario 3 New
	Allocation of Capital Costs[a]					
Collection	75%	25%	75%	25%	75%	25%
Treatment	75%	25%	75%	25%	60%	40%
Storage & Disposal	50%	50%	50%	50%	40%	60%
	Breakdown of Capital Costs					
Collection	$131,000	$44,000	$495,000	$165,000	$495,000	$165,000
Treatment	$702,000	$234,000	$999,000	$333,000	$932,000	$622,000
Storage & Disposal	$1,049,000	$1,049,000	$1,501,000	$1,501,000	$1,512,000	$2,269,000
Total	$1,882,000	$1,327,000	$2,995,000	$1,999,000	$2,939,000	$3,056,000
Units	263	84	331	106	331	186
Cost, $/unit	$7,156	$15,798	$9,048	$18,858	$8,879	$16,430

[a] Costs include overhead contingency of 20 percent.

[b] Collection costs for Scenario 1 do not include improvements for Six-Mile Village collection system.

D. Phasing of Capital Improvements

A summary of the recommended capital improvements is provided in Table 30. The first and second phasing priorities are construction of new storage ponds and new spray fields, respectively. The third phasing priority is to replace the existing Douglas Flat packaged aeration basin and clarifier, which is 30+ years old unit and due for normal replacement. Also, replacing the unit will provide an opportunity to re-design it and correct aeration and clarification deficiencies. Finally, improvements for the lift stations and collection system will maximize equalization of peak flows and minimize infiltration and inflow.

TABLE 30
RECOMMENDED PHASING OF CAPITAL IMPROVEMENTS (SCENARIO 1)

Phasing Priority	Improvements	Timeline	Capital Cost [a]
1.	**New Storage Ponds** A. Acquire additional land B. Complete earthwork for storage ponds C. Install pond liners	**< 1 years**	**$1,043,000**
2.	**New Spray Fields** A. Acquire additional land B. Install irrigation system, i.e. distribution lines and spray nozzles C. Construct spray field berms and perimeter fencing D. Upgrade irrigation pump station and transmission line	**< 3 years**	**$1,056,000**
3.	**Treatment Plant Upgrades** A. Replace Douglas Flat aeration basin and clarifier B. Headworks "Biofilter" odor control C. Add Douglas Flat flow equalization just upstream of existing headworks	**< 3 years**	**$936,000**
4.	**Lift Station Improvements** A. Add emergency storage at the Six-Mile Village pump station to mitigate wet well overflows. B. Add flow equalization at the Vallecito pump station to buffer peak wet weather flows being conveyed to the WWTP. C. Add a flow meter at the Vallecito pump station.	**< 5 years**	**$186,000**
5.	**Collection System Improvements** A. Continue regular replacement and sealing of any observed damaged or leaking septic tank lids to further reduce I&I into Six-Mile Village and Vallecito collection systems. B. Install flushing stations, clean outs and isolation valves to improve ability to flush and clear small diameter sewer lines.	**< 10 years**	**$108,000**

[a] Capital costs include a 20% contingency.

REFERENCES

[1] Nolte Associates, *Technical Memorandum 1, Summary of Projected Wastewater Flows, Land Application Requirements, and Regulatory Constraints for Vallecito/Douglas Flat Wastewater Treatment Plant,* August 2004.

[2] Calaveras County Water District, *Vallecito Regional Wastewater System Phase II,* February 2001

[3] Metcalf and Eddy, *Wastewater Engineering: Treatment and Reuse,* Fourth Edition, 2003.

[4] Nolte Associates, *Technical Memorandum 2, Collection System and Treatment System Limitations for the Communities of Vallecito, Douglas Flat, and Six-Mile Village,* September 2004.

APPENDIX A

CORRESPONDENCE DESCRIBING PROPOSED DEVELOPMENT

March 5, 2004

Calaveras County Water District
423 E. St. Charles Street
San Andreas, CA 95249

Re: Sewage capacity for Douglas Flat treatment plant

Dear Steve Hutchings:

As per are discussion on February 24th 2004 we would like you to include our project, 207 acre development east of Vallecito(approx. 60 – 80 homesites), into your upcoming master plan review.

If you have any further questions please call me at 925 788-0975.

Sincerely,

Jeff Walker

APPENDIX B

PROPOSED IMPROVEMENTS TO COLLECTION SYSTEM

TABLE B-1
PROBABLE CONSTRUCTION COSTS FOR SEWER FORCE MAIN FROM SIX-MILE VILLAGE WASTEWATER PUMP STATION TO VALLECITO

Description	Quantity	Unit	Unit Cost	Cost, $
3-in Pipeline	7,200	LF	$30	216,000
Highway 4 Crossing	60	LF	$500	30,000
Valves, Creek Crossing		LS	$19,000	19,000
Total				265,000

TABLE B-2
PROBABLE CONSTRUCTION COSTS FOR EMERGENCY STORAGE AT SIX-MILE VILLAGE WASTEWATER PUMP STATION

Description	Quantity	Unit	Unit Cost	Cost, $
8-ft RCP	40	LF	$1,000	40,000
Cross-connection Piping		LS	$10,000	10,000
Total				50,000

TABLE B-3
PROBABLE CONSTRUCTION COSTS FOR INSTALLATION OF FLUSHING SYSTEM IN SIX-MILE VILLAGE WASTEWATER COLLECTION SYSTEM

Description	Quantity	Unit	Unit Cost	Cost, $
Plug valve	10	EA	$1,500	15,000
Cleanout	10	EA	$2,000	20,000
Total				35,000

TABLE B-4
PROBABLE CONSTRUCTION COSTS FOR REPLACEMENT OF SEPTIC TANK LIDS IN SIX-MILE VILLAGE WASTEWATER COLLECTION SYSTEM

Description	Quantity	Unit	Unit Cost	Cost, $
Septic Tank Lid	68	EA	$50	3,400
Labor	150	HR	$75	11,250
Total				14,650

TABLE B-5
PROBABLE CONSTRUCTION COSTS FOR ADDITION OF CHEMICAL INJECTION SYSTEM TO SIX-MILE VILLAGE WASTEWATER PUMP STATION FOR ODOR CONTROL

Description	Quantity	Unit	Unit Cost	Cost, $
NaOH Tank , Containment	1	EA	$10,000	10,000
Instrumentation		LS	$5,000	5,000
Metering Pump	1	EA	$5,000	5,000
Piping, Valves, Fittings		LS	$10,000	10,000
Electrical		LS	$10,000	10,000
Total				40,000

TABLE B-6
PROBABLE CONSTRUCTION COSTS FOR REPLACEMENT OF SEPTIC TANK LIDS IN VALLECITO WASTEWATER COLLECTION SYSTEM

Description	Quantity	Unit	Unit Cost	Cost, $
Septic Tank Lid	174	EA	$50	8,700
Labor	400	HR	$75	30,000
Total				38,700

TABLE B-7
PROBABLE CONSTRUCTION COSTS FOR INSTALLATION OF CHAMBER TO PROVIDE FLOW EQUALIZATION AT THE VALLECITO WASTEWATER PUMP STATION[a]

Description	Quantity	Unit	Unit Cost	Cost, $
8-ft RCP	92	LF	$1,000	92,000
Cross-connection Piping		LS	$10,000	10,000
Total				102,000

[a] Equalization storage for both Vallecito and Six-Mile Village flows.

TABLE B-8
PROBABLE CONSTRUCTION COSTS FOR FLOW METER INSTALLATION AT VALLECITO WASTEWATER PUMP STATION

Description	Quantity	Unit	Unit Cost	Cost, $
2.5-in Flow Meter	1	EA	$3,000	3,000
Electrical		LS	$2,000	2,000
Total				5,000

APPENDIX C

WATER BALANCES FOR GROWTH SCENARIOS FOR VALLECITO/DOUGLAS FLAT WASTEWATER TREATMENT PLANT

TABLE C-1

WATER BALANCE FOR VALLECITO/DOUGLAS FLAT WASTEWATER TREATMENT PLANT (EXISTING CONDITIONS, 100-YEAR PRECIPITATION, LAND APPLICATION)

						Storage pond							Land application area				
	Precip[a],	ET, in		Net	Avg. WW	WW	Precip.	Evap.	WW	Δ Vol.,	Net Vol.,	Depth,	Percolation, in			Applied WW	
Month	in	Meas.[b]	Red.[c]	ET[d], in	flow, gal/d	in, ac-ft	in, ac-ft	out, ac-ft	out, ac-ft	ac-ft	ac-ft	ft	Natural	Applied	Total	in	ac-ft
Jan	10.01	1.2	0.5	0.0	82,834	7.88	5.38	0.29	0.00	12.97	36.53	5.66	9.5	0.0	9.5	0.0	0.0
Feb	9.02	1.5	0.7	0.0	82,766	7.11	4.85	0.37	0.00	11.60	48.12	7.46	8.3	0.0	8.3	0.0	0.0
Mar	9.47	2.8	1.3	0.0	81,135	7.72	5.09	0.68	0.00	12.13	60.25	9.33	8.2	0.0	8.2	0.0	0.0
Apr	4.90	4.4	2.0	0.0	67,264	6.19	2.64	1.07	3.46	4.30	64.55	10.00	2.9	1.4	4.3	1.4	3.5
May	1.40	6.0	2.7	1.3	55,703	5.30	0.75	1.47	14.17	-9.58	54.96	8.52	0.0	4.5	4.5	5.8	14.2
Jun	0.38	7.3	3.3	2.9	52,514	4.83	0.20	1.78	17.77	-14.51	40.45	6.27	0.0	4.3	4.3	7.3	17.8
Jul	0.11	7.9	3.6	3.5	51,625	4.91	0.06	1.93	19.45	-16.41	24.04	3.72	0.0	4.5	4.5	7.9	19.4
Aug	0.31	7.0	3.2	2.9	52,248	4.97	0.16	1.71	17.96	-14.54	9.50	1.47	0.0	4.5	4.5	7.3	18.0
Sep	1.08	5.3	2.4	1.3	54,797	5.04	0.58	1.29	13.83	-9.50	0.00	0.00	0.0	4.3	4.3	5.6	13.8
Oct	3.31	3.2	1.5	0.0	61,707	5.87	1.78	0.78	6.39	0.47	0.47	0.07	1.9	2.6	4.5	2.6	6.4
Nov	8.53	1.4	0.6	0.0	79,087	7.28	4.59	0.34	0.00	11.53	12.00	1.86	7.9	0.0	7.9	0.0	0.0
Dec	8.17	0.7	0.3	0.0	77,057	7.33	4.40	0.17	0.00	11.56	23.56	3.65	7.9	0.0	7.9	0.0	0.0
Total	56.68	48.7	22.1	11.9	-	74.44	30.49	11.89	93.04	0.00	-	-	46.5	26.1	72.6	38.0	93.0

Required pond area, ac:	6.5
Maximum pond depth, ft:	10.0
Estimated saturated infiltration, in/hr:	0.06
Infiltration safety factor, percent:	10%
ET reduction factor:	45%
Required wastewater disposal area, ac:	29.4

[a] 100-year values based on annual 100-year precipitation value for Angel's Camp.

[b] Measured evapotranspiration (ET) for San Andreas from UC publication 21426 and 12-month Normal Year ETo maps.

[c] Reduced ET equals measured ET times ET reduction factor to account for local reduction of evaporation.

[d] Net evapotranspiration equals reduced evapotranspiration minus precipitation, zero when negative.

TABLE C-2

WATER BALANCE FOR VALLECITO/DOUGLAS FLAT WASTEWATER TREATMENT PLANT

(EXISTING CONDITIONS, NORMAL-YEAR PRECIPITATION, LAND APPLICATION)

Month	Precip[a], in	ET, in: Meas.[b]	ET, in: Red.[c]	Net ET[d], in	Avg. WW flow, gal/d	Storage pond: WW in, ac-ft	Storage pond: Precip. in, ac-ft	Storage pond: Evap. out, ac-ft	Storage pond: WW out, ac-ft	Storage pond: Δ Vol., ac-ft	Storage pond: Net Vol., ac-ft	Storage pond: Depth, ft	Land application area: Percolation, in: Natural	Percolation, in: Applied	Percolation, in: Total	Applied WW: in	Applied WW: ac-ft
Jan	5.57	1.2	0.5	0.0	68,846	6.55	3.00	0.29	0.00	9.25	26.64	4.13	5.0	0.0	5.0	0.0	0.0
Feb	5.02	1.5	0.7	0.0	68,808	5.91	2.70	0.37	0.00	8.25	34.89	5.41	4.3	0.0	4.3	0.0	0.0
Mar	5.27	2.8	1.3	0.0	67,901	6.46	2.83	0.68	0.00	8.61	43.50	6.74	4.0	0.0	4.0	0.0	0.0
Apr	2.73	4.4	2.0	0.0	60,179	5.54	1.47	1.07	4.09	1.85	45.35	7.03	0.7	1.7	2.4	1.7	4.1
May	0.78	6.0	2.7	1.9	53,744	5.11	0.42	1.47	10.84	-6.77	38.58	5.98	0.0	2.5	2.5	4.4	10.8
Jun	0.21	7.3	3.3	3.1	51,969	4.78	0.11	1.78	13.48	-10.37	28.21	4.37	0.0	2.4	2.4	5.5	13.5
Jul	0.06	7.9	3.6	3.5	51,474	4.90	0.03	1.93	14.71	-11.71	16.50	2.56	0.0	2.5	2.5	6.0	14.7
Aug	0.17	7.0	3.2	3.0	51,821	4.93	0.09	1.71	13.44	-10.13	6.37	0.99	0.0	2.5	2.5	5.5	13.4
Sep	0.60	5.3	2.4	1.8	53,240	4.90	0.32	1.29	10.30	-6.37	0.00	0.00	0.0	2.4	2.4	4.2	10.3
Oct	1.84	3.2	1.5	0.0	57,086	5.43	0.99	0.78	5.13	0.51	0.51	0.08	0.4	2.1	2.5	2.1	5.1
Nov	4.75	1.4	0.6	0.0	66,760	6.15	2.55	0.34	0.00	8.36	8.87	1.37	4.1	0.0	4.1	0.0	0.0
Dec	4.55	0.7	0.3	0.0	65,631	6.24	2.45	0.17	0.00	8.52	17.39	2.69	4.2	0.0	4.2	0.0	0.0
Total	31.55	48.7	22.1	13.4	-	66.91	16.97	11.89	71.98	0.00	-	-	22.8	16.0	38.8	29.4	72.0

Required pond area, ac:	6.5
Maximum pond depth, ft:	7.0
Estimated saturated infiltration, in/hr:	0.06
Infiltration safety factor, percent:	6%
ET reduction factor:	45%
Required wastewater disposal area, ac:	29.4

[a] Normal-year precipitation for Sonora, CA.

[b] Measured evapotranspiration (ET) for San Andreas from UC publication 21426 and 12-month Normal Year ETo maps.

[c] Reduced ET equals measured ET times ET reduction factor to account for local reduction of evaporation.

[d] Net evapotranspiration equals reduced evapotranspiration minus precipitation, zero when negative.

TABLE C-3

WATER BALANCE FOR VALLECITO/DOUGLAS FLAT WASTEWATER TREATMENT PLANT (SCENARIO 1, 100-YEAR PRECIPITATION, LAND APPLICATION)

						Storage pond							Land application area				
	Precip[a],	ET, in		Net	Avg. WW	WW	Precip.	Evap.	WW	Δ Vol.,	Net Vol.,	Depth,	Percolation, in			Applied WW	
Month	in	Meas.[b]	Red.[c]	ET[d], in	flow, gal/d	in, ac-ft	in, ac-ft	out, ac-ft	out, ac-ft	ac-ft	ac-ft	ft	Natural	Applied	Total	in	ac-ft
Jan	10.01	1.2	0.5	0.0	109,291	10.40	7.10	0.39	0.00	17.11	48.19	5.66	9.5	0.0	9.5	0.0	0.0
Feb	9.02	1.5	0.7	0.0	109,200	9.38	6.40	0.48	0.00	15.30	63.49	7.46	8.3	0.0	8.3	0.0	0.0
Mar	9.47	2.8	1.3	0.0	107,049	10.18	6.72	0.90	0.00	16.00	79.49	9.33	8.2	0.0	8.2	0.0	0.0
Apr	4.90	4.4	2.0	0.0	88,747	8.17	3.48	1.42	4.57	5.67	85.16	10.00	2.9	1.4	4.3	1.4	4.6
May	1.40	6.0	2.7	1.3	73,494	6.99	0.99	1.93	18.70	-12.64	72.52	8.52	0.0	4.5	4.5	5.8	18.7
Jun	0.38	7.3	3.3	2.9	69,287	6.38	0.27	2.35	23.45	-19.15	53.37	6.27	0.0	4.3	4.3	7.3	23.4
Jul	0.11	7.9	3.6	3.5	68,113	6.48	0.08	2.55	25.66	-21.65	31.72	3.72	0.0	4.5	4.5	7.9	25.7
Aug	0.31	7.0	3.2	2.9	68,935	6.56	0.22	2.26	23.70	-19.18	12.53	1.47	0.0	4.5	4.5	7.3	23.7
Sep	1.08	5.3	2.4	1.3	72,298	6.66	0.76	1.71	18.25	-12.53	0.00	0.00	0.0	4.3	4.3	5.6	18.2
Oct	3.31	3.2	1.5	0.0	81,416	7.75	2.35	1.03	8.44	0.62	0.62	0.07	1.9	2.6	4.5	2.6	8.4
Nov	8.53	1.4	0.6	0.0	104,346	9.61	6.06	0.45	0.00	15.21	15.83	1.86	7.9	0.0	7.9	0.0	0.0
Dec	8.17	0.7	0.3	0.0	101,668	9.67	5.80	0.23	0.00	15.25	31.08	3.65	7.9	0.0	7.9	0.0	0.0
Total	56.68	48.7	22.1	11.9	-	98.22	40.22	15.69	122.75	0.00	-	-	46.5	26.1	72.6	38.0	122.8

Required pond area, ac:	8.5
Maximum pond depth, ft:	10.0
Estimated saturated infiltration, in/hr:	0.06
Infiltration safety factor, percent:	10%
ET reduction factor:	45%
Required wastewater disposal area, ac:	38.8

[a] 100-year values based on annual 100-year precipitation value for Angel's Camp.

[b] Measured evapotranspiration (ET) for San Andreas from UC publication 21426 and 12-month Normal Year ETo maps.

[c] Reduced ET equals measured ET times ET reduction factor to account for local reduction of evaporation.

[d] Net evapotranspiration equals reduced evapotranspiration minus precipitation, zero when negative.

TABLE C-4

WATER BALANCE FOR VALLECITO/DOUGLAS FLAT WASTEWATER TREATMENT PLANT (SCENARIO 1, NORMAL-YEAR PRECIPITATION, LAND APPLICATION)

Month	Precip[a], in	ET, in Meas.[b]	ET, in Red.[c]	Net ET[d], in	Avg. WW flow, gal/d	Storage pond WW in, ac-ft	Storage pond Precip. in, ac-ft	Storage pond Evap. out, ac-ft	Storage pond WW out, ac-ft	Storage pond Δ Vol., ac-ft	Storage pond Net Vol., ac-ft	Storage pond Depth, ft	Land application area Percolation, in Natural	Percolation, in Applied	Percolation, in Total	Applied WW in	Applied WW ac-ft
Jan	5.57	1.2	0.5	0.0	90,835	8.64	3.95	0.39	0.00	12.21	35.15	4.13	5.0	0.0	5.0	0.0	0.0
Feb	5.02	1.5	0.7	0.0	90,785	7.80	3.56	0.48	0.00	10.88	46.03	5.41	4.3	0.0	4.3	0.0	0.0
Mar	5.27	2.8	1.3	0.0	89,587	8.52	3.74	0.90	0.00	11.36	57.39	6.74	4.0	0.0	4.0	0.0	0.0
Apr	2.73	4.4	2.0	0.0	79,400	7.31	1.94	1.42	5.39	2.44	59.83	7.03	0.7	1.7	2.4	1.7	5.4
May	0.78	6.0	2.7	1.9	70,910	6.75	0.55	1.93	14.30	-8.93	50.90	5.98	0.0	2.5	2.5	4.4	14.3
Jun	0.21	7.3	3.3	3.1	68,568	6.31	0.15	2.35	17.79	-13.68	37.22	4.37	0.0	2.4	2.4	5.5	17.8
Jul	0.06	7.9	3.6	3.5	67,915	6.46	0.04	2.55	19.41	-15.45	21.77	2.56	0.0	2.5	2.5	6.0	19.4
Aug	0.17	7.0	3.2	3.0	68,372	6.50	0.12	2.26	17.73	-13.36	8.41	0.99	0.0	2.5	2.5	5.5	17.7
Sep	0.60	5.3	2.4	1.8	70,244	6.47	0.43	1.71	13.59	-8.41	0.00	0.00	0.0	2.4	2.4	4.2	13.6
Oct	1.84	3.2	1.5	0.0	75,319	7.17	1.31	1.03	6.76	0.67	0.67	0.08	0.4	2.1	2.5	2.1	6.8
Nov	4.75	1.4	0.6	0.0	88,083	8.11	3.37	0.45	0.00	11.03	11.70	1.37	4.1	0.0	4.1	0.0	0.0
Dec	4.55	0.7	0.3	0.0	86,592	8.24	3.23	0.23	0.00	11.24	22.94	2.69	4.2	0.0	4.2	0.0	0.0
Total	31.55	48.7	22.1	13.4	-	88.27	22.39	15.69	94.97	0.00	-	-	22.8	16.0	38.8	29.4	95.0

Required pond area, ac:	8.5
Maximum pond depth, ft:	7.0
Estimated saturated infiltration, in/hr:	0.06
Infiltration safety factor, percent:	6%
ET reduction factor:	45%
Required wastewater disposal area, ac:	38.8

[a] Normal-year precipitation for Sonora, CA.

[b] Measured evapotranspiration (ET) for San Andreas from UC publication 21426 and 12-month Normal Year ETo maps.

[c] Reduced ET equals measured ET times ET reduction factor to account for local reduction of evaporation.

[d] Net evapotranspiration equals reduced evapotranspiration minus precipitation, zero when negative.

TABLE C-5

WATER BALANCE FOR VALLECITO/DOUGLAS FLAT WASTEWATER TREATMENT PLANT (SCENARIO 2, 100-YEAR PRECIPITATION, LAND APPLICATION)

Month	Precip[a], in	ET, in: Meas.[b]	ET, in: Red.[c]	Net ET[d], in	Avg. WW flow, gal/d	Storage pond: WW in, ac-ft	Storage pond: Precip. in, ac-ft	Storage pond: Evap. out, ac-ft	Storage pond: WW out, ac-ft	Storage pond: Δ Vol., ac-ft	Storage pond: Net Vol., ac-ft	Storage pond: Depth, ft	Land application area: Percolation, in: Natural	Land application area: Percolation, in: Applied	Land application area: Percolation, in: Total	Land application area: Applied WW: in	Land application area: Applied WW: ac-ft
Jan	10.01	1.2	0.5	0.0	137,637	13.09	8.94	0.49	0.00	21.55	60.69	5.66	9.5	0.0	9.5	0.0	0.0
Feb	9.02	1.5	0.7	0.0	137,523	11.82	8.06	0.61	0.00	19.27	79.96	7.46	8.3	0.0	8.3	0.0	0.0
Mar	9.47	2.8	1.3	0.0	134,814	12.82	8.46	1.14	0.00	20.15	100.11	9.33	8.2	0.0	8.2	0.0	0.0
Apr	4.90	4.4	2.0	0.0	111,765	10.29	4.38	1.79	5.75	7.14	107.25	10.00	2.9	1.4	4.3	1.4	5.7
May	1.40	6.0	2.7	1.3	92,556	8.80	1.25	2.43	23.54	-15.92	91.33	8.52	0.0	4.5	4.5	5.8	23.5
Jun	0.38	7.3	3.3	2.9	87,257	8.03	0.34	2.96	29.53	-24.12	67.21	6.27	0.0	4.3	4.3	7.3	29.5
Jul	0.11	7.9	3.6	3.5	85,780	8.16	0.10	3.21	32.32	-27.27	39.94	3.72	0.0	4.5	4.5	7.9	32.3
Aug	0.31	7.0	3.2	2.9	86,815	8.26	0.27	2.84	29.85	-24.16	15.79	1.47	0.0	4.5	4.5	7.3	29.8
Sep	1.08	5.3	2.4	1.3	91,050	8.38	0.96	2.15	22.98	-15.79	0.00	0.00	0.0	4.3	4.3	5.6	23.0
Oct	3.31	3.2	1.5	0.0	102,532	9.75	2.95	1.30	10.62	0.79	0.79	0.07	1.9	2.6	4.5	2.6	10.6
Nov	8.53	1.4	0.6	0.0	131,410	12.10	7.63	0.57	0.00	19.16	19.94	1.86	7.9	0.0	7.9	0.0	0.0
Dec	8.17	0.7	0.3	0.0	128,038	12.18	7.31	0.28	0.00	19.20	39.14	3.65	7.9	0.0	7.9	0.0	0.0
Total	56.68	48.7	22.1	11.9	-	123.69	50.66	19.76	154.59	0.00	-	-	46.5	26.1	72.6	38.0	154.6

Required pond area, ac:	10.7
Maximum pond depth, ft:	10.0
Estimated saturated infiltration, in/hr:	0.06
Infiltration safety factor, percent:	10%
ET reduction factor:	45%
Required wastewater disposal area, ac:	48.8

[a] 100-year values based on annual 100-year precipitation value for Angel's Camp.

[b] Measured evapotranspiration (ET) for San Andreas from UC publication 21426 and 12-month Normal Year ETo maps.

[c] Reduced ET equals measured ET times ET reduction factor to account for local reduction of evaporation.

[d] Net evapotranspiration equals reduced evapotranspiration minus precipitation, zero when negative.

TABLE C-6

WATER BALANCE FOR VALLECITO/DOUGLAS FLAT WASTEWATER TREATMENT PLANT

(SCENARIO 2, NORMAL-YEAR PRECIPITATION, LAND APPLICATION)

						Storage pond							Land application area				
	Precip[a],	ET, in		Net	Avg. WW	WW	Precip.	Evap.	WW	Δ Vol.,	Net Vol.,	Depth,	Percolation, in			Applied WW	
Month	in	Meas.[b]	Red.[c]	ET[d], in	flow, gal/d	in, ac-ft	in, ac-ft	out, ac-ft	out, ac-ft	ac-ft	ac-ft	ft	Natural	Applied	Total	in	ac-ft
Jan	5.57	1.2	0.5	0.0	114,395	10.88	4.98	0.49	0.00	15.37	44.27	4.13	5.0	0.0	5.0	0.0	0.0
Feb	5.02	1.5	0.7	0.0	114,331	9.82	4.49	0.61	0.00	13.70	57.97	5.41	4.3	0.0	4.3	0.0	0.0
Mar	5.27	2.8	1.3	0.0	112,823	10.73	4.71	1.14	0.00	14.31	72.28	6.74	4.0	0.0	4.0	0.0	0.0
Apr	2.73	4.4	2.0	0.0	99,994	9.21	2.44	1.79	6.79	3.07	75.35	7.03	0.7	1.7	2.4	1.7	6.8
May	0.78	6.0	2.7	1.9	89,301	8.50	0.70	2.43	18.00	-11.25	64.10	5.98	0.0	2.5	2.5	4.4	18.0
Jun	0.21	7.3	3.3	3.1	86,352	7.95	0.19	2.96	22.40	-17.22	46.88	4.37	0.0	2.4	2.4	5.5	22.4
Jul	0.06	7.9	3.6	3.5	85,529	8.14	0.05	3.21	24.44	-19.46	27.42	2.56	0.0	2.5	2.5	6.0	24.4
Aug	0.17	7.0	3.2	3.0	86,106	8.19	0.15	2.84	22.33	-16.83	10.59	0.99	0.0	2.5	2.5	5.5	22.3
Sep	0.60	5.3	2.4	1.8	88,463	8.14	0.54	2.15	17.12	-10.59	0.00	0.00	0.0	2.4	2.4	4.2	17.1
Oct	1.84	3.2	1.5	0.0	94,854	9.02	1.64	1.30	8.52	0.85	0.85	0.08	0.4	2.1	2.5	2.1	8.5
Nov	4.75	1.4	0.6	0.0	110,929	10.21	4.25	0.57	0.00	13.89	14.74	1.37	4.1	0.0	4.1	0.0	0.0
Dec	4.55	0.7	0.3	0.0	109,051	10.37	4.07	0.28	0.00	14.16	28.90	2.69	4.2	0.0	4.2	0.0	0.0
Total	31.55	48.7	22.1	13.4	-	111.17	28.20	19.76	119.61	0.00	-	-	22.8	16.0	38.8	29.4	119.6

Required pond area, ac:	10.7
Maximum pond depth, ft:	7.0
Estimated saturated infiltration, in/hr:	0.06
Infiltration safety factor, percent:	6%
ET reduction factor:	45%
Required wastewater disposal area, ac:	48.8

[a] Normal-year precipitation for Sonora, CA.

[b] Measured evapotranspiration (ET) for San Andreas from UC publication 21426 and 12-month Normal Year ETo maps.

[c] Reduced ET equals measured ET times ET reduction factor to account for local reduction of evaporation.

[d] Net evapotranspiration equals reduced evapotranspiration minus precipitation, zero when negative.

TABLE C-7

WATER BALANCE FOR VALLECITO/DOUGLAS FLAT WASTEWATER TREATMENT PLANT (SCENARIO 3, 100-YEAR PRECIPITATION, LAND APPLICATION)

						Storage pond							Land application area				
	Precip[a],	ET, in		Net	Avg. WW	WW	Precip.	Evap.	WW	Δ Vol.,	Net Vol.,	Depth,	Percolation, in			Applied WW	
Month	in	Meas.[b]	Red.[c]	ET[d], in	flow, gal/d	in, ac-ft	in, ac-ft	out, ac-ft	out, ac-ft	ac-ft	ac-ft	ft	Natural	Applied	Total	in	ac-ft
Jan	10.01	1.2	0.5	0.0	162,834	15.49	10.58	0.58	0.00	25.49	71.80	5.66	9.5	0.0	9.5	0.0	0.0
Feb	9.02	1.5	0.7	0.0	162,699	13.98	9.54	0.72	0.00	22.80	94.60	7.46	8.3	0.0	8.3	0.0	0.0
Mar	9.47	2.8	1.3	0.0	159,494	15.17	10.01	1.34	0.00	23.84	118.44	9.33	8.2	0.0	8.2	0.0	0.0
Apr	4.90	4.4	2.0	0.0	132,225	12.17	5.19	2.11	6.80	8.44	126.88	10.00	2.9	1.4	4.3	1.4	6.8
May	1.40	6.0	2.7	1.3	109,500	10.42	1.48	2.88	27.85	-18.84	108.05	8.52	0.0	4.5	4.5	5.8	27.9
Jun	0.38	7.3	3.3	2.9	103,231	9.50	0.40	3.50	34.93	-28.53	79.51	6.27	0.0	4.3	4.3	7.3	34.9
Jul	0.11	7.9	3.6	3.5	101,483	9.65	0.11	3.79	38.23	-32.26	47.26	3.72	0.0	4.5	4.5	7.9	38.2
Aug	0.31	7.0	3.2	2.9	102,708	9.77	0.32	3.36	35.31	-28.58	18.68	1.47	0.0	4.5	4.5	7.3	35.3
Sep	1.08	5.3	2.4	1.3	107,718	9.92	1.14	2.54	27.19	-18.68	0.00	0.00	0.0	4.3	4.3	5.6	27.2
Oct	3.31	3.2	1.5	0.0	121,302	11.54	3.50	1.54	12.57	0.93	0.93	0.07	1.9	2.6	4.5	2.6	12.6
Nov	8.53	1.4	0.6	0.0	155,467	14.31	9.02	0.67	0.00	22.66	23.59	1.86	7.9	0.0	7.9	0.0	0.0
Dec	8.17	0.7	0.3	0.0	151,477	14.41	8.64	0.34	0.00	22.72	46.31	3.65	7.9	0.0	7.9	0.0	0.0
Total	56.68	48.7	22.1	11.9	-	146.34	59.93	23.38	182.89	0.00	-	-	46.5	26.1	72.6	38.0	182.9

Required pond area, ac:	12.7
Maximum pond depth, ft:	10.0
Estimated saturated infiltration, in/hr:	0.06
Infiltration safety factor, percent:	10%
ET reduction factor:	45%
Required wastewater disposal area, ac:	57.8

[a] 100-year values based on annual 100-year precipitation value for Angel's Camp.

[b] Measured evapotranspiration (ET) for San Andreas from UC publication 21426 and 12-month Normal Year ETo maps.

[c] Reduced ET equals measured ET times ET reduction factor to account for local reduction of evaporation.

[d] Net evapotranspiration equals reduced evapotranspiration minus precipitation, zero when negative.

TABLE C-8

WATER BALANCE FOR VALLECITO/DOUGLAS FLAT WASTEWATER TREATMENT PLANT (SCENARIO 3, NORMAL-YEAR PRECIPITATION, LAND APPLICATION)

						Storage pond							Land application area				
	Precip[a],	ET, in		Net	Avg. WW	WW	Precip.	Evap.	WW	Δ Vol.,	Net Vol.,	Depth,	Percolation, in			Applied WW	
Month	in	Meas.[b]	Red.[c]	ET[d], in	flow, gal/d	in, ac-ft	in, ac-ft	out, ac-ft	out, ac-ft	ac-ft	ac-ft	ft	Natural	Applied	Total	in	ac-ft
Jan	5.57	1.2	0.5	0.0	135,337	12.87	5.89	0.58	0.00	18.19	52.37	4.13	5.0	0.0	5.0	0.0	0.0
Feb	5.02	1.5	0.7	0.0	135,262	11.62	5.31	0.72	0.00	16.21	68.58	5.41	4.3	0.0	4.3	0.0	0.0
Mar	5.27	2.8	1.3	0.0	133,478	12.70	5.57	1.34	0.00	16.93	85.51	6.74	4.0	0.0	4.0	0.0	0.0
Apr	2.73	4.4	2.0	0.0	118,299	10.89	2.89	2.11	8.03	3.63	89.14	7.03	0.7	1.7	2.4	1.7	8.0
May	0.78	6.0	2.7	1.9	105,649	10.05	0.82	2.88	21.30	-13.31	75.84	5.98	0.0	2.5	2.5	4.4	21.3
Jun	0.21	7.3	3.3	3.1	102,160	9.40	0.22	3.50	26.50	-20.38	55.46	4.37	0.0	2.4	2.4	5.5	26.5
Jul	0.06	7.9	3.6	3.5	101,187	9.63	0.06	3.79	28.92	-23.02	32.44	2.56	0.0	2.5	2.5	6.0	28.9
Aug	0.17	7.0	3.2	3.0	101,869	9.69	0.18	3.36	26.42	-19.91	12.53	0.99	0.0	2.5	2.5	5.5	26.4
Sep	0.60	5.3	2.4	1.8	104,658	9.63	0.63	2.54	20.25	-12.53	0.00	0.00	0.0	2.4	2.4	4.2	20.3
Oct	1.84	3.2	1.5	0.0	112,219	10.68	1.95	1.54	10.08	1.01	1.01	0.08	0.4	2.1	2.5	2.1	10.1
Nov	4.75	1.4	0.6	0.0	131,236	12.08	5.02	0.67	0.00	16.43	17.44	1.37	4.1	0.0	4.1	0.0	0.0
Dec	4.55	0.7	0.3	0.0	129,015	12.27	4.81	0.34	0.00	16.75	34.19	2.69	4.2	0.0	4.2	0.0	0.0
Total	31.55	48.7	22.1	13.4	-	131.52	33.36	23.38	141.50	0.00	-	-	22.8	16.0	38.8	29.4	141.5

Required pond area, ac:	12.7
Maximum pond depth, ft:	7.0
Estimated saturated infiltration, in/hr:	0.06
Infiltration safety factor, percent:	6%
ET reduction factor:	45%
Required wastewater disposal area, ac:	57.8

[a] Normal-year precipitation for Sonora, CA.

[b] Measured evapotranspiration (ET) for San Andreas from UC publication 21426 and 12-month Normal Year ETo maps.

[c] Reduced ET equals measured ET times ET reduction factor to account for local reduction of evaporation.

[d] Net evapotranspiration equals reduced evapotranspiration minus precipitation, zero when negative.

TABLE C-9

WATER BALANCE FOR VALLECITO/DOUGLAS FLAT WASTEWATER TREATMENT PLANT (SCENARIO 1, 100-YEAR PRECIPITATION, LAND APPLICATION AND CREEK DISCHARGE)

	Precip[a],	ET, in		Net	Avg. WW flow		WW to creek,	Storage pond							Land application area				
								WW	Precip.	Evap.	WW out,	Δ Vol.,	Net Vol.,	Depth,	Percolation, in			Applied WW	
Month	in	Meas.[b]	Red.[c]	ET[d], in	gal/d	ac-ft	ac-ft	in, ac-ft	in, ac-ft	out, ac-ft	out, ac-ft	ac-ft	ac-ft	ft	Natural	Applied	Total	in	ac-ft
Jan	10.01	1.2	0.5	0.0	109,291	10.40	10.40	0.00	4.42	0.24	0.00	4.18	15.29	2.88	9.5	0.0	9.5	0.0	0.0
Feb	9.02	1.5	0.7	0.0	109,200	9.38	9.38	0.00	3.98	0.30	0.00	3.68	18.97	3.58	8.3	0.0	8.3	0.0	0.0
Mar	9.47	2.8	1.3	0.0	107,049	10.18	10.18	0.00	4.18	0.56	0.00	3.62	22.59	4.26	8.2	0.0	8.2	0.0	0.0
Apr	4.90	4.4	2.0	0.0	88,747	8.17	0.00	8.17	2.17	0.88	2.39	7.06	29.65	5.59	2.9	1.4	4.3	1.4	2.4
May	1.40	6.0	2.7	1.3	73,494	6.99	0.00	6.99	0.62	1.20	9.78	-3.38	26.27	4.96	0.0	4.5	4.5	5.8	9.8
Jun	0.38	7.3	3.3	2.9	69,287	6.38	0.00	6.38	0.17	1.46	12.27	-7.19	19.09	3.60	0.0	4.3	4.3	7.3	12.3
Jul	0.11	7.9	3.6	3.5	68,113	6.48	0.00	6.48	0.05	1.58	13.43	-8.49	10.60	2.00	0.0	4.5	4.5	7.9	13.4
Aug	0.31	7.0	3.2	2.9	68,935	6.56	0.00	6.56	0.13	1.40	12.41	-7.12	3.48	0.66	0.0	4.5	4.5	7.3	12.4
Sep	1.08	5.3	2.4	1.3	72,298	6.66	0.00	6.66	0.48	1.06	9.55	-3.48	0.00	0.00	0.0	4.3	4.3	5.6	9.6
Oct	3.31	3.2	1.5	0.0	81,416	7.75	0.00	7.75	1.46	0.64	4.42	4.15	4.15	0.78	1.9	2.6	4.5	2.6	4.4
Nov	8.53	1.4	0.6	0.0	104,346	9.61	9.61	0.00	3.77	0.28	0.00	3.49	7.64	1.44	7.9	0.0	7.9	0.0	0.0
Dec	8.17	0.7	0.3	0.0	101,668	9.67	9.67	0.00	3.61	0.14	0.00	3.47	11.11	2.10	7.9	0.0	7.9	0.0	0.0
Total	56.68	48.7	22.1	11.9	-	98.22	49.24	48.98	25.03	9.77	64.25	0.00	-	-	46.5	26.1	72.6	38.0	64.2

Existing pond surface area, ac:	5.3
Maximum pond depth, ft:	5.6
Estimated saturated infiltration, in/hr:	0.06
Infiltration safety factor, percent:	10%
ET reduction factor:	45%
Required wastewater disposal area, ac:	20.3

[a] 100-year values based on annual 100-year precipitation value for Angel's Camp.

[b] Measured evapotranspiration (ET) for San Andreas from UC publication 21426 and 12-month Normal Year ETo maps.

[c] Reduced ET equals measured ET times ET reduction factor to account for local reduction of evaporation.

[d] Net evapotranspiration equals reduced evapotranspiration minus precipitation, zero when negative.

TABLE C-10

WATER BALANCE FOR VALLECITO/DOUGLAS FLAT WASTEWATER TREATMENT PLANT (SCENARIO 1, NORMAL-YEAR PRECIPITATION, LAND APPLICATION AND CREEK DISCHARGE)

							WW to	Storage pond							Land application area				
	Precip[a],	ET, in		Net	Avg. WW flow		creek,	WW	Precip.	Evap.	WW out,	Δ Vol.,	Net Vol.,	Depth,	Percolation, in			Applied WW	
Month	in	Meas.[b]	Red.[c]	ET[d], in	gal/d	ac-ft	ac-ft	in, ac-ft	in, ac-ft	out, ac-ft	out, ac-ft	ac-ft	ac-ft	ft	Natural	Applied	Total	in	ac-ft
Jan	5.57	1.2	0.5	0.0	90,835	8.64	8.64	0.00	2.46	0.24	0.00	2.22	9.49	1.79	5.0	0.0	5.0	0.0	0.0
Feb	5.02	1.5	0.7	0.0	90,785	7.80	7.80	0.00	2.22	0.30	0.00	1.92	11.41	2.15	4.3	0.0	4.3	0.0	0.0
Mar	5.27	2.8	1.3	0.0	89,587	8.52	8.52	0.00	2.33	0.56	0.00	1.77	13.18	2.49	4.0	0.0	4.0	0.0	0.0
Apr	2.73	4.4	2.0	0.0	79,400	7.31	0.00	7.31	1.21	0.88	3.02	4.61	17.79	3.36	0.7	1.8	2.5	1.8	3.0
May	0.78	6.0	2.7	1.9	70,910	6.75	0.00	6.75	0.34	1.20	7.69	-1.80	15.99	3.02	0.0	2.6	2.6	4.5	7.7
Jun	0.21	7.3	3.3	3.1	68,568	6.31	0.00	6.31	0.09	1.46	9.51	-4.57	11.42	2.15	0.0	2.5	2.5	5.6	9.5
Jul	0.06	7.9	3.6	3.5	67,915	6.46	0.00	6.46	0.03	1.58	10.37	-5.46	5.96	1.12	0.0	2.6	2.6	6.1	10.4
Aug	0.17	7.0	3.2	3.0	68,372	6.50	0.00	6.50	0.08	1.40	9.49	-4.31	1.65	0.31	0.0	2.6	2.6	5.6	9.5
Sep	0.60	5.3	2.4	1.8	70,244	6.47	0.00	6.47	0.27	1.06	7.31	-1.65	0.00	0.00	0.0	2.5	2.5	4.3	7.3
Oct	1.84	3.2	1.5	0.0	75,319	7.17	0.00	7.17	0.81	0.64	3.75	3.59	3.59	0.68	0.4	2.2	2.6	2.2	3.7
Nov	4.75	1.4	0.6	0.0	88,083	8.11	8.11	0.00	2.10	0.28	0.00	1.82	5.41	1.02	4.1	0.0	4.1	0.0	0.0
Dec	4.55	0.7	0.3	0.0	86,592	8.24	8.24	0.00	2.01	0.14	0.00	1.87	7.28	1.37	4.2	0.0	4.2	0.0	0.0
Total	31.55	48.7	22.1	13.4	-	88.27	41.31	46.96	13.93	9.77	51.13	0.00	-	-	22.8	16.9	39.7	30.2	51.1

Existing pond surface area, ac:	5.3
Maximum pond depth, ft:	3.4
Estimated saturated infiltration, in/hr:	0.06
Infiltration safety factor, percent:	6%
ET reduction factor:	45%
Required wastewater disposal area, ac:	20.3

[a] 100-year values based on annual 100-year precipitation value for Angel's Camp.

[b] Measured evapotranspiration (ET) for San Andreas from UC publication 21426 and 12-month Normal Year ETo maps.

[c] Reduced ET equals measured ET times ET reduction factor to account for local reduction of evaporation.

[d] Net evapotranspiration equals reduced evapotranspiration minus precipitation, zero when negative.

TABLE C-11

WATER BALANCE FOR VALLECITO/DOUGLAS FLAT WASTEWATER TREATMENT PLANT (SCENARIO 2, 100-YEAR PRECIPITATION, LAND APPLICATION AND CREEK DISCHARGE)

	Precip[a],	ET, in		Net	Avg. WW flow		WW to creek,	Storage pond							Land application area				
								WW	Precip.	Evap.	WW out,	Δ Vol.,	Net Vol.,	Depth,	Percolation, in			Applied WW	
Month	in	Meas.[b]	Red.[c]	ET[d], in	gal/d	ac-ft	ac-ft	in, ac-ft	in, ac-ft	out, ac-ft	out, ac-ft	ac-ft	ac-ft	ft	Natural	Applied	Total	in	ac-ft
Jan	10.01	1.2	0.5	0.0	137,637	13.09	13.09	0.00	4.42	0.24	0.00	4.18	16.42	3.10	9.5	0.0	9.5	0.0	0.0
Feb	9.02	1.5	0.7	0.0	137,523	11.82	11.82	0.00	3.98	0.30	0.00	3.68	20.10	3.79	8.3	0.0	8.3	0.0	0.0
Mar	9.47	2.8	1.3	0.0	134,814	12.82	12.82	0.00	4.18	0.56	0.00	3.62	23.72	4.48	8.2	0.0	8.2	0.0	0.0
Apr	4.90	4.4	2.0	0.0	111,765	10.29	0.00	10.29	2.17	0.88	2.86	8.71	32.43	6.12	2.9	1.4	4.3	1.4	2.9
May	1.40	6.0	2.7	1.3	92,556	8.80	0.00	8.80	0.62	1.20	11.72	-3.50	28.94	5.46	0.0	4.5	4.5	5.8	11.7
Jun	0.38	7.3	3.3	2.9	87,257	8.03	0.00	8.03	0.17	1.46	14.70	-7.96	20.97	3.96	0.0	4.3	4.3	7.3	14.7
Jul	0.11	7.9	3.6	3.5	85,780	8.16	0.00	8.16	0.05	1.58	16.09	-9.46	11.51	2.17	0.0	4.5	4.5	7.9	16.1
Aug	0.31	7.0	3.2	2.9	86,815	8.26	0.00	8.26	0.13	1.40	14.86	-7.87	3.64	0.69	0.0	4.5	4.5	7.3	14.9
Sep	1.08	5.3	2.4	1.3	91,050	8.38	0.00	8.38	0.48	1.06	11.44	-3.64	0.00	0.00	0.0	4.3	4.3	5.6	11.4
Oct	3.31	3.2	1.5	0.0	102,532	9.75	0.00	9.75	1.46	0.64	5.29	5.28	5.28	1.00	1.9	2.6	4.5	2.6	5.3
Nov	8.53	1.4	0.6	0.0	131,410	12.10	12.10	0.00	3.77	0.28	0.00	3.49	8.77	1.66	7.9	0.0	7.9	0.0	0.0
Dec	8.17	0.7	0.3	0.0	128,038	12.18	12.18	0.00	3.61	0.14	0.00	3.47	12.24	2.31	7.9	0.0	7.9	0.0	0.0
Total	56.68	48.7	22.1	11.9	-	123.69	62.01	61.68	25.03	9.77	76.95	0.00	-	-	46.5	26.1	72.6	38.0	77.0

Existing pond surface area, ac:	5.3
Maximum pond depth, ft:	6.1
Estimated saturated infiltration, in/hr:	0.06
Infiltration safety factor, percent:	10%
ET reduction factor:	45%
Required wastewater disposal area, ac:	24.3

[a] 100-year values based on annual 100-year precipitation value for Angel's Camp.
[b] Measured evapotranspiration (ET) for San Andreas from UC publication 21426 and 12-month Normal Year ETo maps.
[c] Reduced ET equals measured ET times ET reduction factor to account for local reduction of evaporation.
[d] Net evapotranspiration equals reduced evapotranspiration minus precipitation, zero when negative.

TABLE C-12

WATER BALANCE FOR VALLECITO/DOUGLAS FLAT WASTEWATER TREATMENT PLANT (SCENARIO 2, NORMAL-YEAR PRECIPITATION, LAND APPLICATION AND CREEK DISCHARGE)

	Precip[a],	ET, in		Net	Avg. WW flow		WW to creek,	Storage pond							Land application area				
								WW	Precip.	Evap.	WW out,	Δ Vol.,	Net Vol.,	Depth,	Percolation, in			Applied WW	
Month	in	Meas.[b]	Red.[c]	ET[d], in	gal/d	ac-ft	ac-ft	in, ac-ft	in, ac-ft	out, ac-ft	out, ac-ft	ac-ft	ac-ft	ft	Natural	Applied	Total	in	ac-ft
Jan	5.57	1.2	0.5	0.0	114,395	10.88	10.88	0.00	2.46	0.24	0.00	2.22	10.31	1.95	5.0	0.0	5.0	0.0	0.0
Feb	5.02	1.5	0.7	0.0	114,331	9.82	9.82	0.00	2.22	0.30	0.00	1.92	12.23	2.31	4.3	0.0	4.3	0.0	0.0
Mar	5.27	2.8	1.3	0.0	112,823	10.73	10.73	0.00	2.33	0.56	0.00	1.77	13.99	2.64	4.0	0.0	4.0	0.0	0.0
Apr	2.73	4.4	2.0	0.0	99,994	9.21	0.00	9.21	1.21	0.88	3.91	5.62	19.61	3.70	0.7	1.9	2.7	1.9	3.9
May	0.78	6.0	2.7	1.9	89,301	8.50	0.00	8.50	0.34	1.20	9.51	-1.87	17.74	3.35	0.0	2.8	2.8	4.7	9.5
Jun	0.21	7.3	3.3	3.1	86,352	7.95	0.00	7.95	0.09	1.46	11.68	-5.10	12.64	2.39	0.0	2.7	2.7	5.8	11.7
Jul	0.06	7.9	3.6	3.5	85,529	8.14	0.00	8.14	0.03	1.58	12.71	-6.14	6.51	1.23	0.0	2.8	2.8	6.3	12.7
Aug	0.17	7.0	3.2	3.0	86,106	8.19	0.00	8.19	0.08	1.40	11.66	-4.80	1.70	0.32	0.0	2.8	2.8	5.8	11.7
Sep	0.60	5.3	2.4	1.8	88,463	8.14	0.00	8.14	0.27	1.06	9.05	-1.70	0.00	0.00	0.0	2.7	2.7	4.5	9.1
Oct	1.84	3.2	1.5	0.0	94,854	9.02	0.00	9.02	0.81	0.64	4.79	4.41	4.41	0.83	0.4	2.4	2.8	2.4	4.8
Nov	4.75	1.4	0.6	0.0	110,929	10.21	10.21	0.00	2.10	0.28	0.00	1.82	6.22	1.17	4.1	0.0	4.1	0.0	0.0
Dec	4.55	0.7	0.3	0.0	109,051	10.37	10.37	0.00	2.01	0.14	0.00	1.87	8.09	1.53	4.2	0.0	4.2	0.0	0.0
Total	31.55	48.7	22.1	13.4	-	111.17	52.02	59.15	13.93	9.77	63.31	0.00	-	-	22.8	17.9	40.7	31.3	63.3

Existing pond surface area, ac:	5.3
Maximum pond depth, ft:	3.7
Estimated saturated infiltration, in/hr:	0.06
Infiltration safety factor, percent:	6%
ET reduction factor:	45%
Required wastewater disposal area, ac:	24.3

[a] 100-year values based on annual 100-year precipitation value for Angel's Camp.

[b] Measured evapotranspiration (ET) for San Andreas from UC publication 21426 and 12-month Normal Year ETo maps.

[c] Reduced ET equals measured ET times ET reduction factor to account for local reduction of evaporation.

[d] Net evapotranspiration equals reduced evapotranspiration minus precipitation, zero when negative.

TABLE C-13

WATER BALANCE FOR VALLECITO/DOUGLAS FLAT WASTEWATER TREATMENT PLANT (SCENARIO 3, 100-YEAR PRECIPITATION, LAND APPLICATION AND CREEK DISCHARGE)

Month	Precip[a], in	ET, in Meas.[b]	ET, in Red.[c]	Net ET[d], in	Avg. WW flow gal/d	Avg. WW flow ac-ft	WW to creek, ac-ft	Storage pond WW in, ac-ft	Storage pond Precip. in, ac-ft	Storage pond Evap. out, ac-ft	Storage pond WW out, ac-ft	Storage pond Δ Vol., ac-ft	Storage pond Net Vol., ac-ft	Storage pond Depth, ft	Land application area Percolation, in Natural	Land application area Percolation, in Applied	Land application area Percolation, in Total	Land application area Applied WW in	Land application area Applied WW ac-ft
Jan	10.01	1.2	0.5	0.0	162,834	15.49	15.49	0.00	4.42	0.24	0.00	4.18	17.43	3.29	9.5	0.0	9.5	0.0	0.0
Feb	9.02	1.5	0.7	0.0	162,699	13.98	13.98	0.00	3.98	0.30	0.00	3.68	21.11	3.98	8.3	0.0	8.3	0.0	0.0
Mar	9.47	2.8	1.3	0.0	159,494	15.17	15.17	0.00	4.18	0.56	0.00	3.62	24.73	4.67	8.2	0.0	8.2	0.0	0.0
Apr	4.90	4.4	2.0	0.0	132,225	12.17	0.00	12.17	2.17	0.88	3.28	10.17	34.91	6.59	2.9	1.4	4.3	1.4	3.3
May	1.40	6.0	2.7	1.3	109,500	10.42	0.00	10.42	0.62	1.20	13.44	-3.61	31.30	5.91	0.0	4.5	4.5	5.8	13.4
Jun	0.38	7.3	3.3	2.9	103,231	9.50	0.00	9.50	0.17	1.46	16.85	-8.65	22.65	4.27	0.0	4.3	4.3	7.3	16.9
Jul	0.11	7.9	3.6	3.5	101,483	9.65	0.00	9.65	0.05	1.58	18.45	-10.33	12.32	2.33	0.0	4.5	4.5	7.9	18.4
Aug	0.31	7.0	3.2	2.9	102,708	9.77	0.00	9.77	0.13	1.40	17.04	-8.54	3.79	0.71	0.0	4.5	4.5	7.3	17.0
Sep	1.08	5.3	2.4	1.3	107,718	9.92	0.00	9.92	0.48	1.06	13.12	-3.79	0.00	0.00	0.0	4.3	4.3	5.6	13.1
Oct	3.31	3.2	1.5	0.0	121,302	11.54	0.00	11.54	1.46	0.64	6.06	6.29	6.29	1.19	1.9	2.6	4.5	2.6	6.1
Nov	8.53	1.4	0.6	0.0	155,467	14.31	14.31	0.00	3.77	0.28	0.00	3.49	9.78	1.85	7.9	0.0	7.9	0.0	0.0
Dec	8.17	0.7	0.3	0.0	151,477	14.41	14.41	0.00	3.61	0.14	0.00	3.47	13.25	2.50	7.9	0.0	7.9	0.0	0.0
Total	56.68	48.7	22.1	11.9	-	146.34	73.36	72.97	25.03	9.77	88.24	0.00	-	-	46.5	26.1	72.6	38.0	88.2

Existing pond surface area, ac:	5.3
Maximum pond depth, ft:	6.6
Estimated saturated infiltration, in/hr:	0.06
Infiltration safety factor, percent:	10%
ET reduction factor:	45%
Required wastewater disposal area, ac:	27.9

[a] 100-year values based on annual 100-year precipitation value for Angel's Camp.

[b] Measured evapotranspiration (ET) for San Andreas from UC publication 21426 and 12-month Normal Year ETo maps.

[c] Reduced ET equals measured ET times ET reduction factor to account for local reduction of evaporation.

[d] Net evapotranspiration equals reduced evapotranspiration minus precipitation, zero when negative.

TABLE C-14

WATER BALANCE FOR VALLECITO/DOUGLAS FLAT WASTEWATER TREATMENT PLANT
(SCENARIO 3, NORMAL-YEAR PRECIPITATION, LAND APPLICATION AND CREEK DISCHARGE)

							WW to	Storage pond							Land application area				
	Precip[a],	ET, in		Net	Avg. WW flow		creek,	WW	Precip.	Evap.	WW out,	Δ Vol.,	Net Vol.,	Depth,	Percolation, in			Applied WW	
Month	in	Meas.[b]	Red.[c]	ET[d], in	gal/d	ac-ft	ac-ft	in, ac-ft	in, ac-ft	out, ac-ft	out, ac-ft	ac-ft	ac-ft	ft	Natural	Applied	Total	in	ac-ft
Jan	5.57	1.2	0.5	0.0	135,337	12.87	12.87	0.00	2.46	0.24	0.00	2.22	11.04	2.08	5.0	0.0	5.0	0.0	0.0
Feb	5.02	1.5	0.7	0.0	135,262	11.62	11.62	0.00	2.22	0.30	0.00	1.92	12.96	2.44	4.3	0.0	4.3	0.0	0.0
Mar	5.27	2.8	1.3	0.0	133,478	12.70	12.70	0.00	2.33	0.56	0.00	1.77	14.72	2.78	4.0	0.0	4.0	0.0	0.0
Apr	2.73	4.4	2.0	0.0	118,299	10.89	0.00	10.89	1.21	0.88	4.70	6.52	21.24	4.01	0.7	2.0	2.8	2.0	4.7
May	0.78	6.0	2.7	1.9	105,649	10.05	0.00	10.05	0.34	1.20	11.13	-1.94	19.30	3.64	0.0	2.8	2.8	4.8	11.1
Jun	0.21	7.3	3.3	3.1	102,160	9.40	0.00	9.40	0.09	1.46	13.61	-5.57	13.73	2.59	0.0	2.8	2.8	5.9	13.6
Jul	0.06	7.9	3.6	3.5	101,187	9.63	0.00	9.63	0.03	1.58	14.80	-6.73	6.99	1.32	0.0	2.8	2.8	6.4	14.8
Aug	0.17	7.0	3.2	3.0	101,869	9.69	0.00	9.69	0.08	1.40	13.60	-5.24	1.76	0.33	0.0	2.8	2.8	5.9	13.6
Sep	0.60	5.3	2.4	1.8	104,658	9.63	0.00	9.63	0.27	1.06	10.59	-1.76	0.00	0.00	0.0	2.8	2.8	4.6	10.6
Oct	1.84	3.2	1.5	0.0	112,219	10.68	0.00	10.68	0.81	0.64	5.71	5.13	5.13	0.97	0.4	2.5	2.8	2.5	5.7
Nov	4.75	1.4	0.6	0.0	131,236	12.08	12.08	0.00	2.10	0.28	0.00	1.82	6.95	1.31	4.1	0.0	4.1	0.0	0.0
Dec	4.55	0.7	0.3	0.0	129,015	12.27	12.27	0.00	2.01	0.14	0.00	1.87	8.82	1.66	4.2	0.0	4.2	0.0	0.0
Total	31.55	48.7	22.1	13.4	-	131.52	61.55	69.97	13.93	9.77	74.14	0.00	-	-	22.8	18.5	41.4	31.9	74.1

Existing pond surface area, ac:	5.3
Maximum pond depth, ft:	4.0
Estimated saturated infiltration, in/hr:	0.06
Infiltration safety factor, percent:	6%
ET reduction factor:	45%
Required wastewater disposal area, ac:	27.9

[a] 100-year values based on annual 100-year precipitation value for Angel's Camp.

[b] Measured evapotranspiration (ET) for San Andreas from UC publication 21426 and 12-month Normal Year ETo maps.

[c] Reduced ET equals measured ET times ET reduction factor to account for local reduction of evaporation.

[d] Net evapotranspiration equals reduced evapotranspiration minus precipitation, zero when negative.

APPENDIX D

PROBABLE CONSTRUCTION COSTS FOR IRRIGATION SYSTEM

TABLE D-1
IRRIGATION SYSTEM COSTS FOR VALLECITO/DOUGLAS FLAT WASTEWATER TREATMENT PLANT

Item	Quantity[a]	Unit	Unit Cost	Cost	Notes
Sprinkler Heads	187	EA	$12	$2,160	Rain Bird Model 30 WH (3/16-inch)
6-in. Air Release/ Vacuum Relief Valve	1	EA	$1,082	$1,082	Cost from Cla-Val
3-in. Automatic Solenoid Operated Valve	5	EA	$144	$721	Cost for Irrotol 100P
3-in Irrigation Pipe	9,002	LF	$24	$216,048	Assuming $8/in-dia, lf
6-in. Force Main	2,118	LF	$48	$101,664	Assuming $8/in-dia, lf
3/4-in Irrigation Pipe	9,350	LF	$6	$56,100	Assuming $8/in-dia, lf
Subtotal	-	-	-	377,775	
Contingency (20 percent)	-	-	-	75,555	
Total	-	-	-	$453,330	

Irrigated area, ac:	26.4
Cost per acre[b]:	$17,000

[a] Quantities for existing sprayfields at Vallecito/Douglas Flat Wastewater Treatment Plant.
[b] Cost per acre equals total cost divided by acreage of existing system (rounded to nearest thousand).

APPENDIX E

PRELIMINARY EVALUATION OF EFFLUENT DISPOSAL ALTERNATIVES FOR THE CCWD VALLECITO WASTEWATER TREATMENT PLANT

NOLTE
BEYOND ENGINEERING

MEMORANDUM

TO:	Tom Schafer	DATE:	June 14, 1999
FROM:	Michael Anderson	PROJ #:	MT 0468
SUBJECT:	Preliminary Evaluation of Effluent Disposal Alternatives for the CCWD Vallecito Wastewater Treatment Plant		

The Calaveras County Water District (CCWD) owns and operates wastewater collection, treatment, and disposal facilities within Calaveras County. The CCWD Vallecito wastewater treatment plant (WWTP) consists of two parallel package plants that receive wastewater from the communities of Vallecito and Douglas Flat. In this memorandum, alternatives for the disposal of wastewater from the WWTP through onsite and offsite vineyard irrigation are considered.

Background Information

The communities of Vallecito and Douglas Flat are located about two miles apart along State Highway 4 in Calaveras County. The WWTP, located between the two communities, consists of two package extended-aeration wastewater treatment plants. The first plant was built in the early 1970s to handle flow from the Douglas Flat area (68 connections estimated). The second plant, completed in the early 1990s, receives flow from the Vallecito area (165 connections estimated). Effluent from the WWTP is disinfected by chlorination, and the combined flow is pumped to an adjacent 15-acre spray field for disposal.

The combined monthly and annual wastewater flows from the WWTP during 1997 and 1998 are presented in Table 1. As shown in Table 1, the average annual daily flow for 1997 and 1998 is approximately 50,000 gal/d. However, during rainy periods, the average daily flow can exceed 100,000 gal/d. The increase in flow is due to high quantities of inflow and infiltration (I&I) that enter the treatment system primarily from the Douglas Flat collection system (gravity sewer). It is estimated that the average dry-weather flow (ADWF) for Douglas Flat is 15,000 gal/d, while the average wet weather flow for Douglas Flat may be as high as 65,000 gal/d. The Vallecito collection system consists of small-diameter lines used to convey septic tank effluent. The amount of I&I entering the Vallecito collection system is believed to be negligible. The Vallecito ADWF is approximately 25,000 gal/d, for a total combined plant ADWF of about 40,000 gal/d.

Two storage ponds, with a combined capacity of 16 million gallons, are used for flow equalization. The older pond (Pond 1) has an area of approximately 2.4 acres, and typically is drained completely by the end of the irrigation season. The newer pond (Pond 2) has an area of approximately 3.0 acres, and is deeper than Pond 1 (maximum pond water depths for

Pond 1 and Pond 2 are 6.5 feet and 10 feet, respectively). Pond 2 is not drained completely, due to the configuration of the pump inlet structure. Pond 1 and Pond 2 are connected hydraulically, and are operated as a single pond.

IRRIGATION WATER BALANCE

To determine the amount of irrigated area needed to dispose of effluent from the WWTP, an irrigation water balance was prepared. In the water balance, historical values for precipitation and evapotranspiration are used to estimate the crop water need, and the irrigated area is calculated based on the volume of water available. Because less water is used during the winter than the summer, the amount of required wastewater storage is also calculated.

Although meteorological data are not collected at the WWTP, several weather stations are located within 60 miles of the facility. A list of weather station located near the WWTP is provided in Table 2. As shown in Table 2, the Sonora RS weather station is located closest to the WWTP (approximately 10 miles). Precipitation values for the Sonora RS weather station are presented in Table 3. It can be seen in Table 3 that while normal precipitation for Sonora is 31.6 inches, annual precipitation totals vary considerably (from 24 to 47 inches). The high I&I values indicated in Table 1 during January and February 1998 can be linked to the high precipitation values measured in Sonora during the same period, as presented in Table 3. Precipitation values used in the Vallecito plant design document (KASL, 1987) have also been included in Table 3. The KASL values are based on an average of precipitation data from San Andreas, Altaville, and Murphys. For the water balance, the KASL normal-year monthly precipitation values have been used. The KASL normal-year precipitation total is 39.3 inches.

In an irrigated vineyard, water losses occur by evaporation from water surfaces and transpiration through plant pores. The processes of evaporation and transpiration usually are combined as evapotranspiration (ET). ET values can be estimated by multiplying pan evaporation values by a pan coefficient (a value of 0.7 is used in this report), or calculated directly. In Table 4, values from stations using both methods are used to estimate evapotranspiration for the WWTP. As shown in Table 4, estimated annual ET for the WWTP ranges from 38.2 to 61.4 inches. For the water balance, the Shenandoah Valley CIMIS (California Irrigation Management Information System) station monthly ET values are used. The Shenandoah Valley CIMIS station average annual ET total is 48.9 inches.

The water balance for the WWTP system is presented in Table 5. Inputs to the system include wastewater and precipitation, and outputs include evaporation and irrigation flow. Irrigation flow is calculated using an assumed leaching factor of ten percent, and an irrigation efficiency of eighty-five percent. It is assumed that no leaks occur from the wastewater storage pond. As shown in Table 5, an irrigated area of 15.5 acres is required to dispose of wastewater during normal years. The required storage pond volume is 13.9 acres, plus the residual volume that cannot be pumped out. Maximum irrigation rates occur in July, when a flow of 139,000 gal/d is required. During the months of November through March, no wastewater is applied to the irrigated area. The wastewater storage ponds are considered as a single system. Minimum pond volume occurs at the end of the September; in October, the wastewater storage ponds begin filling again.

It should be noted that the water balance presented in Table 5 is for normal-year conditions, based on the crop water need (minimum wastewater application). In wetter than normal years, it would be necessary to apply a greater amount of water to the irrigated area. It is likely that the 15-acre irrigated area would be able to accommodate a greater amount of water without causing unfavorable conditions. The maximum amount of water that could be applied to the irrigated area is determined based on soil permeability, BOD loading rates, and nitrogen loading rates.

DISINFECTION REQUIREMENTS

Regulations for the use of reclaimed wastewater for irrigation are found in the California Code of Regulations Title 22, which is currently undergoing revision. In the latest version (September 1998) of the Title 22 revisions, disinfected secondary-2.2 MPN recycled water is required for irrigation of food crops "where the edible portion is produced above ground and not contacted by recycled water." However, disinfected secondary-23 MPN recycled water and even undisinfected secondary recycled water are allowed for irrigation of vineyards and orchards "with no contact between edible portion and recycled water." According to Jeff Stone, the Chair of the Water Reuse Committee (responsible for preparing the Title 22 revisions), it is likely that the current Title 22 revision will be adopted as it now reads, and that no significant changes to the revised code will occur.

Because effluent from the WWTP is treated to secondary standards and is disinfected before discharge, additional improvements to the treatment system will not be required to meet Title 22 disinfection requirements. Total coliform readings from the WWTP generally are below 2.2 MPN. Occasional high total coliform results occur during periods of high I&I, when solids are washed from the Douglas Flat clarifier (which has inadequate capacity). The CCWD is currently implementing a program to reduce I&I, which will result in improved disinfection performance. In addition, if not already implemented, measures should be taken to restrict public access to the wastewater application area.

CCWD SPRAY FIELDS

Currently, effluent from the WWTP is pumped to a 15-acre sprayfield located adjacent to the treatment plant, but at a higher elevation. The maximum water surface elevation of the wastewater storage ponds is 1,885 ft, while the wastewater disposal site elevation ranges from 1,915 to 2,010 ft. Therefore, treatment plant effluent must be pumped vertically from at least 30 to 125 feet.

Estimated force main pumping costs are presented in Table 6. It is assumed in Table 6 that a four-inch PVC force main, with a Hazen-Williams friction coefficient of 140, is used to convey flow to the irrigation site. Based on a combined pump/motor efficiency of fifty percent and a power cost of $0.08/kW-hr, the estimated annual pumping cost to convey effluent from the WWTP to the existing spray fields is approximately $1,260/yr.

Currently, spray irrigation is used at the onsite wastewater disposal site. If vineyards are established at the onsite wastewater disposal area, the sprinkler irrigation system would have to be replaced by drip emitters to prevent wastewater contact with the grapes. Costs for converting the existing sprinkler system to a drip system would include installation of driplines and emitters, control equipment, possibly booster pumps and a filtration system, plus the cost of establishing the vines and supports. It is assumed that if the wastewater disposal area is converted to vineyards, the cost of conversion will be borne by the leasee. Therefore, specific conversion costs are not considered in this report.

KAUTZ VINEYARDS

The Kautz Vineyards property occupies roughly 1,100 acres, and includes apple and Christmas tree orchards, cattle pasture, irrigation and stock ponds, and visitor's facilities in addition to vineyards. The Kautz Vineyards site is located approximately one mile southwest of Murphys on Six-Mile Road, and is separated from the WWTP by a ridge that rises to approximately 2,500 ft. Interest has been expressed in implementing the use of reclaimed WWTP effluent at the Kautz Vineyard. A proposed alignment for a force main to convey flow from the WWTP to the Kautz Vineyard is shown in Figure 1.

Estimated force main pumping costs to discharge flow to the Kautz Vineyards are presented in Table 7. As assumed previously, a four-inch PVC force main, with a Hazen-Williams friction coefficient of 140, is used to convey flow to the irrigation site. The distance to the site and the elevation difference are estimated to be 9,000 ft and 350 ft, respectively. Using a combined pump/motor efficiency of fifty percent and a power cost of $0.08/kW-hr, the estimated annual pumping cost to convey effluent from the WWTP to the Kautz Vineyards is approximately $3,370/yr.

Assuming the pipeline construction rate (including trenching, pipe installation, and backfill) is $25/ft, the pipe construction cost is $225,000. In addition, boring and jacking is required for the pipeline crossing of State Highway 4. Using a boring and jacking rate of $400/ft, and an assumed width of 50 ft, the cost for the highway crossing is an additional $20,000. If $5,000 is added to account for the cost of valves, joints, and other appurtenances, the total probable construction cost for the force main from the WWTP to the Kautz Vineyards is $250,000.

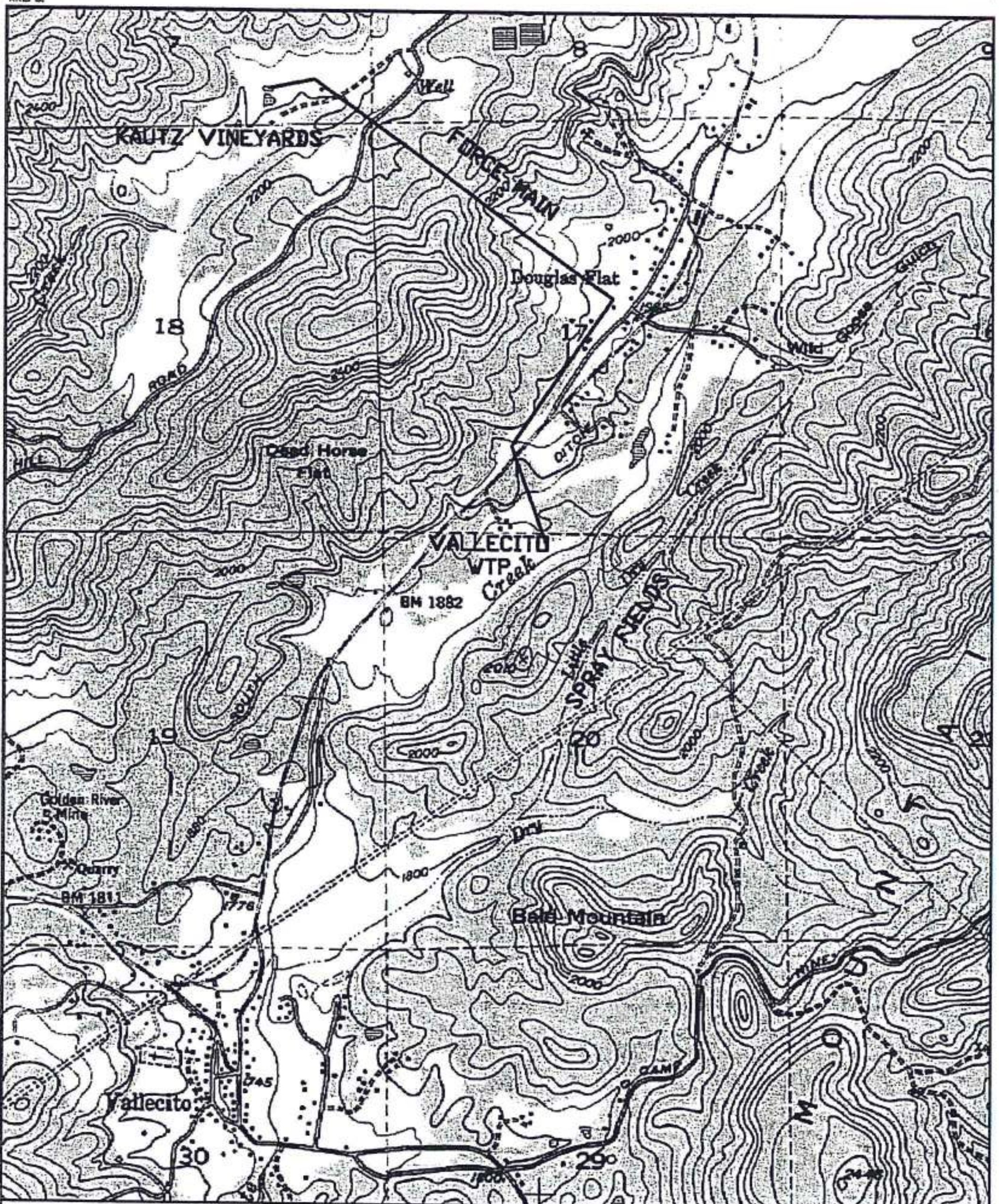
Because irrigation equipment already exists at the Kautz winery, costs for installing irrigation equipment are not estimated in this report. It is assumed that WWTP effluent will be conveyed to a convenient point, such as an irrigation supply pond, from where it can be distributed as desired by the Kautz Vineyard irrigation manager. As calculated for the Vallecito onsite irrigation site, the Kautz Vineyard crop area that can be sustained by WWTP effluent during normal years is 15 acres.

ADDITIONAL FLOW FROM SIX-MILE VILLAGE

The community of Six-Mile Village (Six-Mile Ranch) is located approximately two miles northwest of Vallecito. Currently, wastewater from Six-Mile Village is pumped to the Angels Camp wastewater treatment plant. It has been suggested that, to avoid charges associated with discharging flow to the Angels Camp facility, wastewater from Six-Mile Village could be pumped to the Vallecito WWTP. The impact of adding flows from Six-Mile Village to the Vallecito WWTP are presented in Table 8.

As shown in Table 8, if flows from Six-Mile Village are added to the flows from Vallecito and Douglas Flat received at the Vallecito WWTP, the required irrigated area increases from 15.5 acres to 19.3 acres (based on normal-year conditions, applying minimum water required to meet crop needs). The storage pond volume requirement increases from 13.9 million gallons to 16.2 million gallons, which slightly exceeds the current capacity of the Vallecito WWTP ponds (16 million gallons). However, if additional water is applied to the wastewater disposal area (i.e., more water is applied than needed by the crop), it is possible that the existing facility will have sufficient capacity to accommodate the added flow. To determine the volume of water that can safely be applied to the existing wastewater disposal site, a study of soil permeability, BOD loading rates, and nitrogen loading rates is required.

XREFS:



TIME:3:00 p.m. DATE:04/13/05 PATH:H:\SAB015000\Cadd\ SERVER:NONE SERVICE:NONE DRAWING NAME:KAUTZ.DWG

NOLTE
BEYOND ENGINEERING
1750 CREEKSIDE OAKS DR. SUITE 200, SACRAMENTO, CA 95833
916.641.1500 TEL 916.641.9222 FAX WWW.NOLTE.COM

FORCE MAIN ALIGNMENT
VALLECITO FACILITY
TO KAUTZ WINERY

PREPARED FOR: CCWD

DATE SUBMITTED: 6/8/1999

SHEET NUMBER 1 OF 1 SHEETS

JOB NUMBER MT0468RP

TABLE 1
MONTHLY AND ANNUAL FLOWS FROM VALLECITO WASTEWATER TREATMENT PLANT, 1997 - 1998

	Volume, Mgal		Avg. flow, gal/d	
Month	1997	1998	1997	1998
Jan	1.556	2.566	50,194	82,774
Feb	0.932	2.869	33,286	102,464
Mar	1.236	1.995	39,871	64,355
Apr	1.156	2.125	38,533	70,833
May	1.197	1.771	38,613	57,129
Jun	1.206	1.238	40,200	41,267
Jul	1.280	1.303	41,290	42,032
Aug	1.387	1.341	44,742	43,258
Sep	1.333	1.353	44,433	45,100
Oct	1.364	1.280	44,000	41,290
Nov	1.507	1.382	50,233	46,067
Dec	1.625	1.670	52,419	53,871
Total	15.779	20.893	517,815	690,441
Average	1.315	1.741	43,151	57,537

TABLE 2

SUMMARY OF DATA FOR WEATHER STATIONS LOCATED NEAR VALLECITO WASTEWATER TREATMENT PLANT DISPOSAL SITE[a]

	Site Information				Absolute Error			Error Ranking[c]				Distance,	Annual
Site	Elev, ft	Lat	Long	Years[b]	Elev, ft	Lat	Long	Elev	Lat	Long	Avg.	mi	precip, in
VWTP Disposal Site	1,950	38.10	120.46	-	-	-	-	-	-	-	-	-	-
Fiddletown Dexter RA	2,160	38.52	120.70	49	210	0.41	0.24	6	2	2	3.3	33	36.6
Garden Valley 2 S	1,942	38.83	120.85	25	8	0.73	0.39	1	6	5	4.0	57	38.2
Kelsey 1 N	2,000	38.82	120.82	12	50	0.71	0.36	2	5	3.5	3.5	55	43.0
Mariposa	2,011	37.48	119.97	36	61	0.62	0.49	3	4	6	4.3	55	31.3
Placerville	1,850	38.70	120.82	48	100	0.60	0.36	4	3	3.5	3.5	48	39.0
Sonora RS	1,749	37.98	120.38	63	201	0.12	0.08	5	1	1	2.3	10	31.4

[a] Values from National Oceanic and Atmospheric Administration, National Climatic Data Center, to December 1996. Data included for weather stations located at elevations within 250 ft of Vallecito WWTP elevation, lat/long within 1° of Vallecito WWTP station, with at least ten years of precipitation data collected.

[b] Years equals years of operation times percent coverage.

[c] For ranking, lowest values are best (i.e., closest to Vallecito Wastewater Treatment Plant values).

TABLE 3
MONTHLY PRECIPITATION VALUES FOR
VALLECITO WASTEWATER TREATMENT PLANT AREA

	Precipitation, in				
	Sonora RS[a]			KASL Report[c]	
Month	Normal[b]	1997	1998	Normal[d]	40-year[e]
Jan	5.57	12.87	14.40	4.75	7.98
Feb	5.02	-	14.34	3.19	5.36
Mar	5.27	0.30	6.87	7.95	13.36
Apr	2.73	0.54	-	3.65	6.13
May	0.78	0.10	3.94	2.24	3.76
Jun	0.21	0.00	-	0.56	0.94
Jul	0.06	0.02	-	0.04	0.17
Aug	0.17	0.00	-	0.00	0.00
Sep	0.60	0.17	0.54	0.00	0.00
Oct	1.84	0.98	0.39	3.01	5.06
Nov	4.75	5.85	2.37	6.57	11.04
Dec	4.55	3.08	3.80	7.32	12.30
Total	31.55	23.91	46.65	39.28	66.10

[a] Data for Sonora RS weather station from National Oceanic and Atmospheric Administration, National Climatic Data Center, Asheville, NC.

[b] Normal values are average precipitation values for 1961 to 1990.

[c] KASL report prepared for CCWD May 1987.

[d] Average precipitation for San Andreas, Altaville, and Murphys (1965-1985).

[e] Based on rainfall depth-duration-frequency data for 40-year return period for San Andreas, Altaville, and Murphys.

TABLE 4

MONTHLY EVAPOTRANSPIRATION AND EVAPORATION VALUES FOR VALLECITO WASTEWATER TREATMENT PLANT AREA

	Evaporation or evapotranspiration, in						
	Shenandoah	San	Placerville[c],	San Joaquin Valley[d]		KASL Report	
Month	Valley[a], ET	Andreas[b], ET	Pan*0.7	Pan*0.7	ET	Normal[e]	40-year[f]
Jan	1.04	1.2	0.91	0.9	0.9	1.06	0.66
Feb	1.68	1.5	1.08	1.6	1.7	1.60	1.49
Mar	2.88	2.8	1.86	2.9	3.2	2.32	2.23
Apr	4.35	4.4	2.74	4.1	4.5	4.46	2.65
May	5.63	6.0	4.09	5.8	6.5	6.99	6.06
Jun	6.77	7.3	5.45	6.7	7.5	9.17	6.48
Jul	7.96	7.9	6.51	7.0	7.8	11.18	8.68
Aug	7.16	7.0	5.92	6.0	6.6	9.92	7.36
Sep	5.22	5.3	4.63	4.4	4.8	7.26	5.26
Oct	3.53	3.2	2.75	3.1	3.3	4.57	4.19
Nov	1.70	1.4	1.25	1.5	1.5	1.91	1.07
Dec	0.98	0.7	0.97	0.7	0.7	0.95	0.63
Total	48.90	48.7	38.16	44.7	49.0	61.39	46.76

[a] Data for Shenandoah Valley weather station from CIMIS (California Irrigation Management Information System) for 1990-99. Station located at elevation of 1,550 ft in Amador County (near Plymouth, approximately 40 miles from Vallecito WWTP).

[b] Evapotranspiration values for San Andreas from UC publication 21426 and 12-month Normal Year ET_o Maps.

[c] Data for Placerville IFG weather station from National Oceanic and Atmospheric Administration, National Climatic Data Center, Asheville, NC. Station located at elevation of 2,755 ft (average values from 22 years of data).

[d] Values from CA Department of Water Resources Bulletin No. 113-3 (April 1975).

[e] Based on pan evaporation data from Hogan Dam, Camp Pardee, Jackson, and Don Pedro, multiplied by 0.70.

[f] Based on wet-year pan evaporation data for Hogan Dam, Camp Pardee, Jackson, and Don Pedro, multiplied by 0.70.

TABLE 5

DETERMINATION OF IRRIGATED AREA BASED ON WASTEWATER FLOW FROM VALLECITO WASTEWATER TREATMENT PLANT

	Inflow to storage pond			Outflow from storage pond				Pond volume, Mgal	
	WW[a],	Precipitation		ET[d],	Evap[e],	Irrigation			
Month	Mgal	in[b]	Mgal[c]	in	Mgal	in[f]	Mgal[g]	Change[h]	Total[i]
Jan	2.06	4.75	0.70	1.04	0.15	0.00	0.00	2.60	8.30
Feb	1.90	3.19	0.47	1.68	0.25	0.00	0.00	2.12	10.43
Mar	1.62	7.95	1.17	2.88	0.42	0.00	0.00	2.36	12.78
Apr	1.64	3.65	0.54	4.35	0.64	0.91	0.38	1.16	13.94
May	1.48	2.24	0.33	5.63	0.83	4.39	1.85	-0.86	13.08
Jun	1.22	0.56	0.08	6.77	0.99	8.03	3.38	-3.06	10.01
Jul	1.29	0.04	0.01	7.96	1.17	10.25	4.31	-4.18	5.84
Aug	1.36	0.00	0.00	7.16	1.05	9.26	3.89	-3.58	2.26
Sep	1.34	0.00	0.00	5.22	0.77	6.75	2.84	-2.26	0.00
Oct	1.32	3.01	0.44	3.53	0.52	0.67	0.28	0.96	0.96
Nov	1.44	6.57	0.96	1.70	0.25	0.00	0.00	2.16	3.12
Dec	1.65	7.32	1.07	0.98	0.14	0.00	0.00	2.58	5.70
Total	18.34	39.28	5.76	48.90	7.17	40.27	16.92	0.00	-

Storage pond area[j], ac:	5.4
Leaching factor:	0.10
Irrigation efficiency:	0.85
Irrigated area, ac:	15.5

[a] Pond wastewater inflow values based on monthly flow volumes from Vallecito WWTP for 1997-98.

[b] Precipitation values from 1987 KASL report (average values for San Andreas, Altaville, and Murphys).

[c] Pond precipitation inflow equals precipitation depth times storage pond area.

[d] Evapotranspiration values from Shenandoah Valley CIMIS station (Plymouth, Amador County).

[e] Pond evaporation outflow estimated using evapotranspiration depth times storage pond area.

[f] Irrigation depth equals (1 + leaching factor) * (ET - precipitation) / (irrigation efficiency)

[g] Irrigation volume equals irrigation depth times irrigated area.

[h] Change in pond volume equals wastewater inflow plus precipitation minus evapotranspiration minus irrigation outflow.

[i] Total volume equals volume from preceding month plus change in pond volume (begins in October).

[j] Two storage ponds considered as single pond system.

TABLE 6
PUMPING COSTS TO CONVEY VALLECITO WASTEWATER TREATMENT PLANT EFFLUENT TO EXISTING SPRAY FIELDS

Month	Volume, Mgal	Flow, gal/min	H-W head, ft	Total head, ft	Power, HP	Power, kW	Cost, $
Jan	0.00	0.0	0.0	130	0.0	0.0	$ -
Feb	0.00	0.0	0.0	130	0.0	0.0	$ -
Mar	0.00	0.0	0.0	130	0.0	0.0	$ -
Apr	0.38	8.8	0.3	130	0.6	0.4	$ 25
May	1.85	41.4	4.5	135	2.8	2.1	$ 126
Jun	3.38	78.2	14.6	148	5.8	4.3	$ 250
Jul	4.31	96.5	21.6	156	7.6	5.7	$ 337
Aug	3.89	87.2	17.9	151	6.7	5.0	$ 296
Sep	2.84	65.7	10.6	143	4.7	3.5	$ 204
Oct	0.28	6.3	0.1	130	0.4	0.3	$ 19
Nov	0.00	0.0	0.0	130	0.0	0.0	$ -
Dec	0.00	0.0	0.0	130	0.0	0.0	$ -
Total	16.92	-	-	-	-	-	$ 1,257

Static head, ft:	130
Force main diameter, in:	4
Force main length, ft:	3,500
Hazen-Williams coefficient:	140
Minor losses:	0.20
Pump/motor efficiency:	0.50
Cost per kW-hr:	$0.08

TABLE 7
PUMPING COSTS TO CONVEY VALLECITO WASTEWATER TREATMENT PLANT EFFLUENT TO KAUTZ WINERY

Month	Volume, Mgal	Flow, gal/min	H-W head, ft	Total head, ft	Power, HP	Power, kW	Cost, $
Jan	0.00	0.0	0.0	350	0.0	0.0	$ -
Feb	0.00	0.0	0.0	350	0.0	0.0	$ -
Mar	0.00	0.0	0.0	350	0.0	0.0	$ -
Apr	0.38	8.8	0.7	351	1.6	1.2	$ 67
May	1.85	41.4	11.6	364	7.6	5.7	$ 338
Jun	3.38	78.2	37.5	395	15.6	11.6	$ 670
Jul	4.31	96.5	55.4	417	20.3	15.1	$ 901
Aug	3.89	87.2	46.0	405	17.9	13.3	$ 793
Sep	2.84	65.7	27.2	383	12.7	9.5	$ 546
Oct	0.28	6.3	0.4	350	1.1	0.8	$ 50
Nov	0.00	0.0	0.0	350	0.0	0.0	$ -
Dec	0.00	0.0	0.0	350	0.0	0.0	$ -
Total	16.92	-	-	-	-	-	$ 3,365

Static head, ft:	350
Force main diameter, in:	4
Force main length, ft:	9,000
Hazen-Williams coefficient:	140
Minor losses:	0.20
Pump/motor efficiency:	0.50
Cost per kW-hr:	$0.08

TABLE 8

DETERMINATION OF IRRIGATED AREA BASED ON WASTEWATER FLOW FROM VALLECITO WASTEWATER TREATMENT PLANT AND SIX MILE VILLAGE

	Inflow to storage pond			Outflow from storage pond				Pond volume, Mgal	
	WW[a],	Precipitation		ET[d],	Evap[e],	Irrigation			
Month	Mgal	in[b]	Mgal[c]	in	Mgal	in[f]	Mgal[g]	Change[h]	Total[i]
Jan	2.52	4.75	0.70	1.04	0.15	0.00	0.00	3.07	9.72
Feb	2.28	3.19	0.47	1.68	0.25	0.00	0.00	2.50	12.22
Mar	1.93	7.95	1.17	2.88	0.42	0.00	0.00	2.68	14.90
Apr	1.91	3.65	0.54	4.35	0.64	0.91	0.48	1.33	16.23
May	1.85	2.24	0.33	5.63	0.83	4.39	2.31	-0.95	15.28
Jun	1.55	0.56	0.08	6.77	0.99	8.03	4.22	-3.58	11.70
Jul	1.60	0.04	0.01	7.96	1.17	10.25	5.38	-4.94	6.76
Aug	1.73	0.00	0.00	7.16	1.05	9.26	4.86	-4.18	2.58
Sep	1.74	0.00	0.00	5.22	0.77	6.75	3.55	-2.58	0.00
Oct	1.65	3.01	0.44	3.53	0.52	0.67	0.35	1.22	1.22
Nov	1.78	6.57	0.96	1.70	0.25	0.00	0.00	2.50	3.72
Dec	2.01	7.32	1.07	0.98	0.14	0.00	0.00	2.94	6.66
Total	22.56	39.28	5.76	48.90	7.17	40.27	21.15	0.00	-

Storage pond area[j], ac:	5.4
Leaching factor:	0.10
Irrigation efficiency:	0.85
Irrigated area, ac:	19.3

[a] Pond wastewater inflow values based on monthly flow volumes from Vallecito WWTP and Six Mile Village for 1997-98.

[b] Precipitation values from 1987 KASL report (average values for San Andreas, Altaville, and Murphys).

[c] Pond precipitation inflow equals precipitation depth times storage pond area.

[d] Evapotranspiration values from Shenandoah Valley CIMIS station (Plymouth, Amador County).

[e] Pond evaporation outflow estimated using evapotranspiration depth times storage pond area.

[f] Irrigation depth equals (1 + leaching factor) * (ET - precipitation) / (irrigation efficiency)

[g] Irrigation volume equals irrigation depth times irrigated area.

[h] Change in pond volume equals wastewater inflow plus precipitation minus evapotranspiration minus irrigation outflow.

[i] Total volume equals volume from preceding month plus change in pond volume (begins in October).

[j] Two storage ponds considered as single pond system.

APPENDIX F

COLLECTION, TREATMENT, STORAGE AND DISPOSAL PROBABLE OPERATION AND MAINTENANCE COSTS

The costs presented in this Appendix are based on the Vallecito/Douglas Flat WWTP O&M budget for 2004/2005. In general O&M costs are scaled up based on flow or disposal area where possible. For collection, treatment, storage and disposal strategies L-1, L-2 and L-3, the O&M costs are based on a conventional treatment process that produces secondary effluent. The land application with creek discharge strategies (L/C-1, L/C-2 and L/C-3) and the Kautz offsite land disposal strategies (L-1K, L-2K, and L-3K) are based on operating an MBR facility that produces tertiary effluent.

TABLE F-1
COLLECTION, TREATMENT, STORAGE, AND DISPOSAL PROBABLE OPERATION AND MAINTENANCE COSTS FOR THE DOUGLAS AND VALLECITO PLANTS

		Annual Operation and Maintenance Cost, $/yr				
Strategy		Collection	Treatment	Storage	Disposal	Total
L-1	Unit	LS	GPD	LS	AC	
	Quantity	1	67,700	1	38.8	
	Unit Cost	$ 57,000 [a]	$ 2.1 [b]	$ 10,000 [c]	$ 485 [d]	
	Cost	$ 57,000	$ 142,200	$ 10,000	$ 18,800	$ 228,000
L-2	Unit	LS	GPD	LS	AC	
	Quantity	1	85,200	1	48.8	
	Unit Cost	$ 72,000 [a]	$ 2.1 [b]	$ 10,000 [c]	$ 485 [d]	
	Cost	$ 72,000	$ 178,900	$ 10,000	$ 23,700	$ 284,600
L-3	Unit	LS	GPD	LS	AC	
	Quantity	1	100,800	1	57.8	
	Unit Cost	$ 85,000 [a]	$ 2.1 [b]	$ 10,000 [c]	$ 485 [d]	
	Cost	$ 85,000	$ 211,700	$ 10,000	$ 28,000	$ 334,700
L-1K	Unit	LS	GPD	LS	AC	
	Quantity	1	67,700	1	38.8	
	Unit Cost	$ 57,000 [e]	$ 3.9 [f]	$ 10,000 [c]	$ 679 [g]	
	Cost	$ 57,000	$ 260,600	$ 10,000	$ 26,300	$ 353,900
L-2K	Unit	LS	GPD	LS	AC	
	Quantity	1	85,200	1	48.8	
	Unit Cost	$ 72,000 [e]	$ 3.9 [f]	$ 10,000 [c]	$ 679 [g]	
	Cost	$ 72,000	$ 328,000	$ 10,000	$ 33,100	$ 443,100
L-3K	Unit	LS	GPD	LS	AC	
	Quantity	1	100,800	1	57.7	
	Unit Cost	$ 85,000 [e]	$ 3.9 [f]	$ 10,000 [c]	$ 679 [g]	
	Cost	$ 85,000	$ 388,100	$ 10,000	$ 39,200	$ 522,300

TABLE F-1 (Continued)
COLLECTION, TREATMENT, STORAGE, AND DISPOSAL PROBABLE OPERATION AND MAINTENANCE COSTS FOR THE DOUGLAS AND VALLECITO PLANTS

Strategy		Annual Operation and Maintenance Cost, $/yr: Collection	Treatment	Storage	Disposal	Total
L/C-1	Unit	LS	GPD	LS	LS	
	Quantity	1	67,700	1	1	
	Unit Cost	$ 57,000 [e]	$ 3.9 [f]	$ 10,000 [c]	$ 100,000 [h]	
	Cost	$ 57,000	$ 260,600	$ 10,000	$ 100,000	$ 427,600
L/C-2	Unit	LS	GPD	LS	LS	
	Quantity	1	85,200 [f]	1	1	
	Unit Cost	$ 72,000 [e]	$ 3.9	$ 10,000 [c]	$ 120,000 [h]	
	Cost	$ 72,000	$ 328,000	$ 10,000	$ 120,000	$ 530,000
L/C-3	Unit	LS	GPD	LS	LS	
	Quantity	1	100,800	1	1	
	Unit Cost	$ 85,000 [e]	$ 3.9 [f]	$ 10,000 [c]	$ 140,000 [h]	
	Cost	$ 85,000	$ 388,100	$ 10,000	$ 140,000	$ 623,100

[a] Based on the Vallecito/Douglas Flat WWTP O&M costs for 2004/2005, collection system costs are 40% of treatment costs ($41,700/$101,000).

[b] Based on the Vallecito/Douglas Flat WWTP O&M costs for 2004/2005, treatment costs are $2.1/gpd ($101,000/47,000gpd).

[c] Based on the Vallecito/Douglas Flat WWTP O&M costs for 2004/2005, storage and disposal costs are $22,600/yr. The storage portion is approximately $10,000/yr.

[d] Based on the Vallecito/Douglas Flat WWTP O&M costs for 2004/2005, storage and disposal costs are $22,600/yr. The disposal portion is approximately $485/ac ($12,600/yr for 26 ac).

[e] Collection system costs do not change if the Vallecito/Douglas Flat WWTP is upgraded to a tertiary process.

[f] Treatment costs were increased because of the increased requirements of the tertiary process.

[g] Increase cost by 40% because of the monitoring requirements and time and effort to coordinate pumping to Kautz

[h] Increase cost for monitoring requirements associated with NPDES.