City of Morro Bay • Cayucos Sanitary District

Wastewater Treatment Plant

Facility Master Plan Report

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September 4, 2007
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Joint Board of:

City of Morro Bay
955 Shasta Avenue
Morro Bay, CA 93442

Cayucos Sanitary District
200 Ash Avenue
Cayucos, CA 93430

Attention: Mr. Bruce Ambo, Public Services Director (City of Morro Bay)
Mr. Bill Callahan, District Manager (Cayucos Sanitary District)

Subject: Final Draft Facility Master Plan

Ladies and Gentlemen of the Joint Board:

Enclosed is the final Draft of the Facility Master Plan Report for upgrade of the Morro Bay/Cayucos Sanitary District Wastewater Treatment Plant.

Since August 2006, the Joint Powers Agreement (JPA) Board has been working to develop a draft Facility Master Plan for upgrade of the Wastewater Treatment Plant. During this time, the JPA Board has been presented with various technical topics ranging from regulatory requirements to wastewater and biosolids treatment alternatives, and the JPA Board has consistently provided feedback and direction to Carollo Engineers, P.C. (Carollo). Impacts on the receiving waters, the ratepayers in both communities, and local sustainability were topics that framed discussion in seven public meetings and other smaller technical subcommittee meetings.

The report resulting from these meetings is intended to facilitate the environmental review process. Based on the results of the environmental review process, Carollo will edit the facilities plan and publish a Final Report. This report is also completed so it can be easily adapted to the State Revolving Fund (SRF) program format. The report is one of the first steps needed to apply for the State Water Resources Control Board SRF Loan Program.

This report outlines the wastewater treatment facilities needed to develop the tertiary treatment capacity of the plant to 1.5 mgd. The major components of the project, endorsed by the JPA Board, include oxidation ditches, tertiary filters, and improvements to the current composting process. In addition to these major facilities, the project also includes the rehabilitation of the anaerobic digesters, construction of a new secondary clarifier and chlorine contact basin, and miscellaneous improvements to the control/laboratory building. The existing trickling filters, solids contact basin, chlorine contact basin, Digester No. 1, and primary clarifiers will be retired as part of the project.

Based on initial cost estimates developed as part of the Facility Master Plan analysis, the total construction cost for the project is $20.8 million (June 2006 dollars). In addition to the construction costs, the project also includes planning, environmental, engineering design and

7580 N. Ingram Avenue, Suite. 112, Fresno, California 93711
P. 559.436.6616 F. 559.436.1191
carollo.com

construction monitoring, legal and administrative costs, and interest on the SRF loan incurred during the construction period. The total estimated project cost is $28.1 million.

Carollo would appreciate the opportunity to further assist the City and District on the Wastewater Treatment Plant Upgrade during the environmental review process. Should you have any questions, feel free to call us.

Sincerely,

CAROLLO ENGINEERS, P.C.

David L. Stringfield, P.E.
Partner

DLS/ETC:cjp

Enclosures: Draft Facility Master Plan Report

Morro Bay Cayucos Sanitary District

WASTEWATER TREATMENT PLANT FACILITY MASTER PLAN

September 2007

carollo engineers

Morro Bay Cayucos Sanitary District

WASTEWATER TREATMENT PLANT
FACILITY MASTER PLAN

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REFERENCES

3.1 "Sewer Collection System Master Plan Update", prepared by the Wallace Group, for the City of Morro Bay, May 2006.

3.2 "2004 Water Management Plan Update", prepared by Boyle Engineering Coproation, for the Cayucos Area Water Organization, October 2005.

3.3 "Alternatives Evaluation Report," prepared by Cannon Associates, for the City of Morro Bay and Cayucos Sanitary District, March 2004.

5.1 NPDES Permit No. CA0047881

5.2 "Comprehensive Recycled Water Supply", prepared by Carollo Engineers, P.C., for the City of Morro Bay and Cayucos Sanitary District, March 2000.

MORRO BAY CAYCUCOS SANITARY DISTRICT WASTEWATER TREATMENT PLANT FACILITY MASTER PLAN

ES.1 SUMMARY

Since August 2006, the Joint Powers Agreement (JPA) Board, which is comprised of both the City of Morro Bay (City) Council and members of the Cayucos Sanitary District (CSD) Board, have been working to develop a draft facilities plan for upgrade of the Morro Bay Cayucos Sanitary District (MBCSD) wastewater treatment plant (WWTP) through the twenty-year planning period ending in 2026. During this time, the JPA Board has been presented with various technical topics ranging from regulatory requirements to wastewater and biosolids treatment alternatives, and has consistently provided feedback and direction. Impacts on the receiving waters, the ratepayers in both communities, and local sustainability were topics that framed discussion in seven public meetings and other smaller technical subcommittee meetings. The public meetings were intended to educate the residents of the local community and JPA Board, and to provide Carollo Engineers, P.C. (Carollo) sufficient direction to complete the facilities planning process.

The result of this process has been the selection of tertiary treatment with onsite composting as the preferred project for upgrade of the WWTP. The decisions made by the JPA Board have supported local sustainability by positioning the community for future water reuse, and promoting continued biosolids reuse within San Luis Obispo County.

ES.2 HISTORICAL AND PROJECTED FLOWS AND LOADINGS

Historical and projected flows and loadings were analyzed for the twenty-year planning period. New flows and loadings projections are used to design treatment alternatives for upgrade of the WWTP as well as assist in determining future capacity needs for the City and CSD.

Because of the nature of the WWTP, flows and loadings were determined for the City and CSD separately. While a traditional per capita flow approach was followed for the City, flow projections for the CSD were determined using historical sewer connection data provided by CSD staff. Several flow conditions were included for the analysis including the average annual daily flow (AADF), the peak seasonal dry weather flow (PSDWF), the average day maximum month flow (ADMMF), and the peak hour flow (PHF). The PSDWF condition represents the greatest average monthly flow for the months of July and August, and was chosen because it encompasses the traditional peak tourist season for the community. The PSDWF represents the worst-case scenario the WWTP encounters for organic loading.

Based on population projections and historical flow analysis, the City may reach its build-out population as soon as 2021 with a peak seasonal flow (PSF) of 1.05 mgd. The CSD may reach its build-out as soon as 2015 with a PSF of 0.42 mgd. At the end of the twenty-year planning period, the total PSF at the WWTP is estimated to be1.47 mgd with the City contributing 71.4 percent of the total flow, and the CSD contributing 28.6 percent. This new total peak seasonal flow is less than the existing design capacity of 2.36 mgd and the distribution between the City and CSD has changed. The current split in WWTP ownership is 65 percent the City and 35 percent the CSD. The PHF was also evaluated and a flow factor of 4.5 was chosen. Therefore, the MBCSD WWTP will need to be designed to pass 5.97 mgd during heavy storm events.

Historical plant data has shown that the strength of the wastewater at the WWTP is greater than the existing design criteria for five-day biochemical oxygen demand (BOD_5) and total suspended solids (TSS). The five-year (2002-2006) average peak seasonal BOD_5 and TSS concentrations are 374 milligrams per liter (mg/L) and 404 mg/L respectively. For the design of treatment alternatives, a BOD_5 concentration of 410 mg/L and a TSS concentration of 420 mg/L will be used. This increase in wastewater strength and a corresponding decrease in peak seasonal flow results in new organic loadings, which are similar to the existing design loadings. The design criteria that were used to design and evaluate different treatment alternatives is shown in Table ES.1.

Table ES.1 Summary of Design Flows and Loadings
WWTP Facility Master Plan
MBCSD

	AADF			PSDWF		
Parameter	**Morro Bay**	**CSD**	**Total**	**Morro Bay**	**CSD**	**Total**
Flow	1.00	0.33	1.33	1.07	0.43	1.50
BOD_5 - mg/L	340	340	340	410	410	410
BOD_5 - ppd	2,837	925	3,762	3,592	1,449	5,042
TSS - mg/L	360	360	360	420	420	420
TSS - ppd	3,004	979	3,983	3,680	1,485	5,165

ES.3 SUBSOIL STABILIZATION

Due to the characteristics of the soil at the MBCSD WWTP site, subsoil stabilization was performed in and around areas where structures such as the Administration Building and Headworks were constructed during the last expansion of the MBCSD WWTP in 1982. Carollo assumes that during the next expansion to the WWTP, similar earthwork must also be done to prepare for construction.

The subsoil stabilization method performed in 1982 is known as vibrocompaction. Vibrocompaction is a specialized subsoil stabilization method that is used primarily in clean

saturated sand profiles like those found at the WWTP. Based on information outlined in the specifications, a budgetary cost estimate was obtained from Hayward Baker, a geotechnical contractor with extensive vibrocompaction experience. The vibrocompaction performed in 1982 would cost approximately $1 million/acre if done for this phase of expansion.

In order to present the most accurate cost estimate in the facilities plan for the final recommended project, Carollo will include $1 million to cover the cost of subsoil stabilization for this phase of expansion. The actual cost of subsoil stabilization will be determined by a geotechnical engineer during the design phase of this project.

ES.4 REGULATIONS

The MBCSD received their current WWTP Waste Discharge Requirements (WDR) No. 98 15 in December 1998. Since the MBCSD discharges to the ocean, these requirements are primarily based on the National Pollutant Discharge Elimination System (NPDES) Permit No. 0047881 and the Water Quality Control Plan for Ocean Waters of California (Ocean Plan). The current NPDES permit is a modified 301(h) discharge permit, which modifies full secondary treatment requirements for BOD_5 and suspended solids. Although the modified permit expired on March 1, 2004, it continues to be enforced until a new permit is issued. The draft of a new tentative permit was issued in November 2005, but several issues have delayed approval by the Central Coast Region of the Regional Water Quality Control Board (RWQCB).

In addition to existing discharge requirements, the MBCSD would also be subject to new and more stringent regulations if the current discharge location is changed to another water body such as Chorro Creek. For this reason, the Central Coast Basin Plan, Inland Surface Waters Plan, and Enclosed Bays and Estuaries Plan could be applicable to the MBCSD in the future.

Several other important regulatory areas also apply to the MBCSD including pretreatment, recycled water, and biosolids. Recycled water projects have been previously explored for both City and CSD and biosolids are now being composted at the WWTP. The role of these processes and their regulatory requirements has the potential to affect future design considerations for the WWTP.

ES.5 REHABILITATION

The original MBCSD WWTP was constructed in 1953 with the original digester, trickling filter, and primary clarifier are still in operation. In 1964, a second primary clarifier, trickling filter, chlorination facilities, and digester were added. Between 1982 and 1984, it was expanded to its current configuration. Overall, the equipment and facilities appear to be in a well-maintained condition. This reflects the dedication and commitment of the WWTP operations and maintenance staff. Most of the existing facilities appear to be in good structural condition and with some rehabilitation and upgrades should have the capacity to

serve the MBCSD WWTP for the projected build-out flow conditions. The cost of rehabilitation for each of the process areas is presented in Table ES. 2.

Based on the condition of several of the facilities constructed in 1953 and 1964, the JPA Board has given Carollo the direction to retire Trickling Filter No. 1, Trickling Filter No. 2, Primary Clarifier No. 1, Primary Clarifier No. 2, Digester No. 1, and the Chlorine Contact Basin as part of the WWTP upgrade. These facilities will have been in service for 50 years or longer when the upgraded facility goes online in 2014. It will be more cost effective for the MBCSD to retire and demolish these facilities rather than rehabilitate them as part of the recommended project.

Table ES.2 Summary of Rehabilitation Costs
WWTP Facility Master Plan
MBCSD

Process Area	Estimated Costs	
	Construction[1, 2]	**Project[4]**
Preliminary Treatment Facilities	$2,190,000	$2,957,000
Primary Treatment Facilities	$534,000	$721,000
Interstage Pump Station	$360,000	$486,000
Secondary Treatment Facilities	$480,000	$648,000
Disinfection Facilities	$420,000	$567,000
Digestion Facilities	$3,642,000	$4,917,000
Control Building Facilities	$1,392,000	$1,879,000
Electrical Facilities	$1,860,000	$2,511,000
Miscellaneous Facilities[3]	$780,000	$1,053,000
Total	**$11,658,000**	**$15,739,000**

Notes:
1. ENR (20 cities) June 2006 = 7,700.
2. Includes Contractor overhead and profit.
3. Miscellaneous Facilities include plant water system, plant drain, and yard piping.
4. Includes Engineering, Administrative, Legal, and SRF Loan interest costs.

In response to the findings made during the initial site visit in May 2006, Carollo recommended additional work be performed by discipline experts to accurately determine the extent of corrosion of the existing facilities. The specific areas that required more attention included the WWTP's electrical equipment, underground piping and cathodic protection equipment.

In March 2007, Schiff Associates performed a corrosion survey at the WWTP site. The corrosion survey revealed that the metallic structures are experiencing localized and general corrosion, soil at the site is highly corrosive to ferrous metals, and the cathodic

protection system is not providing adequate protection at several sites throughout the facility.

Based on this high cost, on August 29, 2006, an electrical engineer with Carollo performed a review of the electrical equipment. Initially the cost of rehabilitation for the electrical system was estimated at $2,511,000. Based on this more in-depth assessment performed by the electrical engineer, the actual costs of the upgrades to the existing electrical equipment is estimated at $1,531,000 (Appendix H).

The information obtained from this chapter, as well as the additional information obtained from the electrical and corrosion studies is used in subsequent chapters of this report to develop accurate planning level costs for biosolids and wastewater treatment alternatives for upgrade of the MBCSD WWTP.

ES.6 BIOSOLIDS TREATMENT AND DISPOSAL

The MBCSD WWTP currently treats and stabilizes biosolids using anaerobic digestion. After digestion, the biosolids are applied to sludge drying beds, where they are dried to an average solids concentration of 80 percent. These dried solids meet the requirements for EPA Class B biosolids, and are hauled away by San Joaquin Composting for further treatment and land application in Kern County or composted at the plant site.

Table ES.3 summarizes the project costs and 20-year present value (PV) for the six biosolids management options proposed for the MBCSD. Based on this analysis, the most economically favorable biosolids management practice for the MBCSD with extended aeration activated sludge (EAAS) in the short-term future is Option 6, which involves sending undigested sludge to a centrifuge for dewatering, and directly to a container for offsite disposal. The difference in project cost between offsite disposal of Class B product and onsite composting is relatively small, and the ultimate solution for the MBCSD will be a combination of several of the options that have been presented.

ES.7 ALTERNATIVES ANALYSIS

Prior to the evaluation of the current facility done by Carollo it was assumed the secondary treatment capacity of the existing WWTP was 0.97 mgd. As a result of the alternative analysis process, the secondary treatment capacity of the existing WWTP was found to be approximately 0.5 mgd. This reduced capacity can be attributed to the more restrictive effluent requirements used to evaluate the facility and the increased strength of the wastewater entering the plant. The effluent requirements used to evaluate the WWTP include both a BOD_5 and TSS concentration of 20 mg/L compared to the current BOD_5 and TSS limits of 120 mg/L and 70 mg/L. The concentrations of both BOD_5 and TSS currently entering the WWTP are significantly higher than the design criteria used to design the last expansion of the WWTP.

Table ES.3 Summary of Biosolids Management Options Costs WWTP Facility Master Plan MBCSD					
			Estimated Costs		
Option	Description	Classification	Project	O&M Present Value (20 Years)	Total Present Value
No. 1	TFSC - Composting	Class A	$6,001,000	$3,652,000	$9,653,000
No. 2	TFSC - Sludge Beds	Class B	$5,219,000	$3,104,000	$8,323,000
No. 3	TFSC - No Sludge Beds	Class B	$5,219,000	$4,273,000	$9,492,000
No. 4	Extended Aeration - Composting	Class A	$5,798,000	$3,970,000	$9,768,000
No. 5	Extended Aeration - Sludge Beds	Class B	$5,486,000	$3,464,000	$8,950,000
No. 6	Extended Aeration - Without Digestion	sub-Class B	$3,488,000	$5,140,000	$8,628,000

ES.7.1 Tertiary Treatment Alternatives

A detailed comparison of the tertiary treatment alternatives, membrane bioreactors and extended aeration activated sludge with filtration, is first presented. The criteria used to compare these alternatives include costs, regulatory compliance, and operational factors.

The cost components evaluated for these alternatives include construction, operations, maintenance, and PV costs. The PV cost represents the cost in today's dollars for the construction of the WWTP upgrades as well as operations and maintenance costs for a 20-year period. Based on the initial planning done for these alternatives, the total project costs for a membrane bioreactor (MBR) and extended aeration activated sludge/filtration (EAAS/Filtration) are $23,576,000 and $15,561,000 respectively. These project costs are in June 2006 dollars, and include contingencies and fees for administration, engineering, and legal.

A MBR is an advanced technology that provides an effluent of higher quality than the activated sludge/filtration option. While both provide tertiary treatment as required for unrestricted reuse, a MBR has the added benefit of removing a wider array of pathogens. The benefits of both options will be discussed in this report.

One important aspect of the EAAS/Filtration process is that the amount of tertiary effluent that is produced can be tailored to fit the needs of the City and CSD. With this option, filters can be initially installed to receive only a portion of the daily flow. Units can be easily added in the future to increase the tertiary capacity of the facility.

ES.7.2 Secondary Treatment Alternatives

The two secondary alternatives that have been evaluated for upgrade of the MBCSD WWTP are also compared in this report. A detailed comparison of Alternative No. 1 (Trickling Filter/Solids Contact) and No. 2 (Extended Aeration Activated Sludge) is included. The Trickling Filter/Solids Contact (TFSC) alternative is the process currently used at the MBCSD WWTP.

The EAAS process evaluated in this chapter is an oxidation ditch that is very similar to what was recently designed by Carollo for the City of Pismo Beach and the California Men's Colony in the City of San Luis Obispo. Alternative No. 2 is also the same as Alternative No. 4 (EAAS/Filtration) without the inclusion of cloth-media disk filters or any other type of tertiary filtration.

Based on the initial planning done for these alternatives, the total project costs for TFSC and EAAS are very similar. The difference in cost between these two alternatives is less than 1 percent; that is to say, both alternatives have the same cost based on Carollo's cost estimating capabilities at this stage in the process.

The TFSC process will meet the design criteria of 20 mg/L BOD_5 and TSS, but not significantly better. The EAAS process will treat the wastewater to "advanced" secondary. For example, the effluent quality discharged by the oxidation ditches at the City of Pismo Beach has a BOD_5 and TSS concentration of between 1 and 5 mg/L.

Several operational factors must be considered when comparing the available secondary alternatives for upgrade of the MBCSD WWTP including ease of operation, biosolids management, and odors. While plant staff is familiar with the TFSC process, oxidation ditches are easier to operate and have fewer associated facilities.

While odor has not been a particular problem for the WWTP up to this point, trickling filters and primary clarifiers are known for their potential odor and vector problems. If trickling filters are incorporated into this phase of expansion, the trickling filters and primary clarifiers may need to be covered in the future at a significant cost to the City and CSD. These costs have not been included in the TFSC alternative. A summary of the costs for each alternative is presented in Table ES.4.

Table ES.4	Summary of Treatment Alternatives Costs WWTP Facility Master Plan MBCSD					
			Estimated Costs			
Alternative	Description	Effluent Classification	Project[1]	O&M	O&M Present Value (20 Years)	Total Present Value
No. 1	Trickling Filters/Solids Contact	Secondary	$13,218,000	$589,000	$8,502,000	$21,720,000
No. 2	Oxidation Ditches	Secondary	$13,152,000	$503,000	$7,261,000	$20,413,000
No. 3	MBR	Tertiary	$23,576,000	$822,000	$11,866,000	$35,442,000
No. 4	EAAS/Filtration	Tertiary	$15,561,000	$578,000	$8,344,000	$23,905,000

Note:
1. Includes Engineering, Administrative, Legal, and SRF Loan interest costs.

ES.8 RECOMMENDATIONS

The purpose of this chapter is to present the four recommendations that have been developed for upgrade of the MBCSD WWTP. These recommendations include both secondary and tertiary treatment options. In addition to treatment options, each recommendation has also been presented with different biosolids management options, which include hauling and composting. The aspects of each recommendation and range of biosolids options are described in detail, and the chapter concludes with a critical analysis of each recommendation.

ES.8.1 Recommendation No. 1 - Oxidation Ditch

Recommendation No. 1 includes the construction of new oxidation ditches at the WWTP with biosolids handling facilities that will produce a sub-Class B quality biosolids product. This recommendation has a total project cost of $24,165,000, the lowest of any of the alternatives. Following the upgrade, the WTTP will have the ability to discharge up to 1.5 mgd of advanced secondary quality effluent to the ocean. Sludge will be sent directly to centrifuges for dewatering, and discharged to bins or trailers for immediate disposal offsite.

ES.8.2 Recommendation No. 1A - Oxidation Ditch with Filters

Recommendation No. 1A has been developed as a tertiary treatment alternative to Recommendation No. 1. This recommendation includes all the components of the oxidation ditch and direct hauling processes previously described with the addition of tertiary filters. Following the upgrade, the WWTP will have the ability to discharge 1.5 mgd of tertiary quality effluent to the ocean. The project cost of Recommendation No. 1A is estimated at

$26,233,000, an incremental cost of approximately $2 million over the advanced secondary option.

ES.8.3 Recommendation No. 2 - Trickling Filters/Solids Contact

Recommendation No. 2 includes the rehabilitation of the existing TFSC process with solar drying of biosolids. This recommendation also includes the construction of three new trickling filters and solids contact basins. The type of biosolids management included in this recommendation mirrors what is currently practiced at the WWTP with the addition of mechanical dewatering. Currently, the majority of the Class B biosolids produced are hauled offsite by San Joaquin Composting and 30 percent is composted onsite. Following the upgrade, the WWTP will have the ability to discharge 1.5 mgd of secondary quality effluent to the ocean. The project cost of Recommendation No. 2 is estimated at $25,107,000. While this recommendation will produce an effluent that will meet the future anticipated ocean discharge requirements, the trickling filters produce the lowest quality effluent, with the highest levels of BOD and TSS, of any of the recommendations being considered.

A breakdown of the costs for each recommendation with direct hauling of biosolids is presented in Table ES.5.

Table ES.5 Breakdown of Recommendations Project Costs with Direct Hauling of Biosolids WWTP Facility Master Plan MBCSD

	Recommendations			
Process Area	**Rec. No. 1 EAAS w/Direct Haul**	**Rec. No. 1A EAAS/Filtration w/Direct Haul**	**Rec. No. 2 TFSC w/Hauling**	**Rec. No. 3 MBR w/Direct Haul**
Rehabilitation	$4,834,000	$4,834,000	$6,077,000	$4,956,000
Secondary Treatment	$9,835,000	$10,180,000	$8,223,000	--
Tertiary Treatment	--	$1,722,000	--	$18,757,000
Biosolids Handling	$2,749,000	$2,749,000	$4,275,000	$2,749,000
Disinfection	$575,000	$575,000	$575,000	$575,000
Demolition, Subsoil Stabilization, Flood Impacts	$6,172,000	$6,172,000	$5,957,000	$6,122,000
Total Project Cost[1, 2, 3]	**$24,165,000**	**$26,233,000**	**$25,107,000**	**$33,159,000**

Notes:
1. ENR (20 cities) June 2006 = 7,700.
2. Includes Contractor overhead and profit.
3. Includes Engineering, Administrative, Legal, and SRF Loan interest costs.

ES.8.4 Recommendation No. 3 - Membrane Bioreactor (MBR)

Recommendation No. 3 includes the construction of a new MBR facility at the WWTP and facilities for direct hauling of biosolids. The recommendation has both the highest project and annual operations and maintenance costs at $33,159,000 and $2,038,000 respectively. Following the upgrade the WWTP have the ability to discharge 1.5 mgd of tertiary quality effluent to the ocean, and produce sub-Class B biosolids. The effluent quality associated with this recommendation is the highest of any of the recommendations being considered.

ES.8.5 Biosolids Evaluation

While a majority of the focus when choosing a recommended project is on effluent quality or the type of wastewater treatment process, the JPA Board must also determine the level of biosolids treatment for the recommended project. While all of the recommendations were initially presented with the direct hauling of biosolids, the cost to implement full-scale and partial onsite composting has also been presented for each recommendation. The project cost impact of adding composting to each recommended project ranges from approximately $800,000 for Recommendation No. 2 to $2,400,000 for Recommendation No. 1, 1A, and 3.

ES.8.6 Final Recommended Project

After consideration of the economic and non-economic factors associated with the different project recommendations made in this report, the JPA Board chose Recommendation No. 1A, oxidation ditch with filtration, with partial composting as the final recommended project for the facility master plan. This project will be used for evaluation of the upgrade of the WWTP during the environmental review process. The cost breakdown for the final recommended project is included in Table ES.6.

The final recommendation includes new oxidation ditches, cloth-media disk filters, secondary clarifier, centrifuges, gravity belt thickener (GBT), chlorine contact basin, full rehabilitation of Digester No. 1 and 2, improvements to the existing electrical facilities, rehabilitation of the headworks, and miscellaneous improvements to other support facilities. The structures that will be retired include the existing chlorine contact basin, trickling filters, solids contact basin, Digester No. 1, and primary clarifiers.

After upgrade of the WWTP, the MBCSD will have the ability to discharge 1.5 mgd of tertiary treated effluent to the ocean. If water reuse is implemented in the future, additional chlorine contact capacity must be added to the treatment process or the MBCSD could consider adding an alternative disinfection method such as ultraviolet (UV) disinfection.

Table ES.6 Project Costs for Final Recommended Project WWTP Facility Master Plan MBCSD	
Component	**Cost**
Oxidation Ditch Facility	$10,664,000
Tertiary Filters	$1,722,000
Existing Facilities Rehabilitation	$6,363,000
Existing Electrical Improvements	$1,531,000
Biosolids Management Facilities	$1,682,000
Demolition and Subsoil Stabilization	$2,040,000
Flood Impact Mitigation	$4,050,000
Total Project Costs[1, 2, 3]	**$28,052,000**

Notes:
1. ENR (20 cities) June 2006 = 7,700.
2. Includes Contractor overhead and profit.
3. Includes Engineering, Administrative, Legal, and SRF Loan interest costs.

Biosolids produced at the WWTP will continue to be composted onsite using windrows constructed in the sludge drying beds. The MBCSD currently composts approximately 30 percent of its biosolids onsite. The amount of composting done onsite in the future will be at the discretion of plant staff and will be dictated by the availability of green waste, space in the sludge drying beds, odors, and operator availability. Excess biosolids not composted onsite will continue to be hauled offsite by San Joaquin Composting. A tentative site plan for the final recommended project is included in Figure ES.1.

A project schedule is presented in Section 9.8.4 that reflects the 8-year schedule presented to the RWQCB. In accordance with this schedule, startup of the plant will occur no later than February 2014.

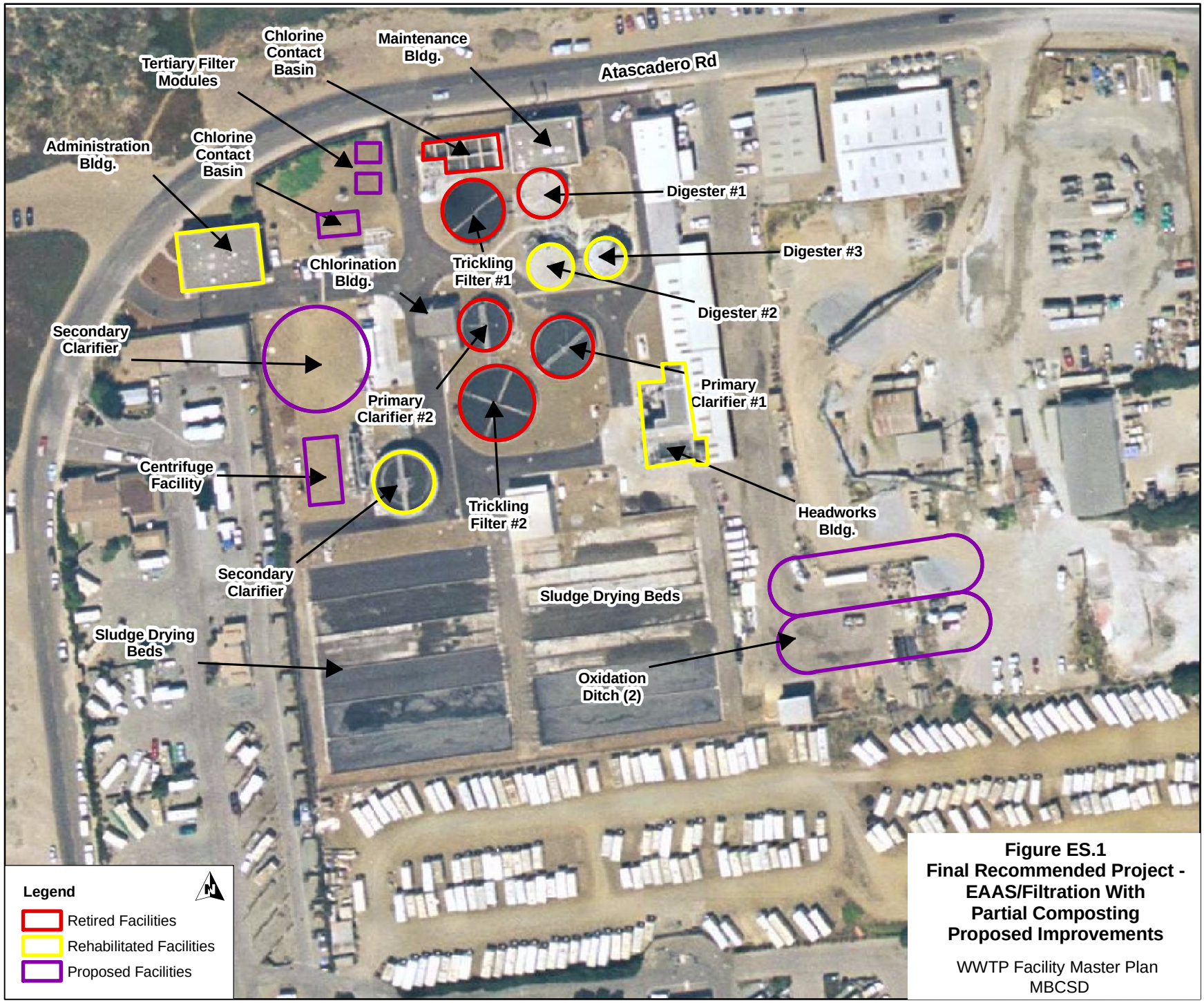


Figure ES.1
Final Recommended Project - EAAS/Filtration With Partial Composting Proposed Improvements

WWTP Facility Master Plan
MBCSD

Chapter 1

INTRODUCTION

1.1 BACKGROUND

The communities of the City of Morro Bay (City) and Cayucos are located in San Luis Obispo County in the area of California known as the Central Coast. They are situated on the coast along U.S. Highway 1, approximately 14 miles northwest of San Luis Obispo about halfway between San Francisco and Los Angeles. A location map is shown in Figure 1.1.

The City and Cayucos Sanitary District (CSD) own and operate a wastewater treatment plant (WWTP) located in Morro Bay. The WWTP was originally constructed in 1953, which included the original digester, trickling filter, and primary clarifier still in operation. In 1964 a second primary clarifier, trickling filter, chlorine contact basin, and second digester were added. The last expansion of the WWTP was started in 1982 and included the addition of a third digester, headworks, secondary clarifier, solids contact basin, and sludge drying beds. The WWTP is rated for an average dry weather flow (ADWF) of 2.06 million gallons per day (mgd), a peak seasonal dry weather flow (PSDWF) of 2.36 mgd, and a peak hour flow (PHF) of 6.6 mgd. The rated design capacity for the secondary treatment facilities is 0.97 mgd. Flows in excess of 0.97 mgd receive primary treatment only. The primary effluent is blended with secondary effluent before being disinfected and sent to the ocean outfall.

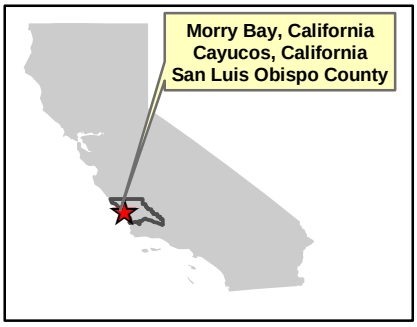
1.2 PURPOSE AND SCOPE OF STUDY

The purpose of this study is to develop a facility master plan for the Morro Bay Cayucos Sanitary District (MBCSD) WWTP based on projected flows and loadings through the year 2026. Treatment and biosolids disposal alternatives were studied, and a recommended project including an implementation schedule is developed for the project.

The primary goal of the facilities planning process is to develop a plan, which will meet the current and anticipated discharge requirements of the California Regional Water Quality Control Board (RWQCB). This facility master plan will also contain sufficient information to allow for evaluation and selection of both wastewater and biosolids treatment alternatives for upgrade of the MBCSD WWTP within the time period established by the 8-year schedule. The information in this report will also be sufficient to begin the environmental review process and design.

1.3 PREVIOUS STUDIES AND REPORTS

The following reports, studies, and drawings were reviewed and incorporated into the preparation of this report, and can be seen Table 1.1.



Legend

Elevation

High :10,500 Feet

Low : Sea Level

Major Roads

Miles

0 10 20 40

Figure 1.1
Location Map
WWTP Facility Master Plan
MBCSD

carollo engineers

Table 1.1 Previous Studies and Reports WWTP Facility Master Plan MBCSD	
Name	**Date**
Improvements to the Morro Bay Cayucos Wastewater Treatment Plant Brown and Caldwell	1982
Comprehensive Recycled Water Study - Carollo Engineers	2000
2004 Management Plan Update (Cayucos) - Boyle Engineering	2004
Alternative Evaluation Report - Cannon Associates	2004
Sewer Collection System Master Plan (Morro Bay) - Wallace Group	2006

1.4 GENERAL

1.4.1 Climate

The climate in both Morro Bay and Cayucos is characterized as coastal with mild to moderate temperatures year-round and little diurnal variation. Average yearly temperatures range from daytime highs between 60 and 70 degrees Fahrenheit to nighttime lows between 40 and 50 degrees Fahrenheit. Average annual rainfall in the region is 15--inches per year and usually occurs between the months of October and April.

1.4.2 Topography

Heading north, the area along the coast consists of mildly sloping beach lands with a gradual slope towards the south end of Cayucos. Downtown Cayucos is set in a lower flat area that quickly rises to hillside terrace-type views from homes. The region has many small creeks draining to the Pacific Ocean and the estuary. Traveling inland along some of the creeks or highways, rolling or gradual hills are seen tapering to the ocean. Hills are also prevalent in Morro Bay State Park located in the south side of Morro Bay.

The existing WWTP is located in an area subject to inundation from floodwaters due to the amount of runoff during a one hundred year storm exceeding the capacity of Morro Creek. The site is also within the area mapped as an "A-14 Zone" on Federal Emergency Management Agency's (FEMA) Flood Insurance Rate Map (FIRM). All new construction within these A-Zones are required to comply with Chapter 14.72 of the City of Morro Bay Municipal Code which specifies certain requirements for construction within the Flood Plain. All new construction must be protected to one foot above (freeboard) the base flood elevation. Additionally, depending on the scope of construction, existing facilities may need to be upgraded to provide the same flood protection. Figure 1.2 shows the relationship of the WWTP and surrounding parcels to the flood zone.

The MBCSD WWTP experiences both localized drainage problems and larger flooding problems. Initial findings have shown that the current site may be flooded by as much as six feet. Wallace Group has prepared a letter memorandum for this report entitled MBCSD Wastewater Treatment Plant Flood Hazard Review, which consists of document collection, site review, and developed initial recommendations regarding flood hazard protection for the WWTP. This letter memorandum is included in Appendix A.

1.4.3 Water Supply

Traditionally, the City of Morro Bay depended upon groundwater for its main municipal and industrial water supply. Twelve wells draw from two small alluvial aquifers, the Morro and Chorro Basins. However, saltwater intrusion into the aquifer and other pollutants has decreased the water quality. In addition, outside groundwater users have decreased the amount of water available in the aquifers. These factors have limited the reliability of obtaining water from potable groundwater wells. Since 1997, the City of Morro Bay has relied primarily on surface water from the State Water Project (SWP). This source is supplemented by both groundwater and City's desalination plant on Atascadero Road. A copy of the City's 2005 Annual Water Quality Report is included in Appendix B.

The community of Cayucos obtains its drinking water from two main sources: Whale Rock Reservoir and a groundwater well located on the east side of U.S. Highway 1. Water from the reservoir is piped to the Cayucos Water Treatment Plant (WTP) and then distributed to the Cayucos Area Water Organization (CAWO). The CAWO consists of three water purveyors: Paso Robles Beach Water Association (PRBWA), Morro Rock Mutual Water Company (MRMWC), and the County of San Luis Obispo (CSA-10A).

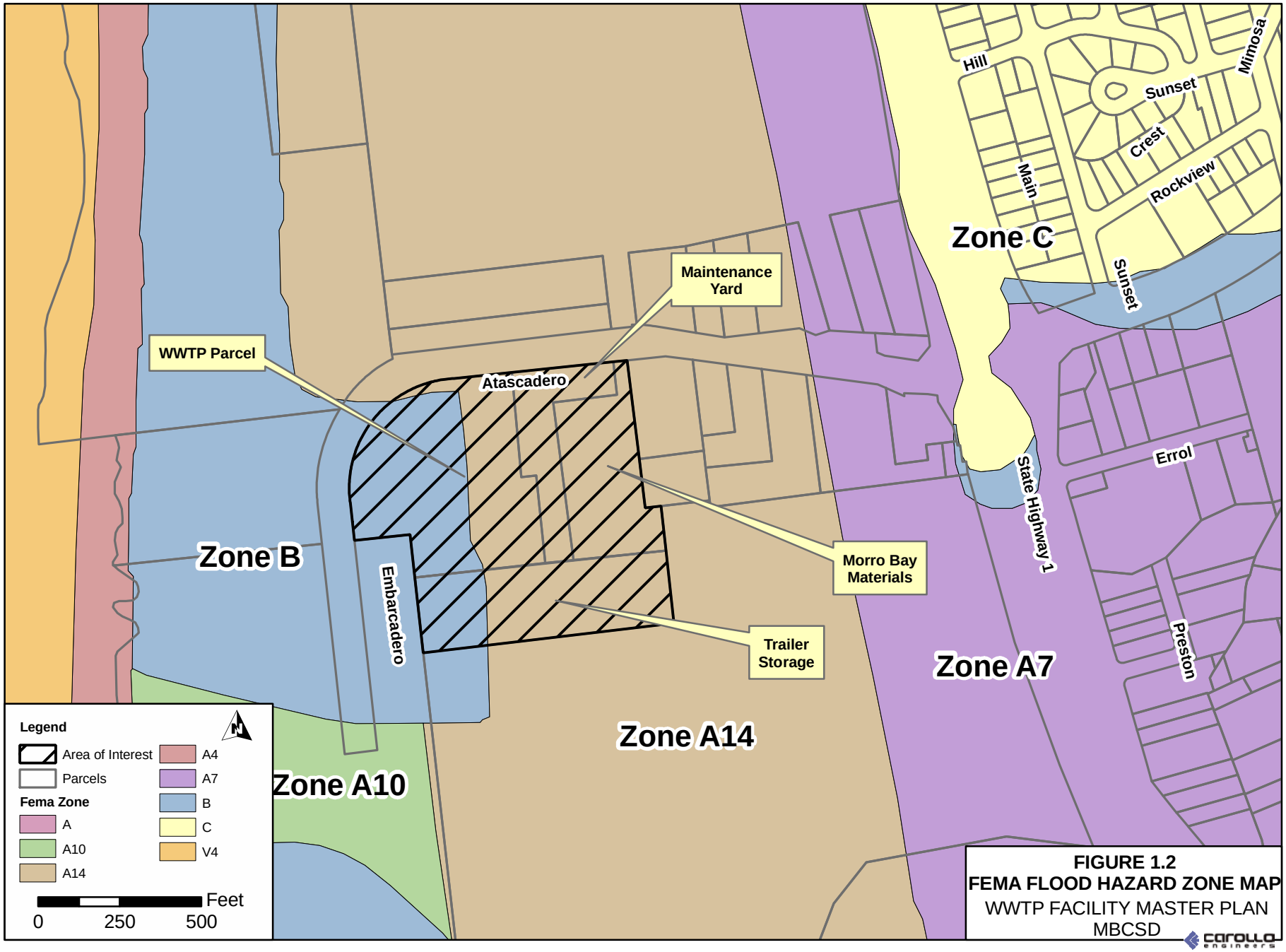


FIGURE 1.2
FEMA FLOOD HAZARD ZONE MAP
WWTP FACILITY MASTER PLAN
MBCSD

EXISTING AND PROJECTED SERVICE AREA

2.1 SERVICE AREA

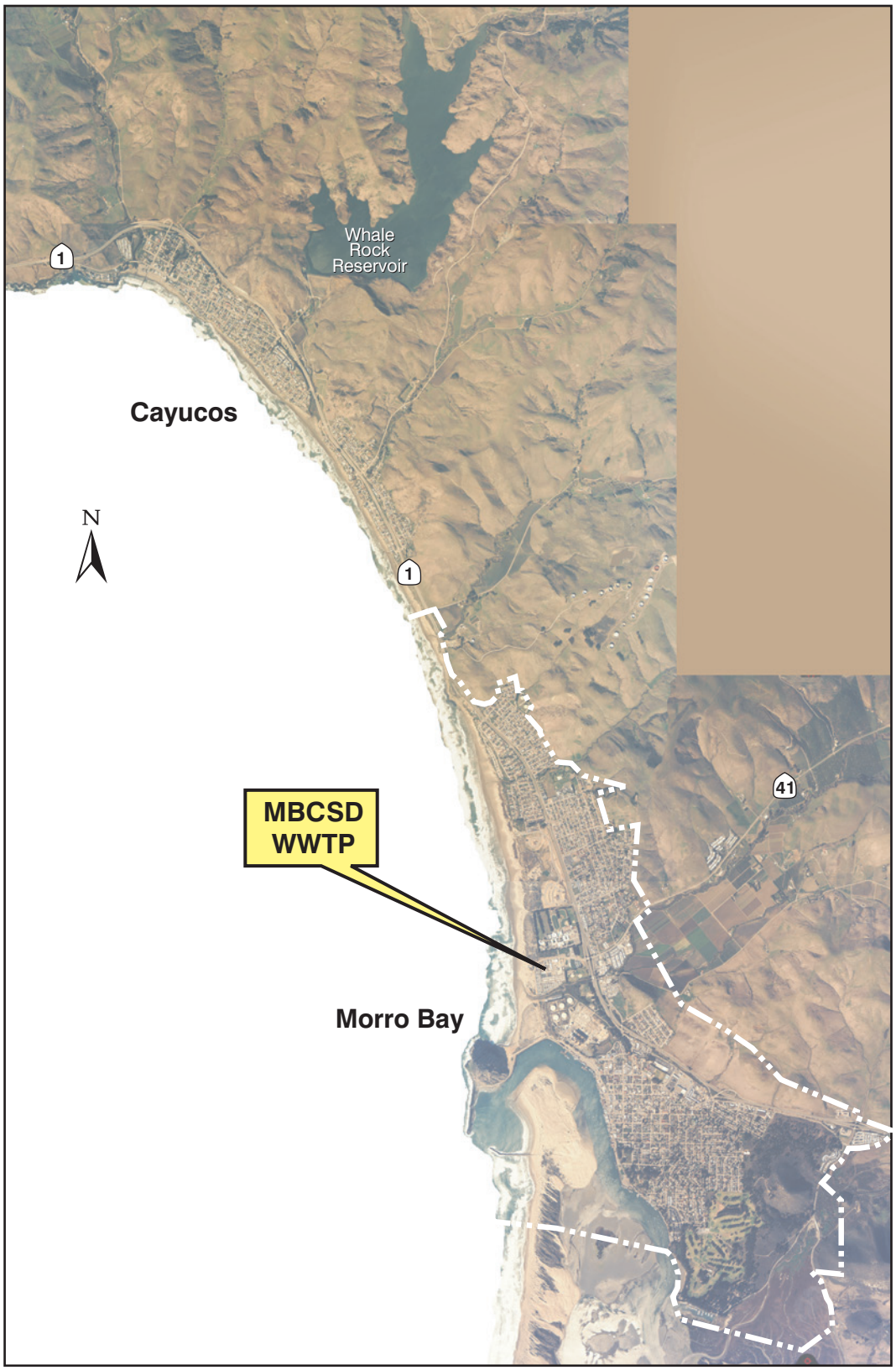
The communities of Morro Bay and Cayucos are located on the Central Coast in San Luis Obispo County. The Morro Bay Cayucos Sanitary District (MBCSD) Wastewater Treatment Plant (WWTP) is located in Morro Bay at the west end of Atascadero Road, also known as Highway 41 near the coast. The existing WWTP site is bordered on the east, west, and south by City owned land and land jointly owned by the City and CSD. The location of the WWTP and service area is shown in Figure 2.1.

2.2 HISTORICAL AND PROJECTED POPULATIONS

The population of both Morro Bay and Cayucos has remained fairly constant over the last few decades. Tourism and retirement living provide the region with a dynamic population, which usually increases during the summer months. Carollo Engineers, P.C. (Carollo) obtained San Luis Obispo Council of Governments (SLOCOG) historic population data and population projections for the City from a report entitled Long Range Socio-Economic Projections (Year 2030). This report was prepared by Economics Research Associates (ERA) in May 2006. This historic population data is actually U.S. Census and the California Department of Finance population data. The historic growth rates for the periods 1990 to 2005, 1995 to 2005, and 2000 to 2005 were determined to be 0.56, 0.75, and 0.31 percent respectively. Based on this historical population data and associated growth rates, a range of population projections was determined. Historical population data and population projections can be seen in Table 2.1 and Table 2.2 respectively.

Population projections for Cayucos could not be taken from the SLOCOG report. Historical population data in the study was only reported for all unincorporated areas in San Luis Obispo County, and not for individual communities. Instead, population data for Cayucos was obtained from the U.S. Census Bureau. U.S. Census Bureau population data for Cayucos was only available for 1990 and 2000 and was reported as 2,943 and 2,960 respectively.

Population data and growth projection estimates are essential to determining the present per capita wastewater flows and to estimate future wastewater flow projections. Population projections for both Morro Bay and Cayucos were presented in the SLOCOG report. In the report, a low, medium, and high population projection was developed for each area. For Morro Bay, annual growth rate projections for the period between 2005 and 2030 ranged from 0.58 to 0.80 percent. For Cayucos, annual growth rate projections ranged from 0.59 to 0.60 percent. To determine the projected population used for flow projections for this facility master plan, an average growth rate needs to be used. The method used to establish an



LEGEND

Morro Bay City Limit

Figure 2.1
Service Area Map
WWTP Facility Master Plan
MBCSD

MOB899M1.CDR
MorrobayTINTED2.tif (70%)

average growth rate and per capita wastewater flows for each community are presented in detail in Chapter 3 of the this report (Historical and Projected Flows and Loadings).

Table 2.1 Historical Population Data
WWTP Facility Master Plan
MBCSD

Year	Morro Bay[1]
1970	7,109
1971	7,275
1972	7,475
1973	7,750
1974	8,150
1975	8,350
1976	8,475
1977	8,750
1978	8,950
1979	9,075
1980	9,050
1981	9,150
1982	9,150
1983	9,300
1984	9,400
1985	9,400
1986	9,450
1987	9,325
1988	9,350
1989	9,425
1990	9,664
1991	9,644
1992	9,682
1993	9,682
1994	9,735
1995	9,756
1996	9,517
1997	9,561

Table 2.1 Historical Population Data
WWTP Facility Master Plan
MBCSD

Year	Morro Bay[1]
1998	9,635
1999	9,736
2000	9,775
2001	10,420
2002	10,502
2003	10,490
2004	10,531
2005	10,535

Note:
1. Population data taken from California Department of Finance.

Table 2.2 Morro Bay Future Population Projections
WWTP Facility Master Plan
MBCSD

	Projected Population		
Year	**Scenario 1[1]**	**Scenario 2[2]**	**Scenario 3[3]**
2005	10,310	10,310	10,310
2010	10,660	10,710	10,760
2015	10,910	11,010	11,260
2020	11,210	11,310	11,710
2025	11,560	11,660	12,060
2030	11,910	12,100	12,610
CAGR[4]	**0.58%**	**0.64%**	**0.80%**

Notes:
1. Population projection based on SLOCOG Low Population Projection.
2. Population projection based on SLOCOG Medium Population Projection.
3. Population projection based on SLOCOG High Population Projection.
4. Compounded Annual Growth Rate.

HISTORICAL AND PROJECTED FLOWS AND LOADINGS

3.1 SUMMARY

The purpose of this chapter is to summarize the historical and projected flows and loadings for the Morro Bay Cayucos Sanitary District (MBCSD) Wastewater Treatment Plant (WWTP) during the twenty-year planning period. New flows and loadings projections will be used to design treatment alternatives discussed later in this report as well as assist in determining future capacity needs for the City of Morro Bay (City) and the Cayucos Sanitary Distsrict (CSD).

Because of the nature of the WWTP, flows and loadings were determined for Morro Bay and Cayucos separately. While a traditional per capita flow approach was followed for the City, flow projections for the CSD were determined using historical sewer connection data provided by CSD staff. Several flow conditions were included for the analysis including the average annual daily flow (AADF), the peak seasonal dry weather flow (PSDWF), the average day maximum month flow (ADMMF), and the peak hour flow (PHF). The PSDWF condition is the greatest average monthly flow between the months of July and August, and was chosen because it encompasses the traditional peak tourist season for the service area. The PSDWF represents the worst-case scenario the WWTP encounters for organic loading.

Based on population projections and historical flow analysis, the City will reach build-out in 2021 with a peak seasonal flow of 1.05 MGD, and the CSD will reach build-out in 2015 with a peak seasonal flow of 0.42 MGD. At the end of the 20-year planning period, the total peak seasonal flow at the WWTP will be 1.47 MGD with the City contributing 71.4 percent of the total flow, and the CSD contributing 28.6 percent. This new total peak seasonal flow is less than the existing design capacity of 2.36 MGD. The current split in WWTP ownership is 65 percent the City and 35 percent the CSD. The PHF was also evaluated and a flow factor of 4.5 was chosen. Therefore, the MBCSD WWTP will need to be designed to pass 5.97 MGD during heavy storm events.

Historical plant data has shown that the strength of the wastewater at the WWTP is greater than the existing design criteria for 5-day biochemical oxygen demand (BOD_5) and total suspended solids (TSS). The five-year average peak seasonal BOD_5 and TSS concentrations are 374 milligrams per liter (mg/L) and 404 mg/L respectively. For the design of treatment alternatives, a BOD_5 concentration of 410 mg/L and a TSS concentration of 420 mg/L will be used. This increase in wastewater strength and a corresponding decrease in peak seasonal flow results in new loadings, which are similar with the existing design loadings.

3.2 BACKGROUND

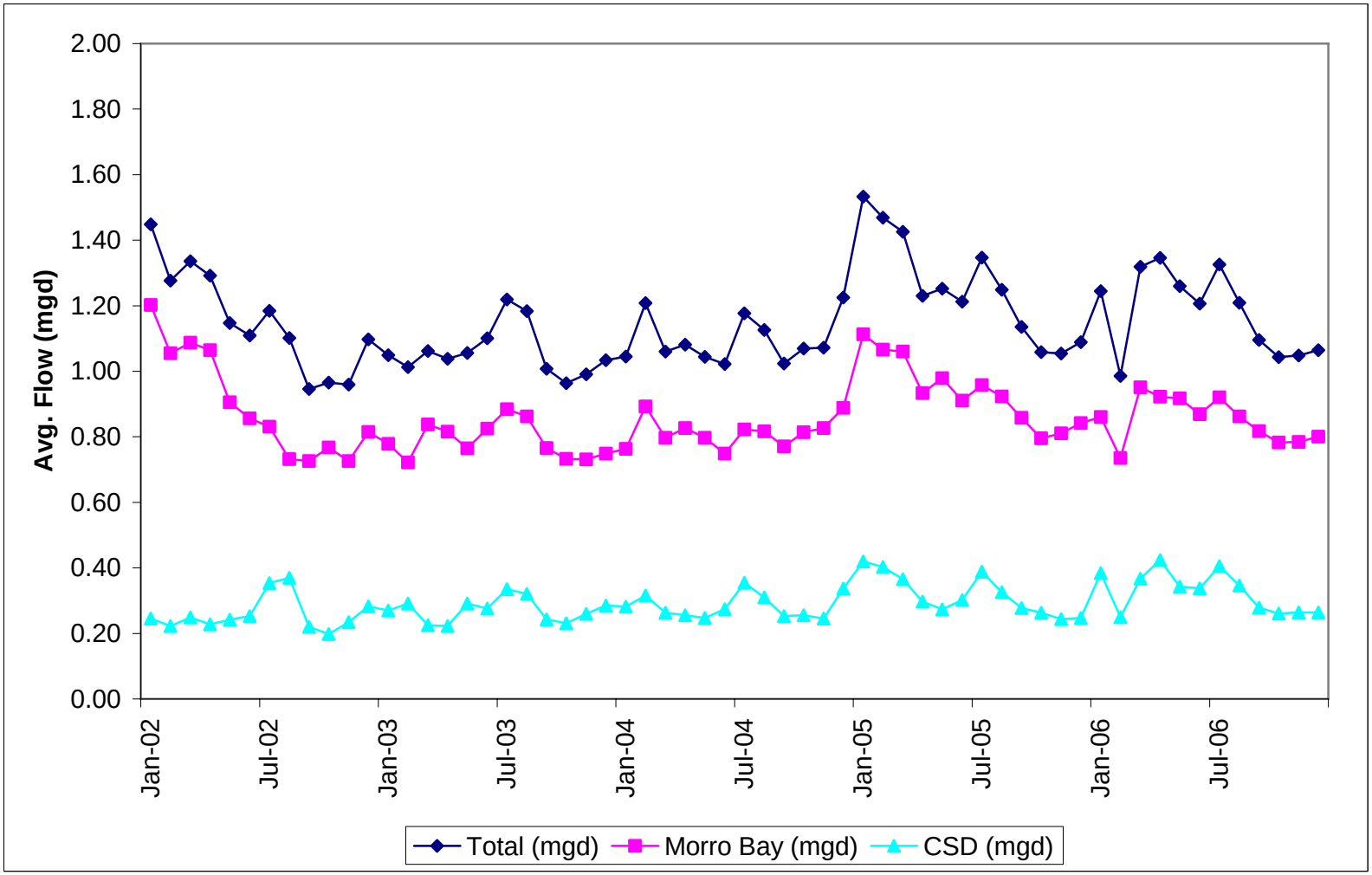
The flows received by the MBCSD WWTP originate from two distinct locations. An average of 75 percent of the total flow is generated within the City, and the remaining 25 percent travels from the CSD by way of a dedicated trunk line.

The relationship between total flow and the contribution from each community between 2002 and 2006 is given to Table 3.1 and shown graphically in Figure 3.1. The two flows converge at the WWTP and flow by gravity in a 30-inch diameter, jointly owned trunk running along the roadway of the WWTP. The CSD has its own dedicated 15-inch diameter line that runs down Main Street to Atascadero Road before it converges with the 30-inch diameter trunk at the headworks facility. Because of this unique situation and the nature of flows from both communities, flows and loadings for this chapter will be analyzed for each community separately in order to ensure the most accurate future design projections.

Table 3.1 Flow Contributions from Morro Bay and Cayucos WWTP Facility Master Plan MBCSD

	Average Annual Daily Flows (mgd)			Percent of Total (%)	
Year	**Morro Bay**	**Cayucos**	**Total**	**Morro Bay**	**Cayucos**
2002	0.90	0.26	1.16	78%	22%
2003	0.79	0.27	1.06	74%	26%
2004	0.81	0.28	1.10	74%	26%
2005	0.94	0.32	1.25	75%	25%
2006	0.85	0.33	1.18	72%	28%
5-Year Average				**75%**	**25%**

Flow data for both the City and the CSD is available from 1986 to present day. However, there is an observed marked decrease in average flow at the WWTP beginning in 2002. This decrease in flow can be partially attributed to the installation of a new Palmer Bowlus Flume in August 2001 in the 30-inch diameter trunk downstream of where flows from the City and CSD converge. The new flume was installed in an attempt to obtain more accurate flow totals. In order to ensure the accuracy of future projections, only flows recorded using the new flume will be used to determine per capita usage and the necessary design flow factors.



carollo engineers

Figure 3.1
HISTORICAL MONTHLY AVERAGE FLOWS
Morro Bay Cayucos Sanitary District
Wastewater Treatment Plant Facility Master Plan

3.3 POPULATION

Based on the 2000 census, the combined current population for the City and CSD is approximately 13,293 (10,350 for Morro Bay, and 2,943 for Cayucos). It should be noted that the population in the two communities has remained relatively constant over the past decade. In 1984, the City passed Measure F, which established an ultimate population cap of 12,200. Similarly in 1985, a building moratorium was enacted for Cayucos to curb increasing water usage in the community. The moratorium in Cayucos was lifted in 1992.

3.3.1 Morro Bay Population Information

A report recently prepared for the City in May 2006 by the Wallace Group titled Sewer Collection System Master Plan Update (Master Plan) (REF 3.1) uses an estimate of 12,500 as the ultimate build-out population for the City. The Master Plan was adopted by the City in May 2006. This estimate was provided for the Master Plan by the Morro Bay Planning Department and will be used as the City build-out for the calculation of flow projections in this report. Population growth for the Master Plan was based on an increase of approximately 60 housing units per year or 125 people per year. Based on this growth rate, the City will reach build-out capacity in approximately 16 years.

Economic Research Associates (ERA) recently developed population projections in a report for the San Luis Obispo Council of Governments (SLOCOG) in May 2006. The report titled Long Range Socio-Economic Projections (Year 2030) provides population projections for all incorporated and unincorporated cities in San Luis Obispo County. Their projections anticipate an annual growth rate for the City between 0.58 and 0.80 percent through 2030. Based on an annual growth rate of 0.80, the City is expected to reach its ultimate build-out population in 2027, or approximately 22 years.

The similarities between the population projections obtained from the Master Plan and those obtained from SLOCOG validate the assumptions made in the Master Plan. Using the assumptions outlined in both reports, the estimated time needed to reach the build-out population for the City are within six years of each other. Therefore, in order to determine future flows generated by the City for this report, a build-out population of 12,500 with an annual growth rate of 125 people per year will be used in order to be consistent with the Master Plan.

3.3.2 Cayucos Population Information

Although population will not be used directly to develop future flow projections for the CSD service area, population data was obtained from SLOCOG for Cayucos. Growth projections for Cayucos are even more conservative than for Morro Bay at 0.59 and 0.60 percent growth annually. The methods used to develop flow projections for the CSD will be based on historical sewer connection data detailed in Section 3.4.2 of this report.

3.4 ANNUAL AVERAGE DAILY FLOW (AADF)

3.4.1 Morro Bay Annual Average Daily Flow

For Morro Bay, the relationship between past population and annual average daily flows (AADF) is used to determine the wastewater flows per capita in gallons per day (gpcd). The historical gpcd is then used to estimate the projected gpcd for the twenty-year planning period. The flows used to determine the gpcd include the flows into the WWTP that come from the City only. Historical AADF for the last five years are shown in Table 3.2 and graphically represented on Figure 3.2.

Table 3.2 Morro Bay Historical AAD Flows
WWTP Facility Master Plan
MBCSD

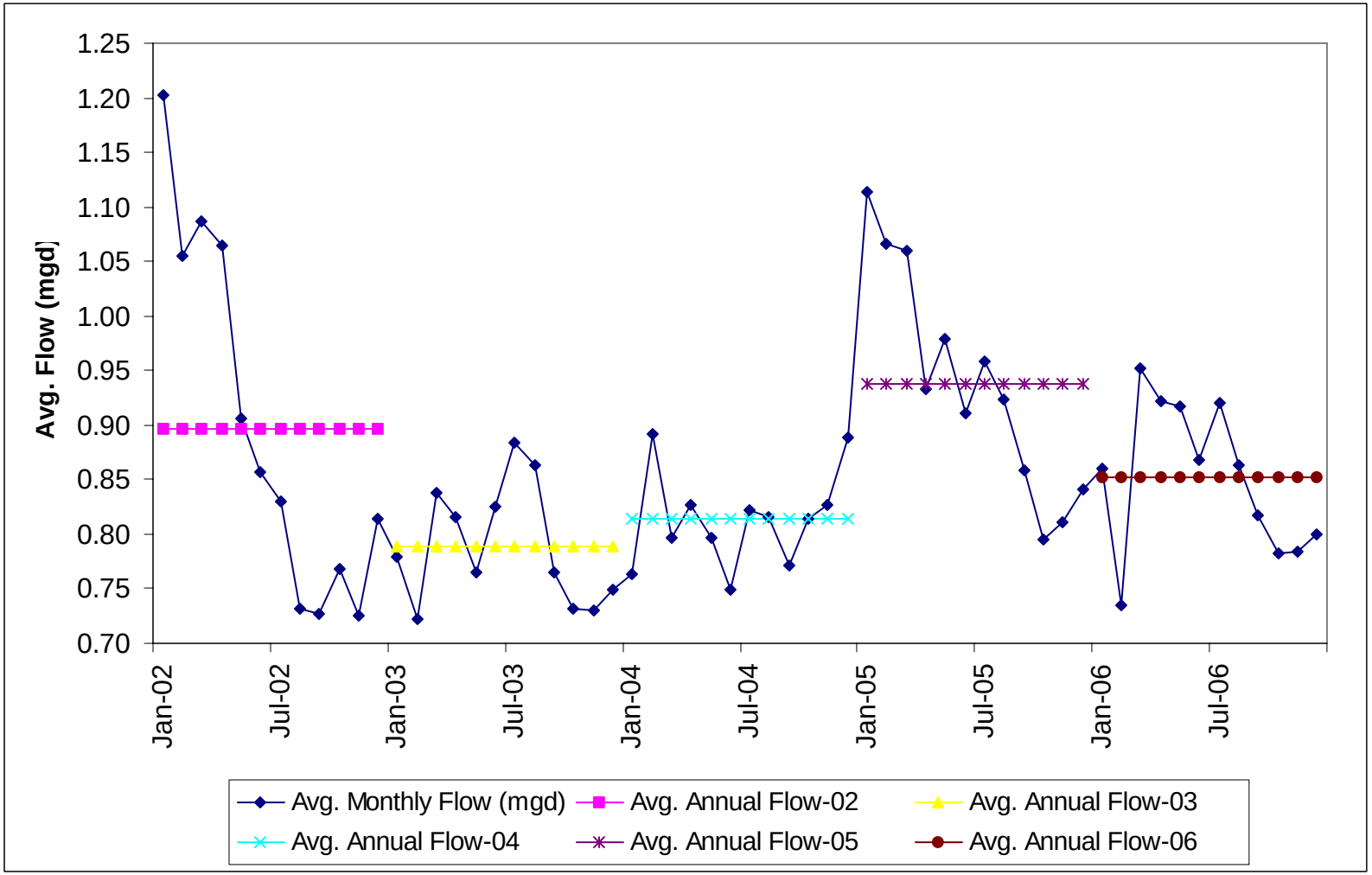
Year	Population[1]	Flow (mgd)	Per Capital Flow (gpcd)
2002	10,502	0.90	85
2003	10,490	0.79	75
2004	10,531	0.81	77
2005	10,535	0.94	89
2006	10,660	0.85	80
5-Year Average		**0.86**	**81**

Note:
1. California Department of Finance Demographic Research Unit.

The calculated average value for the per capita wastewater flow for the past five years is 81 gpcd. This value is similar to the 80 gpcd used in the Master Plan, and is consistent with a community that has fully-metered water connections and conservation measures in place. Therefore, for the purpose of this report, a per capita flow rate of 80 gpcd will be used for projecting future annual average daily flows.

3.4.2 Cayucos Annual Average Daily Flow

The approach to flow analysis for the CSD for this report is handled differently than for the City. Because of the size of the community and its relatively slow population growth in recent years, the use of population data to determine per capita use and future projections could result in inaccurate flow estimates. For these reasons, historical sewer connection data provided by CSD staff and water use data from the Cayucos Area Water Organization (CAWO) will be used to provide accurate estimates of past and future wastewater flows. This approach is aided by the fact that Cayucos has a limited number of vacant lots and hence sewer connections that are available for new construction, which sets an ultimate boundary for future flows.



carollo engineers

Figure 3.2
HISTORICAL MONTHLY
AVERAGE FLOWS (MORRO BAY)
Morro Bay Cayucos Sanitary District
Wastewater Treatment Plant Facility Master Plan

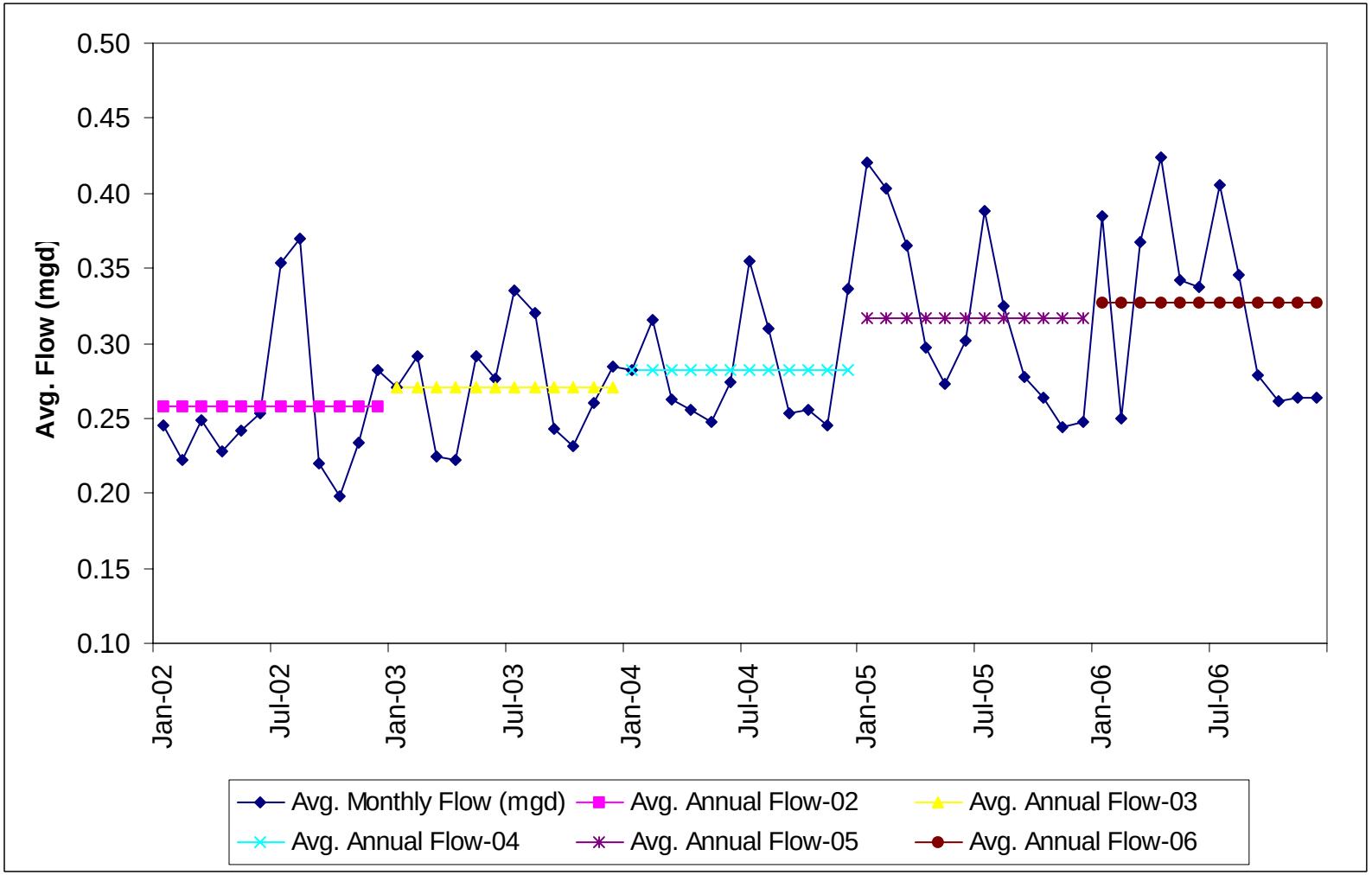
In October 2005, Boyle Engineering completed the 2004 Water Management Plan Update (Water Plan) for the CAWO (REF 3.2). The CAWO is comprised of the four water providers that service the entire Cayucos area. These purveyors are the Paso Robles Beach Water Association (PRBWA), Morro Rock Mutual Water Company (MRMWC), County Service Area 10A (CSA-10A), and the Cayucos Cemetery District. The Water Plan includes a ten-year historical average for the total number of active service connections in the area and total water usage. The information regarding water usage for active service connections in Cayucos will be used to validate estimates made for historical wastewater flows generated per sewer connection for this report.

Two additional assumptions that will be adapted from the Water Plan to aid flow analysis is an assumed vacancy rate and an estimated occupancy density. Due to the large number of vacation residences located in Cayucos, an average vacancy rate of 9 percent was assumed for past and future flow calculations. The occupancy density used both in this report and the Water Plan is 2.08, which is consistent with other coastal cities including Morro Bay. Information obtained from CSD staff regarding sewer connections includes an estimate for the total number of active service connections currently in the CSD, the number of new service connections made between 1996 and present day, and the total number of connections available for future growth. All of the sewer connection data obtained from CSD staff is given in equivalent dwelling units (EDU).

In order to establish the number of connections for each year between 1996 and present day, an annual growth rate of 1.01 percent for the connections was determined based on information provided by CSD staff. The number of sewer connections for the years between 1996 and present day were interpolated using this growth rate. The number of active sewer connections by year can be seen in Table 3.3.

For the CSD, the number of service connection is used to establish the average wastewater flow per connection. Table 3.4 shows the historical wastewater flows attributed to each connection and per capita flows for the last five years. Historical AADF for Cayucos for the last five years are shown graphically in Figure 3.3.

The calculated average flow per connection is 124 gallons per day (gpd) per connection and the average per capita flow is 60 gpcd. For the purpose of this report, the average flow per connection of 120 gpd is used along with the number of connections to determine future AADF. As mentioned previously, the information obtained from the Water Plan can be used to validate the assumption of 120 gpd made for flow generation per sewer connection. According to the Water Plan, the average total water use for active connections was 176.8 gpd per connection. Flow generation of 120 gpd per connection represents approximately 68 percent of total water usage.



carollo engineers

Figure 3.3
HISTORICAL MONTHLY
AVERAGE FLOWS (CAYUCOS)
Morro Bay Cayucos Sanitary District
Wastewater Treatment Plant Facility Master Plan

Table 3.3	Cayucos Sanitary District Historical Water Service Connections WWTP Facility Master Plan MBCSD
Year	**Number of Service Connections[1]**
1996	2,369
1997	2,393
1998	2,417
1999	2,441
2000	2,466
2001	2,491
2002	2,516
2003	2,541
2004	2,567
2005	2,593
2006	2,619

Note:
1. Number of connections based on an annual growth rate of 1.01% between 1995 and 2006.

Table 3.4 Cayucos Sanitary District Wastewater Flows Per Service Connection
WWTP Facility Master Plan
MBCSD

Year	Number of Service Connections[1]	AADF (mgd)	Flow per EDU (gpd)[2]	Per Capita Flow (gpcd)[3]
2002	2,516	0.26	113	54
2003	2,541	0.27	117	56
2004	2,567	0.28	121	58
2005	2,593	0.32	134	65
2006	2,619	0.33	137	66
5-Year Average			**124**	**60**

Notes:
1. Expressed in number of EDUs and based on an annual growth rate of 1.01%.
2. Assumes a vacancy rate of 9%.
3. Based on an occupancy density of 2.08 capita per EDU.

Although slight discrepancies exist for per capita flow between the City and CSD, the figures obtained during this flow analysis are consistent with the range of 63 to 81 gpcd recommended in Wastewater Engineering (Metcalf and Eddy) for an EDU with an occupancy density of two persons per dwelling unit. These discrepancies are most likely due to the small population of Cayucos coupled with a relatively high vacancy rate.

3.5 PEAK SEASONAL DRY WEATHER FLOW (PSDWF)

While it is important to incorporate the hydraulic capacity of a WWTP into the design process, other flow characteristics are needed to determine design parameters such as organic and solid loadings. Since maximum month flows include wet weather flows, the presence of rainwater in the system results in the dilution of normal sanitary sewer influent at the WWTP. For this reason, an analysis of the PSDWF is included in this report. Because of the nature of the two communities in the study area and the heavy influence of summer tourism, the PSDWF represents the greatest average monthly flow that occurs between the months of July and August. Future PSDWF is determined by analyzing the ratio of the historical PSDWF to the AADF of the previous five years. As shown in Table 3.5 and Table 3.6, the average PSDWF to AADF ratio for the City for the most recent five-year period is 1.03, and for the CSD is 1.28. Therefore, a 1.05 and 1.30 PSDWF to AADF flow factor will be used to determine the PSDWF for the future planning period for the City and CSD respectively. Using the PSDWF for WWTP design is consistent with other coastal communities including the City of Pismo Beach.

Discrepancies are apparent between the ratio of PSDWF to AADF for the City and CSD. While the ratio for the City is consistent with other coastal cities such as Pismo Beach, the ratio for the CSD is significantly higher. This discrepancy can again be attributed to the relatively small population of Cayucos. According to Metcalf and Eddy, wastewater flow peaking factors begin to sharply decrease as populations surpass 5,000 people. Since the current population of Cayucos is approximately 3,000 and the City is more than 10,000, the CSD service area would be expected to have a higher peaking factor for PSDWF.

3.6 AVERAGE DAY MAXIMUM MONTH FLOW (ADMMF)

The design of a WWTP can be based on the ADMMF, which may include wet weather month flows. Using this approach the WWTP will have the capacity to treat the wastewater from the maximum month conditions as well as the average month. While this approach is not followed for the Facility Master Plan and subsequent design process for the MBCSD WWTP, the ADMMF is a commonly noted flow condition for treatment facilities and collection systems. To project the ADMMF, the ratio of the historical ADMMF to the AADF of the previous five years is determined. As shown in Table 3.7 and Table 3.8, the ADMMF to AADF ratio for the City for the most recent five-year period is 1.17, and for the CSD is 1.31.

Therefore, a 1.20 and 1.30 ADMMF to AADF flow factor will be used to determine the ADMMF for the future planning period for the City and CSD respectively. These values are typical for a coastal city.

Table 3.5 Morro Bay Historical AADF and PSDWF
WWTP Facility Master Plan
MBCSD

Year	Population	AADF (mgd)	PSDWF[1] (mgd)	PSDWF:AADF Factor
2002	10,502	0.90	0.83	0.93
2003	10,490	0.79	0.88	1.12
2004	10,531	0.81	0.82	1.01
2005	10,535	0.94	0.96	1.02
2006	10,660	0.85	0.92	1.08
5-Year Average				**1.03**

Note:
1. Peak Seasonal represents the greater month of July and August.

Table 3.6 Cayucos Sanitary District Historical AADF and PSDWF
WWTP Facility Master Plan
MBCSD

Year	AADF (mgd)	PSDWF[1] (mgd)	PSDWF:AADF Factor
2002	0.26	0.37	1.43
2003	0.27	0.33	1.24
2004	0.28	0.35	1.25
2005	0.32	0.39	1.23
2006	0.33	0.40	1.24
5-Year Average			**1.28**

Note:
1. Peak Seasonal represents the greater month of July and August.

Table 3.7	Morro Bay Historical AADF and ADMMF WWTP Facility Master Plan MBCSD				
Year	**Population**	**AADF (mgd)**	**ADMMF (mgd)**	**ADMMF (month)**	**ADMMF:AADF Factor**
2002	10,502	0.90	1.20	January	1.34
2003	10,490	0.79	0.88	July	1.12
2004	10,531	0.81	0.89	February	1.10
2005	10,535	0.94	1.11	January	1.19
2006	10,660	0.85	0.95	March	1.12
5-Year Average					**1.17**

Table 3.8	Cayucos Sanitary District Historical AADF and ADMMF WWTP Facility Master Plan MBCSD			
Year	**AADF (mgd)**	**ADMMF (mgd)**	**ADMMF (month)**	**ADMMF:AADF Factor**
2002	0.26	0.37	August	1.43
2003	0.27	0.33	July	1.24
2004	0.28	0.35	July	1.25
2005	0.32	0.42	January	1.32
2006	0.33	0.42	April	1.30
5-Year Average				**1.31**

3.7 PEAK HOURLY FLOW (PHF)

The PHF is required to make certain pipelines, meters, and other critical hydraulic appurtenances are sized adequately, and to minimize any potential for flooding or overflow during high flow events. Usually, wastewater flows increase in wet weather because of infiltration and inflow. To determine this peaking factor, the PHF during large storm events are compared to the average daily flows. For this analysis, the peak rainfall recorded in Morro Bay in 2004-2005 was in December 2004 and January 2005. The hourly flow monitoring data was reviewed for this period. The flow data on December 31, 2004 revealed that the peak flow at the WWTP in the early morning hours was abnormally high and exceeded the maximum flow range for the flume. These readings may have been caused by back up in the flume caused by the bar screens or wet well at the headworks facility. With the exception of these two readings, the flow readings for the remainder of the event were within the flow range of the flume. Disregarding these abnormal readings, the

PHF for the event was 5.49 mgd. Compared to an AADF of 1.25 mgd, the ratio of PHF to AADF was 4.39. For the purpose of this report, the PHF will be 4.5 times the AADF. This factor is consistent with the PHF sited in the Master Plan for the City.

The flow projection factors and the flow per capita and connection values used in this analysis are presented in Table 3.9 and Table 3.10.

Table 3.9 Morro Bay Flow Projections Factors
WWTP Facility Master Plan
MBCSD

Flow Condition	Flow Projection Factor
Average Wastewater Flow per Person per Day (gpcd)	80
Average Annual Daily Flow (AADF)	1.0
Average Day Maximum Month Flow (ADMMF)	1.20
Peak Seasonal Dry Weather Flow (PSDWF)	1.05
Peak Hourly Flow (PHF)	4.5

Table 3.10 Cayucos Sanitary District Flow Projection Factors
WWTP Facility Master Plan
MBCSD

Flow Condition	Flow Projection Factor
Average Wastewater Flow per Connection per Day (gpd)	120
Average Annual Daily Flow (AADF)	1.0
Average Day Maximum Month Flow (ADMMF)	1.30
Peak Seasonal Dry Weather Flow (PSDWF)	1.30
Peak Hourly Flow (PHF)	4.5

3.8 PROJECTED INFLUENT FLOWS

3.8.1 Morro Bay Projected Influent Flows

Applying the above flow projection factors to the estimated future population for the City at a growth rate of 125 people per year, results in the following projected yearly flows as shown in Table 3.11. Based on the current growth rate, the City will reach its maximum build-out capacity in 2021 with a PSDWF of 1.05 mgd.

Table 3.11	Morro Bay Projected Influent Flows WWTP Facility Master Plan MBCSD				
Year	**Population[1]**	**AADF (mgd)**	**ADMMF (mgd)**	**PSDWF (mgd)**	**PHFF (mgd)**
2007	10,785	0.86	1.04	0.91	3.88
2008	10,910	0.87	1.05	0.92	3.93
2009	11,035	0.88	1.06	0.93	3.97
2010	11,160	0.89	1.07	0.94	4.02
2011	11,285	0.90	1.08	0.95	4.06
2012	11,410	0.91	1.10	0.96	4.11
2013	11,535	0.92	1.11	0.97	4.15
2014	11,660	0.93	1.12	0.98	4.20
2015	11,785	0.94	1.13	0.99	4.24
2016	11,910	0.95	1.14	1.00	4.29
2017	12,035	0.96	1.16	1.01	4.33
2018	12,160	0.97	1.17	1.02	4.38
2019	12,285	0.98	1.18	1.03	4.42
2020	12,410	0.99	1.19	1.04	4.47
2021	12,500	1.00	1.20	1.05	4.50

Note:
1. Assumes a 125-person yearly growth rate for years 2006 and beyond.

3.8.2 Cayucos Sanitary District Projected Influent Flows

Applying the above flow projection factors to the estimated future number of service connections for the CSD at a growth rate of 1.01 percent annually, results in the following projected yearly flows as shown in Table 3.12. This reveals, based on the current growth rate of connections, the CSD will reach its maximum number of available connections in 2015 with a PSDWF of 0.42 mgd.

Table 3.12	Cayucos Sanitary District Projected Influent Flows WWTP Facility Master Plan MBCSD				
Year	**Number of Service Connections[1]**	**AADF (mgd)[2]**	**ADMMF (mgd)**	**PSDWF (mgd)**	**PHFF (mgd)**
2007	2,645	0.30	0.39	0.39	1.35
2008	2,672	0.30	0.40	0.40	1.37
2009	2,699	0.31	0.40	0.40	1.38
2010	2,726	0.31	0.40	0.40	1.40
2011	2,753	0.31	0.41	0.41	1.41
2012	2,781	0.32	0.41	0.41	1.42
2013	2,809	0.32	0.42	0.42	1.44
2014	2,838	0.32	0.42	0.42	1.45
2015	2,865	0.33	0.42	0.42	1.47

Notes:
1. Expressed in number of EDUs and based on an annual growth rate of 1.01%.
2. Assumes a vacancy rate of 9%.

Table 3.13 shows the combined projected future influent wastewater flows for major milestones throughout the 20-year planning period. At 2021, the influent flow at the WWTP will reach a maximum combined PSDWF of 1.47 mgd. For the purpose of this report a PSDWF of 1.5 mgd will be used to size secondary and tertiary treatment alternatives. As discussed previously, the City would represent 71.4 percent and CSD would represent 28.6 percent of this flow.

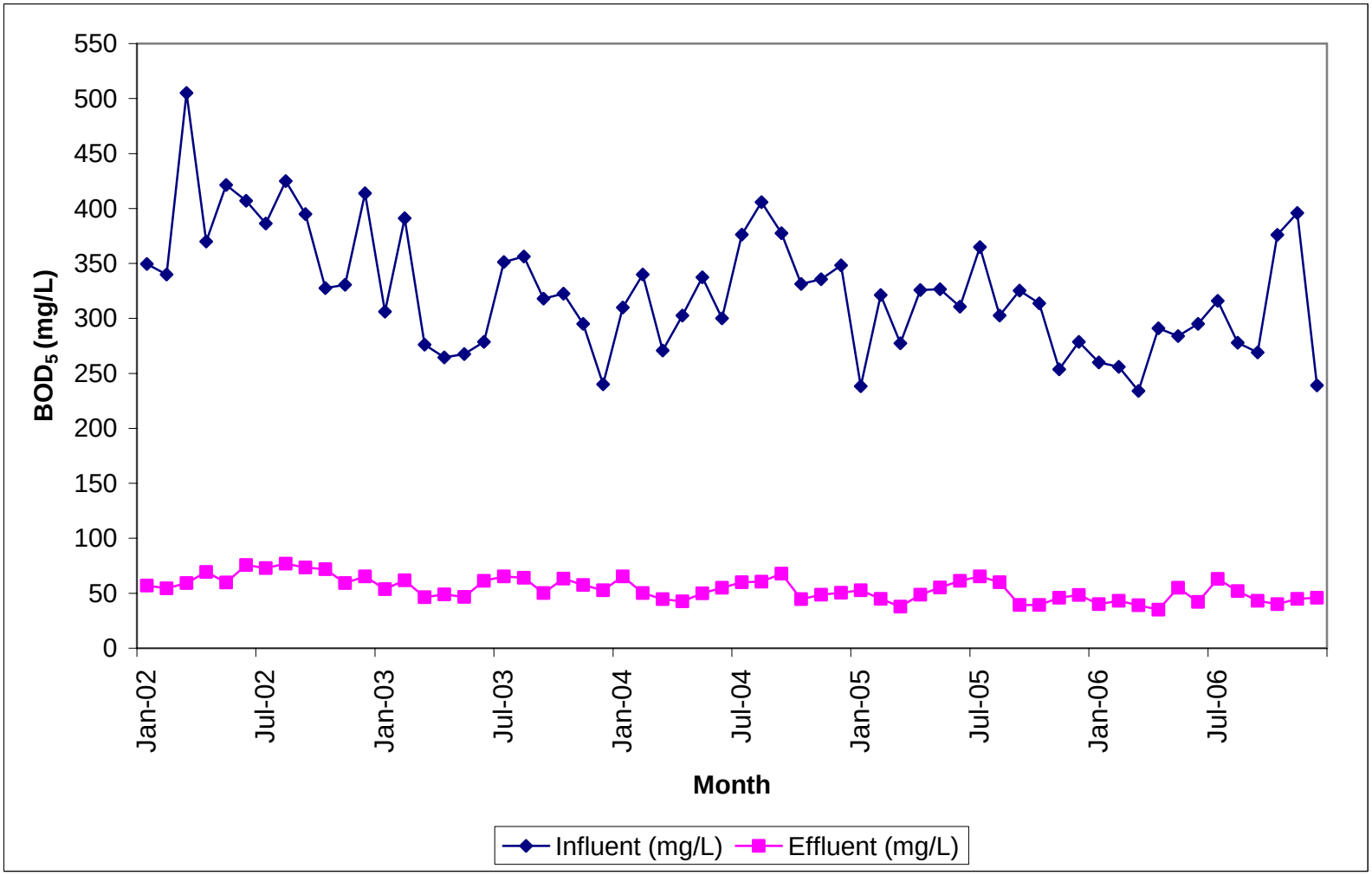
3.9 HISTORICAL INFLUENT LOADINGS

3.9.1 General

Generally, wastewater strength is defined by its BOD_5 and TSS content. The BOD_5 is described as the amount of oxygen required over a five-day period at 20 degrees Celsius by bacteria while stabilizing the decomposable organic matter under aerobic conditions. The TSS is a measure of the suspended material in the influent.

3.9.2 Influent BOD_5

Historical influent BOD_5 loadings for the past five years are shown in Table 3.14 and graphically in Figure 3.4. The five-year historical BOD_5 concentration for this period was 324 milligrams per liter (mg/L) for the annual average loads and 374 mg/L for the PSDWF average loads.



carollo engineers

Figure 3.4
HISTORICAL MONTHLY
AVERAGE BOD_5 CONCENTRATIONS
Morro Bay Cayucos Sanitary District
Wastewater Treatment Plant Facility Master Plan

Table 3.13	Total Projected Inlfuent Flows WWTP Facility Master Plan MBCSD			
Year	**AADF (mgd)**	**ADMMF (mgd)**	**PSDWF (mgd)**	**PHF (mgd)**
2007	1.16	1.43	1.30	5.24
2008	1.18	1.44	1.31	5.30
2009	1.19	1.46	1.33	5.35
2010	1.20	1.47	1.34	5.41
2011[1]	1.22	1.49	1.36	5.47
2015[2]	1.27	1.56	1.41	5.71
2021[3]	1.33	1.62	1.47	5.97
2026[4]	1.33	1.62	1.47	5.97

Notes:
1. Anticipated design start date.
2. Build-out of 2,865 connecitons for CSD reached.
3. Build-out population of 12,500 for Morro Bay reached.
4. End of 20-year planning period.

Table 3.14	Historical Influent BOD_5 Loading WWTP Facility Master Plan MBCSD				
	Annual Average		**Peak Seasonal**		**PSDW:AAD Factor[1]**
Year	**mg/L**	**ppd**	**mg/L**	**ppd**	
2002	386	3,711	425	3,781	1.02
2003	306	2,702	356	3,572	1.32
2004	336	3,074	406	3,811	1.24
2005	303	3,171	365	4,102	1.29
2006	291	2,852	316	3,496	1.23
5-Year Average	**324**		**374**		**1.22**

Notes:
1. Factor for annual average ppd to peak seasonal ppd.
2. Peak seasonal represents the greater month between July and August.

Design criteria from the 1982 construction plans prepared by Brown and Caldwell can be seen in Table 3.15.

Table 3.15 Existing Design Criteria
WWTP Facility Master Plan
MBCSD

Parameters	PSDW
Flow	2.36
BOD_5 - mg/L	280
BOD_5 Loading, ppd	5,510
TSS - mg/L	280
TSS - Loading, ppd	5,510

Based on a review of the plant data and historic design criteria, a PSDWF BOD_5 concentration of 410 mg/L and an AADF BOD_5 concentration of 340 mg/L will be used as future design values. It should be noted that the peak seasonal loadings represented the maximum month loadings for 2003, 2004, 2005, and 2006. These findings are consistent with the highest expected loadings occurring during the summer tourism season of July and August.

3.9.3 Influent TSS

Historical influent TSS loadings for the past five years are shown in Table 3.16 and graphically on Figure 3.5. The five-year historical TSS concentration for this period was 349 mg/L for the annual average and 404 mg/L for the peak seasonal average loads.

Table 3.16 Historical Influent TSS Loading
WWTP Facility Master Plan
MBCSD

	Annual Average		Peak Seasonal		
Year	mg/L	ppd	mg/L	ppd	PSDW:AAD Factor[1]
2002	374	3,576	492	4,707	1.32
2003	311	2,753	340	3,458	1.09
2004	354	3,225	418	3,929	1.18
2005	373	3,906	406	4,562	1.09
2006	335	3,265	366	3,728	1.09
5-Year Average	**349**		**404**		**1.15**

Notes:
1. Factor for ppd to peak seasonal ppd.
2. Peak seasonal respresents the greater month between July and August.

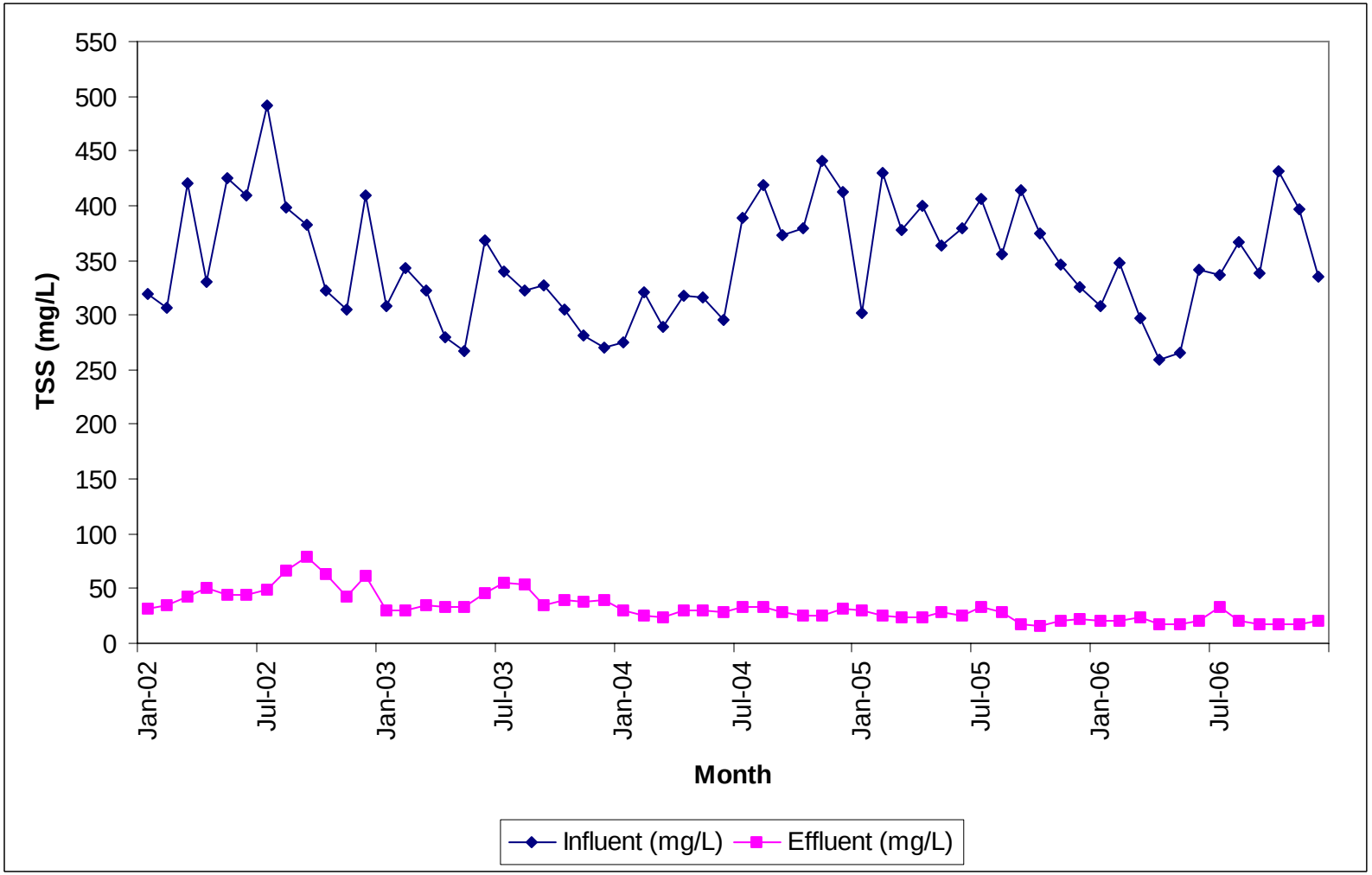


Figure 3.5
HISTORICAL MONTHLY
AVERAGE TSS CONCENTRATIONS
Morro Bay Cayucos Sanitary District
Wastewater Treatment Plant Facility Master Plan

Based on a review of the plant data and historic design criteria, a PSDWF TSS concentration of 420 mg/L and an AADF TSS concentration of 360 mg/L will be used as design values.

3.10 HISTORICAL PLANT PERFORMANCE

The records for the effluent quality from the WWTP for the last five years have also been reviewed and tabulated. Generally, the WWTP has produced an excellent quality effluent that is well below the limits established by its 301(h) modified permit for BOD_5 and TSS.

3.10.1 Effluent BOD_5

The effluent BOD_5 represented in both concentration (mg/L) and loading (ppd) is shown in Table 3.17. Based on this data, over the last five years the plant effluent has averaged 54 mg/L. The corresponding BOD_5 removal rates, determined from comparing the annual average influent and effluent concentration values, have also been shown with a five-year average BOD_5 removal rate of 83.9 percent. As mentioned previously, both of these parameters exceed the requirements of the current discharge permit, WDR No. 98-15, which stipulates a 30-day average BOD_5 concentration less than 120 mg/L and removal efficiency greater than 30 percent before ocean discharge.

Table 3.17 Historical Effluent BOD_5
WWTP Facility Master Plan
MBCSD

Year	Annual Average mg/L[1]	Annual Average ppd	Percent[2] Removal
2002	67	641	83%
2003	56	494	82%
2004	53	486	84%
2005	50	521	83%
2006	45	445	88%
5-Year Average	**54**		**83.9%**

Notes:
1. Current WDR requires a 30-day average less-than 120 mg/L.
2. Current WDR requires removed efficiency greater then 30 percent.

3.10.2 Effluent TSS

Likewise, the effluent TSS represented in both concentration (mg/L) and loading (ppd) is shown in Table 8.18. Based on this data, over the last five years the plant effluent TSS has averaged 35 mg/L. The corresponding TSS removal rates, determined from a comparing the annual average influent and effluent concentration values have also been shown with a

five-year average TSS removal rate of 89.7 percent. Again, these parameters are well within the discharge requirements of a 30-day average TSS concentration less than 70 mg/L and removal efficiency greater than 75 percent.

Table 3.18 Historical Effluent TSS WWTP Facility Master Plan MBCSD

Year	Annual Average mg/L[1]	Annual Average ppd	Percent[2] Removal
2002	49	468	86%
2003	39	345	87%
2004	29	263	92%
2005	24	255	93%
2006	21	202	96%
5-Year Average	**35**		**89.7%**

Notes:
1. Current WDR requires a 30-day average less-than 70 gm/L.
2. Current WDR requires a removal efficiency greater then 75 percent.

3.11 PROJECTED INFLUENT LOADINGS

Based on the nature of the City and the CSD, as well as the design approach previously taken for other coastal cities in the area, the design loading for the WWTP is determined by the PSDWF and peak seasonal loadings previously identified. These projected values will be used to determine the organic loading for the planning period.

3.11.1 BOD_5

The projected BOD_5 loadings are determined using the previously identified PSDWF BOD_5 concentration of 410 mg/L. The PSDWF BOD_5 loading at the end of the planning period 2026 with a flow of 1.5 mgd is approximately 5,042 ppd.

3.11.2 TSS

Utilizing PSDWF influent flows and the PSDWF TSS concentrations previously identified as 420 mg/L, the PSDWF design TSS loading for the year 2026 is projected to be 5,165 ppd.

Although the PSDWF of 1.47 mgd determined previously in this report is significantly less than the PSDWF of 2.36 mgd in the existing design criteria, historical plant data has shown that the concentration of BOD_5 and TSS in the wastewater has increased. Therefore, the

existing design loadings for the WWTP are consistent with loading history over the last five years.

It is important to note that although the hydraulic capacity of upgrades made to the WWTP may be less than the existing design capacity, future organic capacity will be similar to the existing design criteria. This fact is particularly important for the design of new secondary treatment processes such as oxidation ditches, membranes, or activated sludge.

3.11.3 Summary of Projected Influent Flows and Loadings

While the results of the flows and loadings analysis in this report differ significantly in comparison to the exiting design criteria for the WWTP, they are in line with recent studies done for the City and CSD. A report prepared by Cannon Associates in March 2004 titled Alternative Evaluation Report (REF 3.3) provides future flows and loadings projections for the WWTP. These findings are summarized in Table 3.19, and are consistent with the new design criteria developed for this report.

Table 3.19 Summary of Cannon Associates Projections (2004)
WWTP Facility Master Plan
MBCSD

Parameter	AADF	PSDWF
Flow	1.38	1.50
BOD_5 - mg/L	362	405
TSS - mg/L	378	396

Table 3.20 outlines the recommended year 2026 influent design flows and loadings to be used in the alternative evaluations included as part of this Facility Master Plan.

Table 3.20	Summary of Design Influent Flows and Loadings WWTP Facility Master Plan MBCSD					
	Average Annual			**Peak Seasonal**		
Parameter	**Morro Bay**	**CSD**	**Total**	**Morro Bay**	**CSD**	**Total**
Flow	1.00	0.33	1.33	1.05	0.42	1.47
BOD_5 - mg/L	340	340	340	410	410	410
BOD_5 - ppd	2,837	925	3.762	3,592	1,449	5,042
TSS - mg/L	360	360	360	420	420	420
TSS - ppd	3,004	979	3,983	3,680	1,485	5,165

It should also be noted that the majority of the future projected flow is from residential users, which shows potential for water reuse. The decision to recycle the treated effluent from the MBCSD WWTP will depend on the treatment alternative selected in a future chapter of this report.

It is recommended that these planning period design flows and loadings will be confirmed and further refined during the design period.

SUBSOIL STABILIZATION

4.1 SUMMARY

Due to the characteristics of the soil at the Morro Bay Cayucos Sanitation District (MBCSD) Wastewater Treatment Plant (WWTP) site, subsoil stabilization was performed in and around areas where structures such as the Administration Building and Headworks were constructed during the last expansion of the MBCSD WWTP in 1982. Carollo assumes that during this phase of expansion to the WWTP, similar earthwork must also be done to prepare for construction.

The subsoil stabilization method performed in 1982 is known as vibrocompaction. Vibrocompaction is a specialized subsoil stabilization method that is used primarily in clean saturated sand profiles like those found at the WWTP. Based on information outlined in the design specifications for the 1982 expansion of the WWTP, a budgetary cost estimate was obtained from Hayward Baker, a geotechnical contractor with extensive vibrocompaction experience. The vibrocompaction performed in 1982 would cost approximately $1 million/acre if done for this phase of expansion.

In order to present the most accurate cost estimate in the facilities plan for the final recommended project, Carollo Engineers, P.C. (Carollo) will include $1 million to cover the cost of subsoil stabilization for this phase of expansion. The actual cost of subsoil stabilization will be determined by a geotechnical engineer during the design phase of this project.

4.2 PURPOSE

The purpose of this chapter is to identify extraordinary site work that was completed during previous construction at the MBCSD WWTP site. This information will be used to determine the cost of similar site work that must be performed during the current phase of the WWTP upgrade. In order to present the most accurate cost estimate for the WWTP expansion, these costs will be applied to the construction costs of the recommended treatment alternative, which will be presented in the final chapters of this report. Including this information during the facilities planning stage of the project will also ensure that costs in addition to the normal contingencies used during the planning phase will not be left out during design.

4.3 BACKGROUND

Due to the characteristics of the sandy soil at the MBCSD WWTP site, extensive subsoil stabilization was performed in 1982 during construction of the last expansion. Subsoil stabilization was required in and around areas where new structures were constructed.

Subsoil stabilization was done for the construction of the administration building, MCC building, secondary clarifier, solids contact basin, headworks, and Digester No. 3. The combined total compaction area was approximately 0.95 acres (41,000 ft^2) during the last expansion of the WWTP in 1982 and is identified as the crosshatched areas in Appendix C.

4.4 COMPACTION METHOD

The subsoil stabilization method outlined in the specifications provided by Brown and Caldwell is known as vibrocompaction. Vibrocompaction is a compaction method that compacts and densifies the native material, laterally, from ground surface to a minimum specified elevation. This type of subsoil stabilization is highly specialized and is used in areas with a clean saturated sand profile.

Based on information provided by the engineer in the specifications, vibrocompaction was completed in the areas identified in Appendix C from the existing ground elevation of approximately 115 feet to an elevation of 90 feet, a depth of roughly 25 feet. Elevations listed in the drawings were based on adding 100 feet to the actual ground elevation. In each area, the individual densification stations were adjusted by the contractor as needed to achieve a relative compaction of 75 percent over the entire area, but were placed no further than 6 feet apart. Following densification, the stations were suitably backfilled to a relative density of 75 percent.

4.5 COST

The vibrocompaction method described in the drawings and specifications provided by Brown and Caldwell for the last expansion remains a valid subsoil stabilization method today, for clean sand profiles like those found at the MBCSD WWTP site. The assumption has been made that future construction will require subsoil stabilization, in the form of vibrocompaction, similar to that performed in 1982. A budgetary cost estimate has been provided by Hayward Baker, a local geotechnical contractor with experience in vibrocompaction. Carollo has recently worked with Hayward Baker on the expansion of the City of Pismo Beach WWTP. For this project, Hayward Baker performed subsoil stabilization work that included the construction of stone piles to support the new oxidation ditches. This estimate is based on a depth requirement of 25 feet, densification stations placed on 6-foot centers, and the use of native backfill at each station. In order to perform vibrocompaction, according to the specifications listed above, the cost would be approximately $1 million per acre. If stone, rather than native soil, is required for backfill, the cost for subsoil stabilization could be significantly higher.

While the exact size of the area that will require subsoil stabilization for construction during the next expansion of the WWTP is unknown at this time, an area of one acre has been assumed for the purpose of this report. Therefore, a cost of $1 million will be added to the cost of the recommended project that will be presented in the final chapter of this report.

It should be noted that the amount and type of subsoil stabilization assumed is based on the last expansion of the WWTP. Sampling and testing will be performed by a geotechnical engineer during the design phase of this expansion to determine the area and stabilization process that will affect the actual impact of subsoil stabilization on the total construction cost of the project.

REGULATIONS

5.1 SUMMARY

The purpose of this chapter is to summarize the current and future regulations that are applicable to the Morro Bay Cayucos Sanitary District (MBCSD) Wastewater Treatment Plant (WWTP).

The MBCSD received their current WWTP Waste Discharge Requirements (WDR) No. 98-15 in December 1998. Since the MBCSD discharges to the ocean, these requirements are primarily based on the National Pollutant Discharge Elimination System (NPDES) Permit No. 0047881 and the Water Quality Control Plan for Ocean Waters of California (Ocean Plan). The current NPDES permit is modified by a 301(h) waiver, which waives full secondary treatment requirements for 5-day biochemical oxygen demand (BOD_5) and suspended solids. Although the modified permit expired on March 1, 2004, it continues to be enforced until a new permit is issued. The draft of a new tentative permit was issued in November 2005, but disputes governing full secondary treatment upgrades has delayed approval by the Central Coast Region of the Regional Water Quality Control Board (RWQCB).

In addition to existing discharge requirements, the MBCSD may also be subject to new regulations if the current discharge location is changed. For this reason, the Central Coast Basin Plan, Inland Surface Waters Plan, and Enclosed Bays and Estuaries Plan could be applicable to the MBCSD in the future and are discussed in detail in this chapter.

Several other important regulatory areas are also covered in this chapter as they apply to the MBCSD including pretreatment, recycled water, and biosolids. While historically pretreatment has been of little concern to the MBCSD, recycled water projects have been previously explored for both City and CSD and biosolids are now being composted at the WWTP. The role of these processes and their regulatory requirements have the potential to affect future design considerations for the WWTP.

5.2 BACKGROUND

Wastewater discharges are governed by both federal and state requirements. The primary laws regulating water quality are the Clean Water Act (CWA) and the California Water Code. Under the CWA, the United States Environmental Protection Agency (EPA) or a delegated State agency regulates the discharge of pollutants into waterways through the issuance of NPDES permits. The NPDES permits set limits on the amount of pollutants than can be discharged into the surface waters of the United States.

California Water Code and the Porter-Cologne Act, a provision of the Code, require the State to adopt water quality policies, plans, and objectives for the protection of the State's

waters. The State Water Resources Control Board (SWRCB) and the nine RWQCBs meet this requirement by establishing water quality criteria in regional Basin Plans, the Inland Surface Waters, Enclosed Bays and Estuaries Plan, the Thermal Plan, and the Ocean Plan.

The RWQCB is responsible for developing and issuing Waste Discharge Requirements (WDRs) to treatment facilities that discharge to land (for percolation and/or irrigation), and NPDES permits for treatment facilities that discharge to surface waters of the United States. The RWQCB is also responsible for issuing recycled water permits, as well as approving biosolids application for dischargers within the State of California.

5.3 EXISTING REGULATORY REQUIREMENTS

The MBCSD WWTP currently discharges all effluent to the ocean. Therefore, the discharge is primarily regulated by the NPDES permit and the Ocean Plan.

5.3.1 NPDES Permit

The MBCSD WWTP currently discharges under WDR Order No. 98-15 and NPDES Permit No. CA0047881 (REF 5.1). The permit is a modified NPDES permit with a 301(h) waiver, which waives full secondary treatment requirements for BOD_5 and total suspended solids (TSS) only. All other NPDES limits apply to the WWTP without exception. Thus, the effluent limitations are based on a combined primary and secondary effluent blend. The permit limits are summarized in Table 5.1.

In addition to the effluent limits specified in Table 5.1, the NPDES permit requires that as a 30-day average the WWTP shall remove at least 75 percent of TSS and 30 percent of BOD_5 from the influent stream before discharging wastewater to the ocean. The NPDES permit also establishes receiving water requirements based on Ocean Plan requirements and an effluent dilution of 133:1.

5.3.2 Ocean Plan

The Ocean Plan was adopted by the SWRCB in 1972 and most recently amended in 2005. The Ocean Plan specifies the beneficial uses of the ocean to be protected including industrial water supply, water contact and non-contact recreation, navigation, commercial and sport fishing, mariculture, preservation and enhancement of Areas of Special Biological Significance, rare and endangered species, marine habitat, fish migration, fish spawning and shellfish harvesting. Water quality objectives and effluent limits specified in the Ocean Plan are included in the WWTP's NPDES permit.

5.4 HISTORY OF THE MBCSD'S PERMITTING PROCESS

The NPDES Permit No. CA0047881 was originally issued to the MBCSD by the EPA and RWQCB Central Coast Region on March 29, 1985. The modified permit was reissued in March 1993 and again in December 1998. In July 2003, the MBCSD applied for the renewal

of the modified discharge permit, which would continue to waive full secondary treatment requirements and maintain the existing requirements for BOD_5 and TSS. The permit expired on March 1, 2004 but will continue to be enforced until a new permit is issued. The most recent action was taken by the EPA in November 2005 with the signing of a tentative decision to reissue the 301(h) modified NPDES permit to the MBCSD. On May 1, 2006, the RWQCB voted to continue the hearing on the 301(h) modified NPDES permit on a split vote of three to three. At the time of this writing, the RWQCB is deciding how to proceed.

Table 5.1 Current MBCSD NPDES No. CA0047881 Effluent Discharge Requirements WWTP Facility Master Plan MBCSD

Constituent	Units	Monthly (30-day) Average	Weekly (7-day) Average	Maximum
Peak Seasonal Dry Weather Flow	mgd	2.36	-	-
5-day Biochemical Oxygen Demand (BOD_5)	mg/L	120		180
	lbs/day[1]	2,062	-	3,092
Total Suspended Solids	mg/L	70		105
	lbs/day[1]	1,203	-	1,804
Total Coliform	MPN/100 ml	23	-	2,400
Grease and Oil	mg/L	25	40	75
	lbs/day[1]	430	687	1,288
Settleable Solids	ml/L	1.0	1.5	3.0
Turbidity	NTU	75	100	225
pH	Within limits of 6.0 to 9.0 at all times			
Acute Toxicity	TUa	1.5	2.0	2.5

Note:
1. Mass emissions based on ADWF design capacity of 2.06 mgd.

5.5 FUTURE EFFLUENT DISCHARGE REQUIREMENTS

In November 2005, a draft of the new tentative WDR permit was issued, which includes regulations pertaining to effluent discharge, pretreatment, and biosolids. Once adopted by the RWQCB, the WDR will be effective for a period of five years. Although the requirements are similar to those in the existing operating 301(h) waiver permit (WDR 98-15).

5.6 CALIFORNIA COASTAL COMMISSION

5.6.1 Background

The California Coastal Commission (Coastal Commission) oversees land and water use on California's coastline. Created in 1972, and permanently established in 1976 by the California Coastal Act, the primary mission of the Coastal Commission is to plan for and regulate land and water use in the coastal zone as well as enhance its resources. The coastal zone is defined as an area mapped by the state legislature and extends from a boundary three miles seaward of the coastline to an inland boundary with variable width. The jurisdiction granted to the Coastal Commission by the California Coastal Act is broad and covers all public and private entities with respect to all manners of development. These activities include division of land, a change in intensity of use of and public access to state waters. Any development within the coastal zone may therefore not occur until a Coastal Development Permit (CDP) has been issued. The Coastal Commission also includes construction, reconstruction, demolition, or alteration of the size of any structure, including any public facility or municipal utility as development. Additionally, any activity that expands the footprint, increases capacity, or requires the placement of any solid material or structure on land or in the water requires a CDP. The Coastal Commission can also delegate its authority to grant development permits to local governments through a Local Coastal Program (LCP).

Although the main function of the Coastal Commission is to oversee development along the coast, it also works with the SWRCB and RWQCB to reduce the pollution of coastal waters.

5.6.2 Coastal Commission and Facility Improvements

The City has a certified LCP with the Coastal Commission and the authority to grant CDPs within the coastal zone. Therefore, for upgrades made to the WWTP within its existing footprint, the City is the lead agency responsible for issuing any permits that may be required. For rehabilitation or repair work done to any existing facilities, outside of routine rehabilitation and maintenance, or the construction of new facilities, a CDP is required for the City. The City's WWTP is located within the appeals jurisdiction of the Coastal Commission. Thus any action on a CDP, issued by the City, may be appealed to the Coastal Commission.

5.6.3 Required City Permits

Applicable construction permits will be required for the City including building, stormwater, and CDPs as discussed previously. The City planning commission will need to consider the CDP in a public hearing. The decision of the planning commission can be appealed to the City Council. The decision of the City Council may then be appealed to the Coastal Commission.

5.7 ADDITIONAL REGULATORY REQUIREMENTS

If the MBCSD changes its discharge location to groundwater, an inland surface water (i.e. creek or river), an estuary, or irrigation as part of a reuse project, the discharge would be subject to additional requirements based on the Central Coast RWQCB Basin Plan, the Inland Surface Waters Plan, the Enclosed Bays and Estuaries Plan, Title 22 recycled water requirements and/or San Luis Obispo County Policies and Plans. Annexation could also become an issue if the WWTP was located outside of the City.

5.7.1 Central Coast Basin Plan

RWQCB plans (Basin Plans) are required by the Porter-Cologne Act for each of the nine regions of California. The Basin Plans are used to establish beneficial use, water quality objectives, and implementation plans for the water bodies within each region.

The Central Coast Regional Board adopted the latest version of the Central Coast Water Quality Control Plan (Basin Plan) in 1994. The Basin Plan identifies beneficial uses for the major creeks in the study areas as well as the Morro Bay Estuary, as shown in Table 5.2. The Basin Plan contains general water quality objectives, water quality objectives specific to each beneficial use, and water quality objectives for specific water bodies. The general objectives and the objectives specific to each beneficial use are too numerous for discussion herein. However, the objectives for specific water bodies within the study area, namely Chorro Creek and the Chorro groundwater basin, are shown in Table 5.3.

The Basin Plan implementation section specifies that for stream discharge secondary treatment is a minimum requirement. Discharges to streams with water contact recreation designations are required to follow California Department of Health Services (DHS) recommendations of coagulation, filtration, and disinfection to provide a median coliform of 2.2 MPN/100 ml. Where fisheries protection in a stream is a concern, detoxification is required. This coliform standard would apply to possible future discharges to Chorro Creek.

The Basin Plan implementation section also states that requirements for disposal into an estuary are the most stringent, and that discharge to estuaries are prohibited unless the discharge will enhance water quality. Eutrophication of estuaries is of specific concern, and the Basin Plan suggests secondary treatment with denitrification. Phosphorus removal and disinfection may also be required. Because Chorro Creek discharges to the Morro Bay estuary, these standards would likely apply.

Table 5.2 Beneficial Uses of Creeks in Study Area
WWTP Facility Master Plan
MBCSD

Beneficial Use	Cayucos Creek	Old Creek		Toro Creek	Morro Creek	Little Morro Creek	Chorro Creek	Morro Bay Estuary
		Above WRR[1]	Below WRR					
Municipal Supply	X	X	X	X	X	X	X	
Agricultural Supply	X	X	X	X	X	X	X	
Industrial Process/Service Supply		X	X					X
Ground Water Recharge	X	X	X	X	X	X	X	
Water Contact Recreation	X	X	X	X	X	X	X	X
Non-contact Recreation	X	X	X	X	X	X	X	X
Wildlife Habitat	X	X	X	X	X	X	X	X
Cold Water Habitat	X		X	X	X	X	X	X
Warm Water Habitat	X	X	X	X	X		X	
Migration	X			X	X	X	X	X
Spawning	X	X	X	X	X	X	X	X
Biological Significance							X	X
Rare, Threatened or Endangered Species	X	X	X	X	X	X	X	X
Estuarine Habitat				X	X			X
Freshwater Replenishment				X	X		X	
Commercial/Sport Fishing	X	X	X	X	X	X	X	X
Shellfish Harvesting								X

Note:
1. WRR - Whale Rock Reservoir

Table 5.3	Water Quality Objectives for Chorro Creek and Chorro Groundwater Basin WWTP Facility Master Plan MBCSD					
Constituent (mg/L)	**Total Dissolved Solids (TDS)**	**Chloride (Cl)**	**Sulfate (SO_4)**	**Boron (B)**	**Sodium (Na)**	**Nitrogen (N)**
Chorro Creek	500	50	50	0.2	50	-
Chorro Groundwater Basin	1000	250	100	0.2	50	5

5.7.2 Inland Surface Waters Plan/Enclosed Bays and Estuaries Plan

In 2000, the SWRCB issued the Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California. This document presents Phase 1 of the Inland Surface Waters Plan and the Enclosed Bays and Estuaries Plan, and is commonly referred to as the State Implementation Plan (SIP). The SIP contains provisions for implementing the pollutant criteria promulgated by EPA in the California Toxics Rule (CTR), the National Toxics Rule (NTR), and the water quality objectives adopted by the RWQCBs in their respective Basin Plans. The SIP was last amended in February 2005.

The CTR and the NTR establish water quality standards for toxic pollutants and create provisions for implementation of the standards. The objective of the SIP is to provide a standardized approach for permitting discharges of toxic pollutants to non-ocean surface waters. The SIP is also used in conjunction with the watershed management approaches to achieve the water quality standards designated in the regional Basin Plans.

The ability of the WWTP to attain compliance with these criteria would need to be assessed if a change in discharge location to a stream or estuary is proposed. Although the discharge of toxic pollutants is currently governed by the Ocean Plan, a change in discharge location may result in more stringent regulations, and compliance with the criteria may require additional source control or advanced treatment.

5.8 PRETREATMENT REQUIREMENTS

The current domestic WWTP's WDR No. 98-15, Provision D.1, requires the MBCSD to implement a pollution prevention program. The requirement states that the pretreatment program will include a source control for both domestic and industrial discharges that assures compliance with the limits in the WDR and minimizes the exposure of WWTP employees to hazardous chemicals. The pretreatment program is also meant to increase opportunities for recycle and reuse of wastewater effluent and biosolids.

With the exception of vacation lodgings, both communities are residential communities with little to no industry. The pretreatment goals outlined in MBCSD's WDR are aimed at minimizing discharges of household hazardous chemicals from residential and commercial users to the collection system.

5.9 RECYCLED WATER REGULATIONS

Several agencies have regulatory authority or jurisdiction over potential projects using recycled water. The major state agencies include the DHS, the SWRCB, and the RWQCB. In addition to State regulatory agencies, there may also be involvement by county and local authorities. There are currently no federal regulations pertaining to water recycling.

The DHS is the primary State agency responsible for public health, whereas the SWRCB and the RWQCB are the primary State agencies charged with protection, coordination, and control of water quality. These agencies work together to develop discharge permits for recycling projects. Generally, the DHS interprets the laws dictated by the California Code of Regulations applicable to recycling and makes recommendations on individual projects to the RWQCB, which is overseen by the SWRCB. In order to implement recycling of wastewater, the MBCSD would be required to submit a Title 22 Recycled Water Engineering Report and the two application forms, a Report of Waste Discharge (RWD) and Water Reclamation Requirements (WRR), to the DHS. Once DHS approves the report and applications, the RWQCB must approve the report and then issue the final permit for the recycling project.

A major component of Title 22 regulations, which affects future design parameters for the MBCSD, is the demonstration of reliability. DHS requires full reliability for recycled water use in the form of redundant treatment units, short-term retention, long-term storage, or disposal. In order to satisfy this requirement, the MBCSD may have the option to divert additional discharge to its current ocean outfall or other discharge point.

The existing water recycling regulations, which dictate wastewater treatment processes and effluent quality criteria, are contained in the California Code of Regulations, Title 22, Division 4, Chapter 3, Sections 60301 through 60355. A compilation of the water recycling regulations can be found in "The Purple Book," which can be found at http://www.dhs.ca.gov/ps/ddwem/publications/waterrecycling/purplebookupdate6-01.PDF. The regulations are intended "...to establish acceptable levels of constituents of recycled water and to prescribe means for assurance of reliability in the production of recycled water in order to ensure that the use of recycled water for the specified purposes does not impose undue risks to health..." The most recent revision to these regulations came into effect in 2001.

5.9.1 2001 Recycled Water Regulations - Recycled Water Quality

The DHS regulations define four types of recycled water determined by the treatment process and total coliform, bacteria, and turbidity levels. Although the DHS has not assigned type designations to the grades of recycled water defined by the current regulations, designations are provided here for clarity. The four treatment types of recycled water that are currently allowed are summarized in Table 5.4 and detailed in Appendix D.

Article 3 of the Water Recycling Criteria details the acceptable uses of recycled water. Some of the uses specifically addressed include irrigation, impoundment, and cooling. The only exception noted for using recycled water is that the regulations shall not apply to on-site use at a water recycling plant, or WWTP, provided public access is restricted to the area where reuse occurs.

In the case of MBCSD, the facility currently discharges effluent that meets secondary treatment standards under a 301(h) modified permit. However, in order for the MBCSD to be classified as Disinfected Secondary-23, current maximum coliform standards, as outlined in WDR 98-5, would need to be limited to 240 MPN/100mL. Allowable uses for Disinfected Secondary-23 effluent are listed in Table 5.4 and the section below.

5.9.1.1 Irrigation

Recycled water may be used for irrigation of various crops and landscapes. Recycled water specifically for the irrigation of the following must be disinfected tertiary recycled water:

- Food crops where the irrigation water comes into contact with the consumed portion of the crop;
- Parks and playgrounds;
- School yards;
- Residential landscaping; and
- Unrestricted access golf courses.

If the consumed portion of the food crop is produced above ground and recycled water does not contact the edible portion of the food crop, then Disinfected Secondary-2.2 recycled water must be used as a minimum standard. One recent clarification was made by the DHS in regards to orchard and vineyard irrigation using recycled water (see Appendix E). The position of the DHS Food and Drug Branch (FDB) is that undisinfected secondary recycled water, which was previously allowed, is not suitable for orchard and vineyard crops. The DHS states that it is “quite likely the crops will come into contact with recycled water or soil irrigated with recycled water through typical harvesting practices.” As a result of this position, irrigation of orchard and vineyard crops must meet the requirements of Disinfected Secondary-2.2 recycled water.

A minimum standard of Disinfected Secondary-23 recycled water must be used for irrigation of the following:

- Cemeteries;
- Freeway landscaping;
- Restricted access golf courses;
- Unrestricted access ornamental nursery stock and sod farms; and
- Pasture for animals producing milk for human consumption.

Any non-edible vegetation where access is controlled so that the irrigated area cannot be used as if it were part of a park, playground, or schoolyard. Recycled water used for the irrigation of the following must have a minimum standard of undisinfected secondary recycled water.

- Non food-bearing trees;
- Fodder and fiber crops and pasture for animals not producing milk for human consumption;
- Seed crops eaten by humans;
- Food crops that must undergo commercial pathogen-destroying processing before being consumed by humans; and
- Restricted access ornamental nursery stock and sod farms.

Recycled water may be used for irrigation of various crops and landscapes. Recycled water specifically for the uses described in the following sections must be disinfected tertiary recycled water:

5.9.1.2 Industrial Use

Industrial use of recycled water is not specifically addressed by existing regulations. These projects are considered on a case-by-case basis. Frequently the required effluent water quality is determined by the particular industrial process needs.

5.9.1.3 Impoundments

Recycled water that is used, as a source of supply for non-restricted recreational impoundments shall be disinfected tertiary recycled water that has been subjected to conventional treatment. Disinfected tertiary recycled water that has not been subjected to conventional treatment may be used for non-restricted recreational impoundments provided it is monitored for pathogenic organisms. The total coliform bacteria concentration shall comply with the criteria specified for disinfected tertiary recycled water.

Table 5.4 Recycled Water Treatment Regulations
WWTP Facility Master Plan
MBCSD

Recycled Water Type	Treatment Process	Approved Uses	Median Coliforms (MPN/100 ml)
Disinfected Tertiary	Filtered[1] and Disinfected[2]	Spray Irrigation of food Crops Landscape Irrigation[3] Nonrestricted Recreational Impoundment	2.2[4]
Disinfected Secondary - 2.2	Oxidized and Disinfected[2]	Surface Irrigation of Food Crops Restricted Recreational Impoundment	2.2[3]
Disinfected Secondary - 23	Oxidized and Disinfected[2]	Pasture for Milking Animals Landscape Irrigation[6] Landscape Impoundment	23
Undisinfected Secondary	Oxidized	Fodder, Fiber, and Seed Crops Surface Irrigation of Orchards and Vineyards[5]	

Notes:
1. "Filtered" means an oxidized wastewater that satisfied (a) or (b) below:
   a. Has been coagulated and passed through natural undisturbed soils or filter media with a specified maximum flux rate depending on the type of filtration system and does not exceed:
      1. An average of 2 NTU within a 24-hour period,
      2. 5 NTU more than 5 percent of the time within a 24-hour period, and
      3. 10 NTU at any time.
   b. Has been passed through a microfiltration, ultrafiltration, nanofiltration, or reverse osmosis membrane so that the turbidity does not exceed:
      1. 0.2 NTU more than 5 percent of the time within a 24-hour period, and
      2. 0.5 NTU at any time.
2. Disinfected by either:
   a. A chlorine process with a continuous concentration contact time (CT) 450 mg-mins/L with a modal contact time ≥ 90 minutes (based on peak dry weather design flow).
   b. A process combined with filtration that inactivates and/or removes 99.999% of F- specific bacteriophage MS-2, or polio virus.
3. Includes unrestricted access golf courses, parks, playgrounds, school yards, and other landscaped areas with similar areas.
4. For the last seven days that analyses have been completed.
5. **No longer allowed**. The DHS has required that undisinfected secondary standards are not suitable, and that recycled water must meet disinfected secondary-2.2 requirements.
6. Includes restricted access golf courses, cemeteries, freeway landscapes, and landscapes with similar public access.

Restricted recreational impoundments and publicly accessible impoundments at fish hatcheries shall have a minimum standard of Disinfected Secondary-2.2 recycled water. Landscape impoundments without decorative fountains have a minimum standard of Disinfected Secondary-23 recycled water.

5.9.1.4 Cooling

Recycled water used for industrial or commercial cooling or air conditioning that involves the use of a cooling tower, evaporative condenser, spraying, or any mechanism that creates a mist shall be disinfected tertiary recycled water. If a mist is not created then the water shall be at least Disinfected Secondary-23.

Whenever a cooling system, using recycled water in conjunction with an air conditioning facility, utilizes a cooling tower or otherwise creates a mist that could come into contact with employees or members of the public, the cooling system must use a drift eliminator while in operation. In addition, chlorine, or other biocide, must be used to treat the cooling system recirculating water to minimize the growth of microorganisms.

5.9.1.5 Other Purposes

Disinfected tertiary recycled water may also be used for the following:

- Flushing toilets and urinals;
- Priming drain pipes;
- Industrial process water that may come into contact with workers;
- Structural fire fighting;
- Decorative fountains;
- Commercial laundries;
- Consolidation of backfill around potable water pipelines;
- Artificial snowmaking; and
- Commercial mechanical car washes.

Recycled water used for flushing sanitary sewers shall be at least undisinfected secondary recycled water.

5.9.1.6 Other Methods of Treatment

If a treatment process is demonstrated to the DHS to meet Title 22 regulations, upon their approval, it may be implemented for water recycling.

5.9.2 Future Trend for Recycled Water

Based on a report written for MBCSD by Carollo in March 2000 entitled Comprehensive Recycled Water Study (REF 5.2), the most attractive reuse projects are in the area of irrigation. Possible sites around the City include Morro Bay High School, Cloisters Development, and the Morro Bay Golf Course. Since these projects fall within the category of landscape irrigation, the recycled water type that must be used is disinfected tertiary. Therefore, unrestricted use tertiary treated recycled water is the required level of treatment based on viable use. It should be noted that since this report was completed, possible reuse projects in the area have changed. The report should be updated before the WWTP upgrade is completed to identify new projects and reuse opportunities.

5.10 BIOSOLIDS REGULATIONS FOR LAND APPLICATION

Since 1998, the MBCSD has been disposing of the bulk of its biosolids by having a permitted land applier, San Joaquin Composting, pickup, haul, compost, and spread the biosolids on agricultural land. On July 1 2004, the MBCSD was permitted by the California Integrated Waste Management Board (CIWMB) to conduct a pilot biosolids-composting project with the goal of developing a cost effective technique for producing Exceptional Quality (EQ) that meets both metal and Class A standards. As of February 2006, the biosolids composting operation is permitted as a Biosolids Composting Operation at a Publicly Owned Treatment Works (POTW). The compost produced by MBCSD serves as a high quality soil amendment that is available to the public.

This section provides a summary of the biosolids regulations that the WWTP must comply with for offsite reuse of biosolids either as direct land application or from composting now and into the future. Tables listing the various land application criteria are provided in Appendix F.

5.10.1 Overview

The major regulations that govern the application of biosolids at the reclamation area are the MBCSD's WDR, the U.S. EPA Sewage Sludge Regulations (40 CFR 503), the SWRCB Water Quality Order No. 2004-0012 - DWQ (General Order), and any county Biosolids Ordinance from the county where the biosolids are land applied. Any offsite facility that would take the biosolids must be permitted by the RWQCB through either the General Order or a site-specific permit. Since the MBCSD also composts a portion of its biosolids at the WWTP location, they must also comply with San Luis Obispo County regulations.

Since MBCSD sends their biosolids to an offsite facility, the MBCSD must comply with the 40 CFR 503 Regulations (as they pertain to biosolids generators), the WDR specifications for proper treatment and disposal, and the Kings County regulations, since this is the county where the sludge is land applied. Previously, compost was spread in both Kern

County and Kings County, but land application of biosolids has become controversial demostrated by popular vote in Kern County in 2006.

5.10.2 Federal Regulations (40 CFR 503)

The Federal Regulations, 40 CFR 503, became effective in 1994. The regulation is self-implementing and imposes requirements on the facilities that produce the biosolids and on the land appliers. The regulation establishes standards for pollutant limits, operational standards, management practices, and monitoring, record keeping, and reporting requirements. In order for the biosolids to qualify for land application, the biosolids must meet the maximum pollutant limitations for ten metals, and satisfy requirements for pathogen reduction and vector attraction reduction. This section provides a brief summary of the Federal Standards the biosolids must meet in order to comply with the 40 CFR 503 Regulations.

5.10.2.1 Metals Limitations

The 40 CFR 503 Regulations contain pollutant ceiling concentrations for metals that are the maximum allowable concentrations for any biosolids to be land applied (40 CFR 503.13 Table 1). In addition, there is a set of lower pollutant limits for biosolids to be defined as “exceptional quality” (EQ) biosolids (see 40 CFR 503.13 Table 3). Biosolids with pollutants above the 40 CFR 503 Table 1 ceiling limits cannot be applied to land. Biosolids with pollutants below the 40 CFR 503 Table 1 ceiling limits, but above the Table 3 limits, can be applied to land but are subject to annual and cumulative pollutant loading limits. Biosolids below the 40 CFR 503.13 Table 3 limits can be applied to land without regard to the annual or cumulative loading limits.

The Table 1 and Table 3 metals limits are listed in Appendix F.

MBCSD biosolids currently meet the standards for Table 3 metals limits, making them eligible for EQ biosolids classification.

5.10.2.2 Pathogen Reduction

In addition to pollutant concentrations, biosolids must not pose a public health risk. Performance-based pathogen reduction standards, contained in 40 CFR 503.32, classify biosolids as either Class A or Class B. The goal of Class A biosolids is to reduce pathogens to below detectable limits. The goal of Class B biosolids is to meet adequate pathogen reduction requirements and to rely on environmental factors at the reuse site to further reduce pathogens. Therefore, sites that use Class B biosolids must follow additional site restrictions concerning public access, animal grazing, and crop harvesting.

The Class A and Class B alternatives are provided in Appendix F.

The pathogen reduction requirements for MBCSD biosolids, as outlined in 40 CFR 503, are met using the windrow composting method. The temperature of the biosolids is held at

55 degrees Celsius or higher, for 15 days or longer. During this time, the windrows are turned a minimum of five times. Biosolids hauled to McCarthy Farms are certified as Class B when they leave the WWTP. However, these biosolids are composted to Class A standards before they are land applied by San Joaquin Composting. MBCSD biosolids composted on site meet Class A requirements. Photo No. 5.1 shows a windrow being turned at the WWTP.

Photo No. 5.1

5.10.2.3 Vector Attraction Reduction

Vector attraction is any characteristic that attracts disease vectors, such as insects or animals that may transport or transmit infectious agents. The 40 CFR 503 regulation specifies ten alternatives for meeting the vector attraction reduction requirements. One alternative must be met in order for biosolids to be land applied. The alternatives are provided in Appendix F.

The vector attraction reduction requirement for MBCSD biosolids is currently achieved by satisfying Option 1. The mass of volatile solids in the sludge is reduced by a minimum of 38 percent during the sludge treatment process using anaerobic digestion.

5.10.2.4 Exceptional Quality Biosolids

EQ biosolids may be used and distributed in bulk or bag form and are not subject to general requirements and management practices other than monitoring, record keeping, and reporting to substantiate that the quality criteria have been met. In order to be classified as EQ biosolids, the biosolids must meet the lower EQ pollutant limits, be classified as Class A, and meet one of the vector attraction reduction requirements.

5.10.3 General Order

In 2004, the SWRCB adopted general WDRs for the discharge of biosolids as a soil amendment. The WDRs are contained in Water Quality Order No. 2004 – 0012 - DWQ (General Order). The General Order is intended to streamline the regulatory process for land application sites statewide. Key provisions that go beyond the requirements of 40 CFR 503 are:

- It is applicable for all land applied Class A and Class B biosolids, and essentially all EQ biosolids that contain more than 50 percent biosolids (i.e. compost blended with green waste, where the biosolids exceed 50 percent of the blend).
- The discharger and the applier must file a Notice of Intent (NOI), which is a form and associated data, and submit a filing fee. A separate NOI and filing fee must be submitted for each landowner involved in a reuse project. After approval of the NOI, the RWQCB will issue a Site ID Number. Once the City receives the number, the City submits the Application information. If all requirements are met, then the RWQCB will issue a Notice of Applicability (NOA). For comparison, the self-implementing 40 CCFR 503 Regulations do not require application forms or pre approvals.
- The 40 CFR 503 pollutant ceiling concentrations must be met. In addition, the General Order contains a molybdenum limit of 75 milligrams per kilogram (mg/kg) and a cumulative loading limit of 16 pounds per acre (lbs/acre). Cumulative loading limits are required for all sites, even those that receive EQ biosolids. Background soils concentrations must be measured and used to calculate cumulative loading limits on the soils. This reduces the overall effective cumulative loading limit for any given site. The metal limits are listed in Appendix B.
- In addition to metals and nutrients, biosolids must be monitored annually for pesticides and PCBs (EPA Method 8080) and semi-volatile organics (EPA Method 8270).
- Biosolids must be incorporated into the soil within 24-hours in arid areas.
- To protect from dust and blown particulates, biosolids with a moisture content less than 50 percent moisture cannot be land applied. Depending on the biosolids density, this may correspond to a maximum dryness of 50 to 60 percent solids.
- Class B biosolids within a half mile of sites with a high potential of public exposure (schools, parks, hospitals, etc) shall be injected.
- Annual plant tissue testing for molybdenum, copper, and selenium is required.
- Previously undisturbed lands or sites that lay fallow for a period of more than one year (excluding land that has been disked or tilled) must have a biological site assessment completed to identify special-status species.
- Individual owners of the property at which the land application occurs are ultimately responsible for ensuring compliance with the General Order.

5.10.4 Future Trends for Biosolids Land Application

A recent trend throughout California is the elimination of biosolids land application. Counties that have banned, or practically banned, all biosolids applications include Shasta, Lassen, Glenn, Yuba, Lake Sutter, Contra Costa, San Joaquin, Stanislaus, Madera, Santa Cruz, Monterey, San Benito, Tulare, San Bernardino, and Imperial. Other counties, such as

Fresno, Kings, and Riverside have passed ordinances banning land application of Class B biosolids. Kings County allows Class A, EQ composted biosolids. Kern County has recently banned all biosolids application except on incorporated land.

In response to this trend, the MBCSD began a pilot scale windrow-composting project to make beneficial use of biosolids locally. Since 2004, the MBCSD has produced EQ compost that meets the metal standards, Class A pathogen reduction standards, and vector attraction reduction standards as outlined previously. Currently, the volume of biosolids being composted at the WWTP is constrained by space limitations and availability of green waste. Due to the success of the pilot study, the MBCSD has received a positive response from local residents.

The biosolids regulations in San Luis Obispo County are also unclear at this time. A temporary ordinance went into effect in March 2004, which put a limit on the amount of Class A biosolids that can be land applied annually on county land. A cumulative total of 1,500 cubic yards of EQ biosolids can be applied or distributed within unincorporated areas of San Luis Obispo County during any 12-month period. This temporary ordinance does however exclude Class A biosolids composted with other organic products such as green waste and sold in bulk form. The compost currently produced onsite by the MBCSD falls into this category. This 24-month ordinance was set to expire in March 2006, but was extended for a four-year time period until a permanent ordinance can be adopted. A recent draft of the permanent ordinance does not exclude compost from the annual limit of 1,500 cubic yards. The fate of this ordinance should be closely monitored if the MBCSD continues to compost biosolids onsite as part of the WWTP upgrade.

The success of the pilot study is a positive step for the MBCSD in that it will give the WWTP the opportunity to reuse biosolids within the community and relieve the burden of complying with other county ordinances that continue to become more restrictive.

5.11 SAN LUIS OBISPO COUNTY AIR POLLUTION CONTROL DISTRICT REGULATIONS

5.11.1 Overview

The San Luis Obispo County Air Pollution Control District issues emission permits based on both the Federal Clean Air Act (FCAA), which has created a comprehensive national framework designed to protect ambient air quality by limiting air emission from both stationary and mobile sources, and California's comprehensive state air quality control program.

The FCAA requires the EPA to set National Ambient Air Quality Standards (NAAQS) for several problem air pollutants to protect human health and welfare. Standards were established for carbon monoxide, ozone, fine particulate matter (PM-10), nitrogen dioxide, sulfur dioxide, and lead.

The California Air Resources Board (CARB) is the agency responsible for coordination and oversight of state and local air pollution control programs in California and for implementing the California Clean Air Act of 1988 (CCAA). CARB has also developed state air quality standards, which are generally more stringent than federal standards. Other CARB duties include monitoring air quality in conjunction with local air districts, setting emissions standards for new motor vehicles, and reviewing district input for the State Implementation Plan (SIP). The SIP consists of the emissions standards for vehicles and consumer related sources set by CARB, and attainment plans and rules adopted by the local air districts. CARB has designated the San Luis Obispo County as a non-attainment area for ozone and fine particulate matter (PM-10) because California standards are currently exceeded in the county for these pollutants.

The San Luis Obispo County Air Pollution Control District (APCD) has the primary responsibility for control of air pollution from sources other than motor vehicles and consumer products in the San Luis Obispo County. The APCD is currently in the process of developing a plan to achieve and maintain the ozone standard.

5.11.2 Background

Air Pollution Control District activities include rule development and enforcement, monitoring of air quality, a permit system for stationary and mobile air pollution sources, air quality planning, protection of the public from the adverse affects of toxic air contaminants, and responses to public requests for information regarding air quality issues.

The APCD administers rules and regulations that apply to stationary and mobile sources that emit air contaminants in San Luis Obispo County APCD regulations are separated into eight categories, summarized in Table 5.5.

Table 5.5 San Luis Obispo County Air Pollution District Regulations
WWTP Facility Master Plan
MBCSD

Regulation	Description
I	General
II	Permits
III	Fees
IV	Source Emissions Standards, Limitation and Prohibitions
V	Burning Provisions, Limitations and Prohibitions
VI	New Source Performance Standards
VII	National Emission Standards for Hazardous Air Pollutants (NESHAPs)
VIII	Procedure Before the Hearing Bond

For this facility master plan, the regulations that specify prohibitions and/or compliance limits that are applicable to wastewater treatment facilities are separated into two categories, which impact major and minor treatment plant operations.

Prohibitory Rules applicable to major treatment plant operations are listed in Table 5.6. The rules include emission limits for conventional pollutants (NOx, SOx, CO, VOCs), non-conventional pollutants (i.e. metals), visible emissions, odors (nuisance), fugitive dust emissions, and particulates.

Table 5.6 San Luis Obispo County Air Pollution District Regulations WWTP Facility Master Plan MBCSD

Rule No.	Title	Requirements	Facilities and Operations Affected
401	Visible Emissions (Ringlemann Scale)	Opacity less than Ringlemann Standards	Combustion Equipment
402	Nuisance	No Emission Causing Nuisance and Annoyance	Odor Generating Facilities
403	Particulate Matter Concentration	<0.12 lbs/million BTU fuel input	Combustion Equipment
404	Sulfur Compounds	Sulfur <200 lbs/hour (as SO_2)	Combustion Equipment
405	Nitrogen Oxides	Nitrogen <140 lbs/hour (as NO_2)	Combustion Equipment
404	Carbon Monoxide	CO <2000 ppm	Combustion Equipment (Boilers, flare)
430	Control of Oxides of Nitrogen from Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters	NO_x <30 ppm	Boiler > 5 MMBtu/hr
431	Stationary Internal Combustion Engines		Emergency diesel engine exempt if operating < 200 hr/yr

There are also prohibitions governing minor treatment plant equipment and operations. These regulations include gasoline storage and dispensing, painting of equipment, and use of volatile solvents. Though important for compliance, these “minor” activities are not in the scope of this document.

At the MBCSD WWTF, sources of conventional air contaminants are predominantly derived from the operation of equipment fueled by digester gas (boilers and flare) and diesel fuel

(standby generator). Other sources of air contaminants are derived from fugitive emissions from wastewater processes.

5.11.3 SLOCAPCD Permitting Process

Rule 202 specifies a “two-tiered” permitting process for the San Luis Obispo County APCD. The permitting process governs the construction, replacement, operation, or alternation of any source operation that emits or may emit contaminants. The two-tiered process includes an “Authority to Construct” (ATC) followed by a “Permit to Operate” (PTO).

The permit application begins with an evaluation of the project’s ability to comply with APCD’s Rules and Regulations. A completed permit application must be submitted to the APCD along with a description of the operation and the equipment/materials to be used. The APCD analyzes the proposed operations and determines the air quality impact to ensure consistency with local, state, and federal air pollution control requirements. Rule 204 outlines Best Available Technology (BAT) and offset requirements for new or modified sources. It is useful to note that the APCD continues to provide a Community Bank (Rule 212). The WWTF, as an essential public service (Rule 105), is qualified to draw from the Community Bank for offsets, provided certain conditions have been satisfied.

Once preliminary permit evaluation is complete, APCD staff issues an ATC permit that allows construction of a new facility, and installation or modification of equipment at an existing facility. The ATC ensures that the equipment is designed, constructed, and operated to meet air quality requirements and describes how the equipment must be operated to minimize air pollution.

After construction, installation, or modifications, the startup process allows time to test, calibrate, and demonstrate compliance with permit conditions included in the ATC. Following a successful startup inspection, a PTO is issued to allow the continued operation of the permitted equipment in accordance with all permit conditions and local, state, and federal air pollution requirements. The PTO is reevaluated and updated as necessary to ensure compliance and to reflect any changes in local, state, or federal requirements.

REHABILITATION

6.1 SUMMARY

The original Morro Bay Cayucos Sanitary District (MBCSD) Wastewater Treatment Plant (WWTP) was constructed in 1953 with the original digester, trickling filter, and primary clarifier remaining in operation. In 1964, a second primary and secondary clarifier, biofilter, chlorination facilities, and digester were added. Between 1982 and 1984, it was expanded to its current configuration using grants from the Environmental Protection Agency (EPA) Construction Grants Program. Overall, the equipment and facilities appear to be in a well-maintained condition. This reflects the dedication and commitment of the WWTP operations and maintenance staff. The 1953 vintage concrete structures should likely be retired.

The Preliminary Treatment facilities include the flow meter, bar screen, influent pumps, and grit chamber. Overall, the headworks appears to be in good structural condition, and with some rehabilitation and upgrades should have the capacity to serve the MBCSD WWTP for the projected build-out flow conditions. The major items needing rehabilitation include the screening conveyor system, grit basin aeration system and classifier, and Motor Control Center (MCC) “C”. Overall, the estimated construction cost is $2,190,000 with an estimated total project cost of $2,957,000.

The Primary Treatment facilities include the primary clarifiers, and the primary sludge and scum pumps. Overall, the primary clarifiers appear to be in good structural condition and with some upgrading and rehabilitation should be capable of providing a good level of service to MBCSD for the projected build out flow projections. The major items needing rehabilitation include sludge valves and access walkways. Overall, the estimated construction cost is $534,000 with an estimated total project cost of $721,000.

The Interstage Pump Station includes the blending valve (to be abandoned), primary effluent flow meter, and biofilter recirculation and effluent pumps. Overall, these facilities appear to be in good structural condition and could serve the MBCSD with some rehabilitation and upgrades. The major items needing rehabilitation include the installation of the third effluent pump and controls. Overall, the estimated construction cost is $360,000 with an estimated total project cost of $486,000.

The Secondary Treatment facilities include the trickling filters, solids contact basin, secondary clarifier, return and waste pumps, and the scum pumps. Overall, the secondary facilities appear to be in good structural condition and with some rehabilitation and upgrades should serve the MBCSD WWTP for the projected build out flow conditions. The major items needing rehabilitation include the aeration equipment and trickling filter structure. Overall, the estimated construction cost is $480,000 with an estimated total project cost of $648,000.

The Disinfection facilities include the contact basin (vintage 1953) and hypochlorite and bisulfite feed systems. Due to the age and structural condition of the basin, a replacement basin is recommended. The chlorine feed systems should also be evaluated and updated with equipment that is more modern. If the systems were to be kept in service, the estimated construction cost is $420,000 with an estimated total project cost of $567,000.

The Digestion facilities include the digesters (No.1 vintage 1953), and the heating and mixing equipment. Digester No. 1 should be removed from service due to its age and structural condition. The other two should be thoroughly inspected when taken offline. The mixing systems need to be replaced. If the systems were to be kept in service, the estimated construction cost is $3,642,000 with an estimated total project cost of $4,917,000.

The Control Building facilities include the main electrical transformer, MCC-A, standby generator, and laboratory. Significant improvements to the electrical systems are recommended. Improvements to the laboratory are also recommended. Overall, the estimated construction cost is $1,392,000 with an estimated total project cost of $1,879,000.

A category of Other Buildings is presented that includes two MCC, the shop, and the old chlorine building. Significant improvements are recommended for the MCC. Overall, the estimated construction cost is $1,860,000 with an estimated total project cost of $2,511,000.

A final category of Site Facilities include the plant water system, sludge drying beds, plant drain, electrical pull boxes, and yard piping. Significant work is anticipated for the yard piping much of which could be associated with repavement of disturbed areas. Overall, the estimated construction cost is $ 780,000 with an estimated total project cost of $1,053,000.

The total construction cost to keep all the existing structures in service is estimated to be $11,658,000 with a project cost of $15,738,000.

Based on the condition of several of the facilities constructed in 1953 and 1964, the JPA Board has given Carollo the direction to retire Trickling Filter No. 1, Trickling Filter No. 2, Primary Clarifier No. 1, Primary Clarifier No. 2, Digester No. 1, and the Chlorine Contact Basin as part of the WWTP upgrade. These facilities will have been in service for 50 years or longer when the upgraded facility goes online in 2014. It will be more cost effective for the MBCSD to retire and demolish these facilities rather than rehabilitate them as part of the recommended project.

In response to the findings made during the initial site visit in May 2006, Carollo recommended additional work be performed by discipline experts to accurately determine the condition of the existing facilities. The specific areas that required more attention included the WWTP's electrical equipment, underground piping and cathodic protection equipment.

In March 2007, Schiff Associates performed a corrosion survey at the WWTP site, which included a visual inspection of accessible facilities, analysis of soil samples, and a survey of the cathodic protection system. The corrosion survey revealed that the metallic structures are experiencing localized and general corrosion, soil at the site is highly corrosive to ferrous metals, and the cathodic protection system is not providing adequate protection at several sites throughout t the facility. The corrosion study is included in Appendix G of this report.

On August 29, 2006, a Carollo electrical engineer performed a review of the electrical equipment including the main switchboard, MCCs, panelboards, control panels, standby generator, field wiring, connections, and control devices. Initially the cost of rehabilitation for the electrical system was estimated at $2,957,000. Based on the more in-depth assessment performed by the electrical engineer, the actual costs of the upgrades to the existing electrical equipment is estimated at $1,531,000. The electrical study is included in Appendix H of this report.

The information obtained from this chapter, as well as the additional information obtained from the electrical and corrosion studies is used in subsequent chapters of this report to develop accurate costs for biosolids and wastewater treatment alternatives for upgrade of the MBCSD WWTP.

6.2 BACKGROUND

6.2.1 Facilities

The original WWTP was constructed in 1953 and consisted of primary clarification followed by the trickling filter process. The solids generated in the process were digested in an anaerobic digester. Facilities that are still in use from the original WWTP include Digester No. 1, Trickling Filter No. 1, and the rectangular primary clarifier, which has been converted to function as the Chlorine Contact Chamber. In 1964, a second primary and secondary clarifier, biofilter, chlorination facilities, and digester were added. Between 1982 and 1984, the WWTP was expanded to its current configuration. The current layout for the WWTP is shown in Figure 6.1.

Overall, the equipment and facilities appear to be in a well maintained condition. This reflects the dedication and commitment of the WWTP operations and maintenance staff. The 1953 vintage concrete structures should likely be retired.

6.2.2 Wastewater Sources

The wastewater that enters the WWTP is from two agencies, the City of Morro Bay (City) and the Cayucos Sanitary District (CSD). Due to the local topography a majority of the wastewater that enters the WWTP is pumped. The wastewater is generally domestic and commercial with no major industrial components.

6.2.3 Design

The WWTP is rated for an average dry weather flow (ADWF) of 2.06 million gallons per day (mgd), a peak season dry weather flow (PSDWF) of 2.36 mgd, and a peak wet weather flow (PWWF) of 6.6 mgd. The WWTP was designed such that all of the design PSDWF flow is all treated to primary levels, while 0.97 mgd is treated to secondary levels of treatment. The primary and secondary effluents are then blended prior to being disinfected and discharged through an ocean outfall.

The 1982 design for the WWTP was based on influent 5-day biochemical oxygen demand (BOD_5) and total suspended solids (TSS) of 280 mg/L each. The actual influent loadings have increased as outlined in Chapter 3 (Flows and Loadings) of this report. These increases are most likely attributable to water conservation and inflow/infiltration (I/I) reduction efforts.

6.3 PRELIMINARY TREATMENT (HEADWORKS)

The preliminary treatment consists of flow metering, screening, grinding, pumping, and grit removal. The headworks structure consists of spaces that are both open to the atmosphere and enclosed.

6.3.1 Influent Flow Metering

6.3.1.1 Existing Conditions

The flow enters the WWTP through a 30-inch diameter gravity sewer that is located just east of the digesters. Located in this line is a metering manhole incorporating a Palmer Bowlus Flume as shown in Photo No. 6.1. This meter was installed and placed into operation in August 2001. As the flow passes through the throat of the flume, the depth of flow is measured. This liquid depth is converted to a flow reading. The local readout panel for this flow meter is located on the south wall of the Maintenance building. According to staff, this meter is in good operating condition and been functioning with little or no problems. Staff also reports that the water level in the headworks must remain shallow to avoid surcharging the flume resulting in erroneously high flow totals.

Photo No. 6.1

Figure 6.1
Wastewater Treatment Plant Site Layout
WWTP Facility Master Plan
MBCSD

6.3.1.2 Recommendations

The influent flow meter appears to be in good condition and no problems were observed or have been noted. No recommendations for upgrading or rehabilitating this facility are noted at this time. Care must be taken to avoid submerging the flume.

6.3.2 Influent Sluice Gate

6.3.2.1 Existing Conditions

Downstream from the influent flow meter is the influent sluice gate as shown in Photo No. 6.2. The sluice gate is equipped with a pneumatic actuator. The primary control for this gate is downstream channel liquid level, secondary control is manual. The actuator is powered by plant air; however, a local compressed air tank is provided to provide a limited amount of air to operate the gate in the event that the plant air system is out of service.

Photo No. 6.2

The intent of this gate is to control the quantity of wastewater that enters the headworks to prevent flooding of the influent channels. To complicate this, located between the sluice gate and influent wetwell is a bar screen and grinder, both of which create a restriction in the flow channel. Additionally, the small volume of storage in the influent channels between the influent sluice gate and the influent pump wetwell, and the cycling effects of both the influent pumps and influent sluice gates tends to create an undesirable hydraulic effect that caused both the influent pumps and influent sluice gate to cycle and operate erratically. To minimize this effect, staff manually operates the position of the sluice gate during high flow events.

To further complicate this hydraulic phenomena, plant staff has indicated that during periods of high flow, the primary clarifiers flood when all three influent pumps are in operation indicating a hydraulic restriction downstream of the primary clarifiers.

6.3.2.2 Recommendations

Due to the age of the influent sluice gate, it is recommended that a qualified service representative be contracted to overhaul the pneumatic operating system. In addition, it is recommended that the bubbler systems be replaced with narrow bean ultrasonic or radar level detectors. Plant staff have scheduled this bubbler system repair for 2008.

6.3.3 Screening/Grinding

6.3.3.1 Existing Conditions

Following the influent sluice gate the flow is directed into one of two channels. The northerly channel contains a mechanically cleaned bar screen manufactured by Case Cotter as shown in Photo No. 6.3. The screenings that are removed from the wastewater stream using this process are deposited into a stainless steel trash container. Removing the trash container is a dirty and difficult task, which requires the use of an overhead crane, or physically carrying the trash up the stairs to a dumpster. Safety and health improvements should be implemented.

The rated capacity of this equipment is 8.2 mgd. The bar screen is controlled either automatically using liquid level in the upstream channel or manually. The liquid level is determined using a bubbler system. The screen is only used during periods of high flow or when the grinder is out of service. Slide gate are provided upstream and downstream of the bar screen to provide isolation. This screen is original equipment that was installed in 1984.

Photo No. 6.3

Located in the southerly channel is a channel screening/grinding system. This system consists of a moving belt screen that transports the trash in the influent wastewater stream to a grinder. In the grinder, the large pieces of debris are reduced where they enter the flow and continue to the downstream processes. This equipment has been reported to require frequent maintenance, on the submerged seal and bearing, to keep it in good working condition. Like the mechanical bar screen, slide gates are provided upstream and downstream of the grinder to provide isolation. This channel grinder was installed in 1995.

Photo No. 6.4

Located in each of the two channels are eight shear box aeration diffusers. It has been reported that the use of the diffusers has been discontinued due to fouling of the diffusers and other operational and maintenance considerations. The air manifold piping for this system is shown in Photo No. 6.5.

Photo No. 6.5

6.3.3.2 Recommendations

It is recommended that the existing screening and grinding systems be removed and replaced with modern state of the art screening system and that this rehabilitation be considered for early implementation. Current trends in the screen technology are to incorporate fine screens with openings 3/8-inch or less. A screen with this size opening will dramatically reduce the amount of trash that is allowed to flow downstream where it caused operational and maintenance issues in the clarifiers and digesters. However, small screens tend to remove fecal material with the trash. To mitigate this it is recommended that the new screening system incorporate a screenings washing and compacting features. These systems remove the majority of the organic materials by introducing water and incorporating agitation to liquefy the organic material. The liquefied waste is then directed back into the influent flow. A transportation system should be provided to convey the washed and dewatered screenings from the headworks area. Depending on the manufacturer of the bar screen, this can be accomplished using different methods including shaftless screw conveyors or belt conveyors. Once the screening are at ground level they should be deposited into a dumpster for disposal. Two bar screens with their associated washer/compactors should be installed. Each with the capacity to accommodate the peak flows expected.

The primary method of control will be based on time. However, it is recommended that liquid level control also be provided. During high upstream channel conditions the bar screen(s) will start and will run continuously until the upstream liquid depth has lowered for a preset length of time. This is critical due to the size of the wetwell and the potential to flood the influent channels. As with any equipment, provisions to operate the bar screens, washers, compactors, and conveyance systems manually should be provided. To more efficiently handle peak flows it is recommended that both screens be allowed to operate in parallel at all times. Provisions to isolate a bar screen should remain to allow for

maintenance. Care must be taken to avoid submerging the influent meter with any modifications to the headworks.

The shear box diffusers and associated air control piping should be removed from the structure. Any piping remaining that passes through walls or concrete floors should be filled with grout and capped to provide a smooth finish.

6.3.4 Chemical Feed Systems

6.3.4.1 Existing Conditions

Located in the headworks is a chlorination feed system. This system was originally installed to control odors and prevent septic conditions. The injection point for the chlorine was just upstream from the influent sluice gate. This system has been decommissioned and the chlorine yard piping has been abandoned and capped.

In lieu of chlorine, the MBCSD WWTP now uses ferrous chloride ($FeCl_2$) for hydrogen sulfide (H_2S) control. The $FeCl_2$ is injected into the influent wastewater just upstream from the influent sluice gate. The addition of the $FeCl_2$ has caused some minor surface corrosion on some of the ferrous metals in the influent channel area of the headworks. Despite this minor corrosion, the staff has reported good operating results with the $FeCl_2$ as documented by the low H_2S concentrations in the digester gas. As an additional benefit, $FeCl_2$ has been known to improve the settling characteristics in the primary clarifier.

The $FeCl_2$ is stored in an 800-gallon tank that is located within a concrete containment area. Two LMI chemical feed pumps are located outside next to the storage tank. The pumps deliver the $FeCl_2$ to the manhole just upstream from the influent sluice gate. The pumps are reported to be easy to operate and maintain, and have proven to be reliable.

Since the 800-gallon storage tank is less than a full truckload MBCSD WWTP pays a higher rate for the chemical. One way to avoid this surcharge cost would be to install a larger chemical storage tank. However, due to the small volume of $FeCl_2$ that is used on a daily basis (12-15 gallons per day (gpd)), the long detention time may prove to be detrimental to the effectiveness of the $FeCl_2$.

6.3.4.2 Recommendations

It is recommended that the chlorination system including the chlorine injection panel located in the headworks be removed. Any piping that passes through concrete walls or floors should be filled with grout and capped to provide a smooth finish.

6.3.5 Influent Pumping

6.3.5.1 Existing Conditions

The influent pumps deliver the screened wastewater up to the grit removal process. The suction for these pumps is located immediately downstream from the bar screen and

grinder in the influent pump channel which also functions as the influent pump wetwell. This area is extremely small and provides no meaningful liquid storage for the influent pumps to operate. Located in this channel are nine shear box diffusers. Like the other diffusers in the influent channels these diffusers are inoperable are not used. Located in this channel is a bubbler system that is used to control the speed of the influent pumps.

Located on the lowest level of the headworks structure are the three influent pumps as shown in Photo No. 6.6. These pumps were installed in 1984 and are controlled by 25 horsepower (hp) variable frequency drives (VFDs). The pumps are centrifugal solids handling pumps manufactured by Fairbanks Morse. The pumps are drive shaft driven with the motors located on an upper level. Each pump has a new rated capacity of 3.3 mgd at a total dynamic head (TDH) of 31.6 ft. These pumps have recently been inspected by a factory representative and are reported to be in good condition. There is room for a fourth pump to be added in the future as flows dictate. The influent pumps are original equipment that was installed in 1984.

Photo No. 6.6

Each pump is equipped with a suction isolation knife gate valve, which are showing wear. No discharge isolation or check valves are provided because the piping discharges above the grit chambers liquid level eliminating any chance of backflow. Each pump is equipped with a pressure gauge. The influent pump discharge piping shows signs of corrosion in several locations as shown in Photo No. 6.7.

Photo No. 6.7

Located on the upper level of this structure is where the motors and their associated VFDs are located. The pump motors appear to be in good condition as well as the newer VFD drives. The new VFDs are fed from the old MCCs. Located next to the VFDs is the headworks control panel shown in Photo No. 6.8. This panel has a feature during high liquid

level events. As shown in Photo No. 6.8, these panels show signs of corrosion. They are also considered obsolete.

Photo No. 6.8

6.3.5.2 Recommendations

The addition of the fourth pump and VFD should be completed if the projected flows indicate the need. This will give the WWTP the ability to meet future flow needs and provide additional operating flexibility for pump maintenance and servicing. The age of the pumps and VFDs warrant the equipment be placed on the replacement schedule.

The discharge piping, especially the piping located outside shows signs of severe corrosion due to the harsh marine environment. The condition of the piping should be determined through a corrosion study and replaced as needed. In addition piping that is not replaced should be sand blasted and recoated; where possible the use of corrosion resistant materials such as fiberglass reinforced plastic (FRP) should be incorporated for pipe supports.

It is recommended that the headworks control panel and the hard wired controls be replaced with new state of the art control system using programmable logic controller (PLC) technology with local and remote indication.

6.3.6 Sump Pumps

6.3.6.1 Existing Conditions

Located in the lower level of the headworks is a sump that houses two sump pumps. This sump collects drainage water from the headworks and pumps it to the grit removal basin influent box. Each pump is equipped with a suction and discharge isolation valve, and a check valve on the discharge piping prior to a common 6-inch pipe. The pumps are controlled based on liquid level in the sump. A new level control device was installed in 2003. The sump pumps are believed to be original equipment that was installed in 1984.

6.3.6.2 Recommendations

The sump pumps appear to be in good condition and no problems were observed or have been noted. No recommendations for upgrading or rehabilitating this facility are noted at

this time; other than the new level controls need to be incorporated in a new headworks control panel.

6.3.7 Grit Removal

6.3.7.1 Existing Conditions

Following the influent pumps is the aerated grit removal basins. There are two basins that are operated in series as shown in Photo No. 6.9. A bypass channel is provided to allow bypass of the basins if needed for maintenance. The air for the grit removal process is provided by one positive displacement blower. The blower is driven by a 7.5 hp motor and is sized for 150 scfm at 4.6 psig. The blower was installed in 2001. The air is introduced into the aerated grit removal basin along one side through swing arms and diffusers. The diffusers and their associated piping were installed in 1984 and have been in service since that time. There is minor concrete spalling that should be repaired as shown in Photo No. 6.10.

Photo No. 6.9

Photo No. 6.10

The grit that settles in the aerated grit basins is collected in two sumps. The collected grit is pumped from the basins by one of two grit pumps. These pumps are Model C grit handling pumps as manufactured by WEMCO as shown in Photo No. 6.11. These pumps are driven by 10 hp constant speed electric motors. Each pump is rated for 250 gpm at 40 feet of TDH. Each pump is outfitted with a suction isolation plug valve, a discharge isolation plug valve, and a discharge check valve. Much of the suction and discharge piping for these units has been repaired and sections of the piping replaced. Plant staff plans to replace the remaining piping in 2007 and 2008.

Photo No. 6.11

The grit slurry is pumped to one of two grit cyclones located on top of the grit classifier as shown in Photo No. 6.12. Through centrifugal force the grit cyclones remove the majority of the water from the slurry. The water that is removed from the cyclones flows by gravity to the influent sewer. The grit that is retained drops in to the classifier. In the classifier the grit travels up an inclined screw where wash water removes the majority of the organics. The dewatered and washed grit is deposited into a grit receiving bin, while the overflow water flows by gravity back to the influent sewer.

Photo No. 6.12

6.3.7.2 Recommendations

The exposed air piping, swing arms, and diffusers in the grit basins have reached their useful life and should be replaced. When the basins are out of service to replace the swing arms and diffusers, settled grit should be removed and the concrete inspected for corrosion and spalling. Any spalled areas should be repaired and the interior of the basins should be re-coated with a suitable abrasion and corrosion resistant coating.

The grit cyclones and classifier have been in service for 20 plus years and have reached their useful life. Although this equipment has performed well with only minor maintenance, it is recommended that a new unit of similar size and configuration be installed.

Exposed grit piping has been repaired in many areas as shown in Photo Nos. 6.13 and 6.14. The grit piping should be removed and replaced in several areas. The actual extent of the piping that needs to be replaced should be determined based on a corrosion study. In addition piping that is not replaced should be sand blasted and recoated; where possible the use of corrosion resistant materials such as FRP should be incorporated for pipe supports.

Photo No. 6.13

Photo No. 6.14

The WWTP owns two grit roll-off bins as shown in Photo No. 6.15. These bins have been in service for 20 plus years and have been repaired several times. It is recommended that new grit receiving bins be manufactured and placed into service within the next three years.

Photo No. 6.15

Finally, the slide gates in the grit area have been reported to be difficult to operate and maintain. During the final design, replacement of the sluice gates with channel mounted sluice gates and actuators should be considered.

6.3.8 Headworks Ventilation

6.3.8.1 <u>Existing Conditions</u>

The original ventilation system consisted of a series of supply and exhaust fans. The air that is exhausted from the influent pumping rooms is discharged into the influent channel area. Due to corrosion of the equipment, especially the electrical panels and associated equipment the ventilation system has been removed from the MCC-C area. This was done to slow down the corrosion that was being caused by the moist salty marine air that was being pulled through the system into the MCC room as shown in Photo No. 6.16.

Photo No. 6.16

The influent channel area of the headworks incorporates a H_2S gas detection system. This system is outdated and has been in service since 1985.

6.3.8.2 Recommendations

It is recommended that the new closed ventilation system incorporating a filtration system be installed that is constructed completely from corrosion resistant materials such as aluminum and FRP. The system should be designed to meet the requirements of NFPA 820. Any duct work and appurtenances should be constructed from corrosion resistant materials. The ventilation system will be designed to only use a minimum of outside make up air, and will be controlled using a simple thermostat. The system will include an air conditioner that will function as a dehumidifier and keep the space at tolerable temperatures for both personnel and electronic equipment.

The existing H_2S monitoring system should be replaced with a new state of the art ambient air monitoring system that meets the requirements of NFPA 820. It is recommended that the system should monitor for H_2S as well as CH_4. This system should have both local alarms as well as the capacity for remote alarm indication.

6.3.9 MCC-C

6.3.9.1 Existing Conditions

The electrical equipment in MCC-C has been in service for 20 plus years. There are visible signs of corrosion on the exterior as well as interior of the MCCs as shown in Photo Nos. 6.17 and 6.18. Over time, parts have been taken from some of the buckets to make repairs to other components. Plant staff plans to replace the 600-amp breaker in 2006/07. Regardless, the staff has done a good job of keeping the electrical equipment in good operating condition.

Photo No. 6.17

Photo No. 6.18

In addition, this space includes the digester control panel and PLC equipment for the digesters and pumps as shown in Photo No. 6.19. This equipment has very limited capacity and has exceeded its useful life. According to staff, this panel has never worked properly, and many of the features do not work at all. Like the MCCs, these panels also show signs of corrosion.

Photo No. 6.19

6.3.9.2 Recommendations

During final design the MCCs should be evaluated and where required replaced with new upgraded equipment. It is recommended that the digester control panel and the hard wired controls be replaced with new state of the art control system using PLC and PC technology with local and remote indication. The 120-volt LP panels have visible signs of corrosion and breakers and parts have failed and been used in other locations. This panel should be considered for replacement.

6.3.10 Miscellaneous Headworks Observations

6.3.10.1 Existing Conditions

Several of the doors and other facilities are in need of repair. This is due to the corrosive nature of the marine air as shown in Photo No. 6.20.

Photo No. 6.20

Located near the influent sluice gate is a jib crane and hoist. The jib crane is rated at 1000 lbs, while the hoist is rated at two tons. The short reach of the arm of the hoist is such that it can not be used to remove the majority of the equipment from the influent channel areas. The staff has reported that this hoist has need of electrical repairs and that repairs will be completed. The hoist does work adequately to remove equipment from the lower headworks level.

A monorail and hoist are installed in the upper pump room. This system is used to remove and move the pumps and other equipment into and out of the building. It was noted that the crane did not extend out through the wall of the building making it difficult to actually move equipment into and out of the building.

Several of the exterior lights are in a bad state of repair, or are gone completely resulting in inadequate work space lighting as shown in Photo No. 6.21.

Photo No. 6.21

It was noted that some of the junction and outlet electrical boxes that are cast into the concrete walls have water leaking through them. An example of this is shown in Photo No. 6.22.

Photo No. 6.22

6.3.10.2 Recommendations

The doors and other architectural, mechanical, and structural systems that are corroded should be replaced or repaired.

During the final design of the improvements, the need for a crane with a longer reach and or capacity should be determined based on the new equipment being installed.

The source of water should be located and corrected, or surface mounted outlet boxes should be installed.

6.3.11 Summary of Preliminary Treatment Recommendations

Overall the headworks appears to be in good structural condition, and with some rehabilitation and upgrades should have the capacity to serve for the MBCSD WWTP for the planning period. An opinion of probable costs for the recommendations list above is outlined in Table 6.1 below.

6.4 PRIMARY TREATMENT

The primary treatment consists of primary clarification, the blending valve, primary effluent flow meter, and associated sludge and scum pumping facilities.

6.4.1 Primary Clarifiers

6.4.1.1 Current Operating Conditions

Located at the effluent of the aerated grit basins is a weir box. It is in this location where the degritted wastewater is directed into the two primary clarifiers. Leaving the weir box is an 18-inch diameter pipe that directs the wastewater to Primary Clarifier No. 1, and a 15-inch diameter pipe that directs the wastewater to Primary Clarifier No. 2. Primary Clarifier No. 1 is the larger of the two primary clarifiers with a diameter of 50 feet and a side water depth (SWD) of 9 feet. Primary clarifier No. 2 is 40 feet is diameter with a SWD of 9 feet.

The MBCSD WWTP co-settles their WAS from the trickling filter solids contact process in the primary clarifiers. The WAS from the secondary process is delivered to the aerated grit box weir box where it is mixed with the de-gritted wastewater. There are several design and

operating criteria that are used to determine the capacity of primary clarifiers that co-settle WAS. They are shown in Table 6.2.

Table 6.1 Opinion of Probable Preliminary Treatment Rehabilitation Costs WWTP Facility Master Plan MBCSD

Parameter	Value
Rehabilitate and Overhaul Influent Sluice Gate	$10,000
Install New Level Indication Devices	$25,000
Two New Fine Bar Screens with Washer/Compactor	$300,000
Screening Conveying System	$100,000
Remove Unused Piping in Influent Channel Area	$10,000
Install Fourth Influent Pump and VFD	$150,000
Replace and Upgrade Influent Pump Piping	$50,000
Replace Exposed Air Piping and Swing Diffusers in Grit Basins	$250,000
Replace Grit Cyclone and Classifier	$100,000
Allowance for Piping Corrosion Study	$5,000
Replace and Upgrade Exposed Grit Piping	$50,000
Replace Grit Roll Off Bins	$50,000
Remove Old Slide Gates and Install New Channel Mounted Slide Gates With Actuators	$50,000
Inspect, Clean, and Repair Concrete in Grit Basins	$25,000
Ventilation Upgrades	$50,000
MCC-C	$500,000
Miscellaneous Headworks Improvements	$100,000
Subtotal	$1,825,000
Unidentified Items Contingency (20 percent)	$365,000
Subtotal Construction Cost 2006[1, 2]	$2,190,000
Engineering, Legal, and Administrative Contingency (35 percent)	$767,000
Total Project Cost 2006	$2,957,000

Notes:
1. ENR (20 cities) June 2006 = 7700.
2. Includes Contractor overhead and profit.

Table 6.2	**Primary Clarifier Design Criteria WWTP Facility Master Plan MBCSD**
Parameter	**Typical Design Values**
Overflow rate, at PSDWF (gpd/ft^2)	600-800 gpd/ft^2
Overflow rate at PWWF (gpd/ft^2)	1,200-1,700 gpd/ft^2
Detention Time, at ADF	1.5 - 2.5 hrs
Weir Loading (gpd/ft)	10,000 - 40,000 gpd/ft

As shown in Table 6.3, Primary Clarifier No. 1 has a PSDWF capacity of 1.55 mgd and a PWWF capacity of 3.4 mgd. This results in a PWWF to PSDWF ratio of 2.2. Likewise, as shown in Table 6.4, Primary Clarifier No. 2 has a PSDWF capacity of 1.00 mgd with a PWWF of 2.2 mgd, which results in the same PWWF to PSDWF ratio of 2.2. Adding the values results in an estimated primary clarifier capacity at PSDWF of 2.55 mgd, and an estimated PWWF capacity of 5.6 mgd.

Table 6.3	**Primary Clarifier No. 1 Capacity WWTP Facility Master Plan MBCSD**
Parameter	**Value**
Diameter	50 ft
SWD	9 ft
PSDWF	1.55 mgd
Overflow rate at PSDWF (gpd/ft^2)	789 gpd/ft^2
Detention Time at PSDWF	2.0 hrs
Weir Loading at PSDWF (gpd/ft)	9,868 gpd/ft
PWWF	3.4 mgd
Overflow rate at PWWF (gpd/ft^2)	1,737 gpd/ft^2
Weir Loading at PWWF (gpd/ft)	21,709 gpd/ft

Table 6.4	Primary Clarifier No. 2 Capacity WWTP Facility Master Plan MBCSD
Parameter	**Value**
Diameter	40 ft
SWD	9 ft
PSDWF	1.00 mgd
Overflow rate at PSDWF (gpd/ft^2)	796 gpd/ft^2
Detention Time at PSDWF	2.0 hrs
Weir Loading at PSDWF (gpd/ft)	7,958 gpd/ft
PWWF	2.20 mgd
Overflow rate at PWWF (gpd/ft^2)	1,751 gpd/ft^2
Weir Loading at PWWF (gpd/ft)	17,507 gpd/ft

The primary clarifiers are considered to be one of the most economical forms of treatment employed at wastewater treatment plants. The primary clarifiers at the MBCSD are no exception. As previously noted the wastewater strength has been increasing over the past years, probably due to water conservation and I/I improvements in the collection system. Based on the recently completed "Alternatives Evaluation Report", March 2004, prepared by Cannon Associates, the primary clarifiers have been operating within generally accepted guidelines as shown in the following table. It is noted that the results are from a short test period but do reinforce the other data collected.

Table 6.5 Primary Clarifier Removal Efficiencies[1]
WWTP Facility Master Plan
MBCSD

Constituent	Influent	Effluent	Removal Effluent	Range [(2)]
BOD_5	242 mg/L	171 mg/L	29 percent	25 - 40 percent
TSS	301 mg/L	127 mg/L	58 percent	50 - 70 percent

1. Alternatives Evaluation Report", March 2004, Cannon Associates, page12. The data is based on testing over several weeks from 9/29/2003 to 11/3/2003.
2. Wastewater Engineering, Third Edition, Metcalf and Eddy, page 473.

In addition to the above, the MBCSD staff provided additional primary clarifier influent and effluent TSS data for the period from January 2002 to June 2006. This data revealed that the average TSS removal for Primary Clarifier No. 1 is 62 percent and 61 percent for Primary Clarifier No. 2. This data correlates well with the data presented in the Cannon Associates report. Based on a comparison of the data it is suggested that the primary clarifiers are operating within their expected range. Based on the above removal efficiencies across the primary clarifiers, and the average day maximum month (ADMM)

BOD_5 and TSS influent loading, the estimated primary clarifiers effluent characteristics is shown in Table 6.6.

Table 6.6 Estimated Primary Clarifier Effluent Characteristics[1]
WWTP Facility Master Plan
MBCSD

Constituent	Influent	Removal Effluent	Estimated Effluent
BOD_5	432 mg/L	29 percent	307 mg/L
TSS	430 mg/L	58 percent	181 mg/L

Note:
1. Based on ADMM influent values as outlined in Chapter 3.

6.4.1.2 Existing Conditions

During the site visit on May 24, 2006, Primary Clarifier No. 2 was out of service and had been drained. This allowed a visible observation of the interior of the tank and the submerged mechanical equipment. This revealed that some of the metal components show signs of corrosion. The original drive units have been replaced with new Westech drives as shown in Photo No. 6.23.

Photo No. 6.23

It has been reported that during high flow events that the primary clarifier effluent launders flood, submerging the weirs and effluent launders. To prevent the clarifiers from actually overtopping, a high water level float has been installed that will activate an alarm as shown in Photo No. 6.24. This alarm is connected to a dialer so that staff can be notified during non-working hours if needed.

Photo No. 6.24

The 1982 design drawings show a butterfly valve on the discharge piping from each primary clarifier. The intent of this valve would be to allow isolation of the primary clarifier if the unit is out of service. According to staff, these valves have not been used and are not functional, and the position of the valve (completely open or partially open) is not known.

The outdoor lighting on the primary clarifiers and surrounding areas is in need of upgrading and rehabilitation. As shown in Photo No. 6.25, this light is being supported by a rope.

Photo No. 6.25

6.4.1.3 Primary Clarifier Recommendations

It is recommended that each clarifier be taken off line, drained, sand blasted, and cleaned. At this time, the condition of the interior concrete can be examined, and repairs, if needed made. The existing mechanical equipment should also be sand blasted, cleaned, and inspected for corrosion and deterioration. Corroded areas should be repaired and or replaced as identified. When repairs have been completed the interior of the tank and the equipment should be protected with appropriate coatings. During the time that the tank is out of service the effluent weirs and launder should be inspected, re-leveled, and if needed repaired.

The walkway to the new drive units does not provide adequate room for access and maintenance. The walkway should be modified to allow a clear working area around the new drive unit of at least 3 feet. The entire walkway will need to be blasted and painted.

The outdoor lighting should be upgraded and replaced.

There are several factors that need to be considered to improve the hydraulics out of the primary clarifier, and to prevent the effluent launders from flooding. As shown in Photo Nos. 6.26 and 6.27, the primary clarifier, and its effluent contain large amounts of trash. In an effort to keep this trash off the trickling filters, the staff has installed screens. These screens need to be manually cleaned, and a plugged screen can increase the headloss between the primary clarifiers and the downstream components. This situation can be improved by installing more efficient screening and trash removal equipment in the headworks as discussed in the screening/grinding section heretofore.

Photo No. 6.26

Photo No. 6.27

Generally, a butterfly valve is not recommended to be used in waters that contain trash, rags and undesirable fibrous materials such as primary effluent as shown in Photo No. 6.26. The main reason for this recommendation is that butterfly valves open and close around a shaft that is located in the center of the valve (or pipe). This results in the disc always being in the flow path where rags and other material can become wrapped around and caught on its edge. Over time, the amount of trash on the disc can prevent the valve from functioning properly. This can greatly restrict the flow carrying capability, which results in a much greater headloss. Due to this and other concerns about the use of butterfly valves in primary effluent, it is recommended that the butterfly valves be removed. There are additional hydraulic concerns relating to the flooding of the primary clarifier effluent launders such as the reduction of pipe diameter at the primary effluent flowmeter.

6.4.2 Primary Sludge Pumps

6.4.2.1 Existing Conditions

The sludge that is settled in the primary clarifiers is directed to the center of the clarifiers by the sludge rakes. Periodically, based on time, the sludge is withdrawn from the bottom of the primary clarifiers by the sludge pumps. The sludge pumps are positive displacement air operated diagram pumps as shown in Photo No. 6.28. These pumps were replaced in 1993, and have a good operating history associated with them. Two sludge pumps are furnished. Each pump has a capacity range from 90 to 300 gpm. The pumps deliver the co-settled primary and WAS to the anaerobic digesters for further treatment. The pumps are installed with isolation valves that will allow each pump to remove the sludge from each clarifier. This feature provides a good level of redundancy.

Photo No. 6.28

The sludge that is pumped to the digesters is metered using a newly installed Toshiba mag meter as shown in Photo No. 6.29. Additionally, the above ground piping was replaced with stainless steel piping as part of this project.

Photo No. 6.29

Operating staff has done a good job of maintaining the exposed piping and valves in this area. Regardless, the effects of being exposed to the marine environment have taken its toll. Additionally, there are several buried plug valves that are inoperable, or require excessive force to operate. An example of this situation is the buried primary clarifier drain valve which requires tremendous force to operate as indicated by the pipe wrench and steel pipe used to operate the buried valve as shown in Photo No. 6.30.

Photo No. 6.30

6.4.2.2 Recommendations

It is recommended that the sludge valves (buried and exposed) be replaced with new valves. The age of the pumps warrants the equipment be placed on a replacement schedule.

Exposed primary sludge piping should be replaced in several areas. The actual extent of the piping that needs to be replaced should be determined based on a corrosion study. In addition piping that is not replaced should be sand blasted and recoated; where possible the use of corrosion resistant materials such as FRP should be incorporated for pipe supports.

6.4.3 Primary Scum Pumps

6.4.3.1 Existing Conditions

Each clarifier is outfitted with a scum pump that pumps the removed grease and floatables to the digesters. The pumps operate on time clocks. The scum pumps are positive displacement air operated diagram pumps. These pumps were replaced in 1993, and have a good operating history associated with them. Each pump has a capacity range from 90 to 300 gpm. These pumps should be placed on a replacement schedule.

6.4.3.2 Recommendations

It is recommended that the scum valves (buried and exposed) be replaced with new valves.

Exposed scum piping should be replaced in several areas. The actual extent of the piping that needs to be replaced should be determined based on a corrosion study. In addition piping that is not replaced should be sand blasted and recoated; where possible the use of corrosion resistant materials such as FRP should be incorporated for pipe supports.

6.4.4 Summary of Primary Treatment Recommendations

Overall, the primary clarifiers appears to be in good structural condition and with some upgrading and rehabilitation should be capable of providing a good level of service to the MDCSD. The hydraulic restriction downstream of the primaries needs to be corrected. An opinion of probable costs for the recommendations list above is outlined in Table 6.7.

6.5 INTERSTAGE PUMP STATION

The Interstage pump station is a major flow distribution location where the primary effluent that is to receive secondary treatment is pumped to the trickling filters, and where the trickling filter effluent is either pumped to the solids contact basin or re-circulated back to the trickling filters. An integral part of this flow distribution system is the blending valve. The blending valve controls the amount of primary effluent that is sent to the chlorine contact chamber without secondary treatment. Historically, the blending valve has remained closed

(100 percent to secondary) except during extremely high flow events.

Table 6.7 Opinion of Probable Primary Treatment Rehabilitation Costs WWTP Facility Master Plan MBCSD	
Parameter	**Value**
Drain, Clean and Sandblast Primary Clarifier No. 1	$15,000
Patch and Coat Concrete Primary Clarifier No. 1	$15,000
Sandblast and Repair Primary Clarifier No. 1 Mechanism	$15,000
Repair and Re-Level Primary Clarifier No. 1 Weirs	$10,000
Modify Primary Clarifier No.1 Walkway	$30,000
Drain, Clean and Sandblast Primary Clarifier No. 2	$15,000
Patch and Coat Concrete Primary Clarifier No. 2	$15,000
Sandblast and Repair Primary Clarifier No. 2 Mechanism	$15,000
Repair and Re-Level Primary Clarifier No. 2 Weirs	$10,000
Modify Primary Clarifier No.2 Walkway	$30,000
Replace Butterfly Valves on Primary Effluent Discharge Piping	$50,000
Replace 12 Sludge Valves	$120,000
Allowance for Upgrading and Repairing Yard Lighting	$50,000
Allowance for a Corrosion Study	$5,000
Allowance for Piping Rehabilitation and Replacement	$50,000
Subtotal	$445,000
Unidentified Items Contingency (20 percent)	$89,000
Subtotal Construction Cost 2006[1, 2]	$534,000
Engineering, Legal, and Administrative Contingency (35 percent)	$187,000
Total Project Cost 2006	$721,000
Notes: 1. ENR (20 cities) June 2006 = 7700. 2. Includes Contractor overhead and profit.	

6.5.1 Flow Control Operations

As the blending valve is opened and the sluice gate in the Interstage pump station is raised, the amount of primary effluent that is sent to the chlorine contact chamber is increased. Conversely, as the blending valve is closed, and/or the sluice gate in the Interstage pump station is lowered, more primary effluent is sent to the secondary treatment process for biological treatment.

6.5.2 Blending Valve

6.5.2.1 Existing Conditions

Installed on the 24-inch diameter buried primary clarifier effluent piping just upstream from the primary clarifier effluent meter is a wye. One leg of the wye directs the primary effluent to the Interstage pump station, while the other directs the primary effluent to the 30-inch diameter secondary effluent pipe and the downstream chlorine contact basin. Located on the leg of the wye that connects with the 30-inch diameter secondary effluent pipe is a 24-inch diameter butterfly valve. This 24-inch diameter butterfly valve is known as the blending valve. As the blending valve is opened, the primary effluent will tend to flow to the secondary effluent line and downstream chlorine contact basin. Likewise, as the valve is closed the flow is redirected to the Interstage pump station for secondary treatment. Staff has indicated that when they operate the system to send all of the primary effluent to secondary treatment that the wastewater tends to backup in the primary clarifier effluent launders during peak hour flow periods. Despite this, the WWTP staff strives to maximize the flow that is sent to the secondary treatment process.

6.5.2.2 Recommendations

As discussed above in Section 6.5, a butterfly valve is generally not used in waters that contain trash, rags, and undesirable fibrous materials such as primary effluents. Due to this and other concerns about the use of butterfly valves in primary effluent, it is recommended that the butterfly valves be removed and replaced with a full port wastewater valve such as a plug valve. With the conversion to full secondary treatment, the valve will only function as a bypass valve.

6.5.3 Primary Effluent Flow Meter

6.5.3.1 Existing Conditions

Located downstream from the blending valve is the primary effluent meter. The intent of this meter is to record the amount of primary effluent that receives secondary treatment. The meter is an ultrasonic meter that is installed in a vault. Located immediately upstream from the meter is a butterfly valve used to isolate the meter. The 24-inch diameter combined primary effluent pipe is reduced to a 12-inch diameter pipe just prior to the meter vault. Located on this 12-inch diameter pipe are a butterfly valve and an ultrasonic meter. Following the ultrasonic meter the pipe increases to 24-inch diameter. Staff has reported that this meter does not function properly, in fact it is submerged a majority of the time as documented in Photo No. 6.31.

Photo No. 6.31

6.5.3.2 Recommendations

It is assumed that this meter will not be needed in the future. The meter, valve, and smaller pipes should be removed. If the meter is kept in service, the 12-inch butterfly valve should be replaced with a valve that has a full port opening to minimize turbulence to upstream from the meter and to minimize and ragging potential.

If it is determined that this meter is to be used as part of the upgraded secondary treatment process, it is recommended that it be replaced with a mag meter.

6.5.4 Biofilter Circulation Pumps

6.5.4.1 Existing Conditions

The standard rate trickling filter process incorporates a higher hydraulic loading than the low rate trickling filter process. To accomplish this higher hydraulic loading or wetting rate, the primary effluent is mixed with effluent from the trickling filter and applied to the media. This recirculation provides the opportunity for the wastewater to pass over the media multiple times, and provides the needed hydraulic loading to keep the media active. The recirculation process also aids in providing the filters with a more constant organic loading. This blending of the primary effluent and trickling filter takes place in the Interstage Pump Station.

The Interstage pump station houses two sets of pumps in a common wetwell. The wetwell is divided hydraulically such that the primary effluent and the amount of trickling filter effluent to be recirculated are pumped by the Biofilter Circulation Pumps to the top of the trickling filters for biological oxidation. There are three Biofilter Circulation Pumps that perform this work as shown in Photo No. 6.32. The pumps are of the vertical, mixed flow type that was installed in 1985. The design parameters for these pumps are shown in Table 6.8. Staff reports that the pumps are rebuilt approximately every seven years.

Table 6.8	Biofilter Circulation Pumps WWTP Facility Master Plan MBCSD		
Pump	**Capacity**	**TDH**	**Power**
P 4501	950 gpm	11.1 ft.	5 hp constant speed
P-4502	1,420 gpm	14.0 ft.	7.5 hp constant speed
P-4503	960/1,660 gpm	11.2/14.3 ft.	10 hp two speed

Photo No. 6.32

On the discharge side of each pump is a butterfly valve that is used for pump isolation. Each pump discharges into a common header. Located on the common header are two additional butterfly valves. These valves are used to allow for redundancy in the event that a pump is out of service, and to vary the amount of blended primary effluent and trickling filter effluent that is applied to each filter.

According to the operating staff, these pumps operate with little attention and have not been a maintenance burden. One valve has been replaced in 2006. Additional valves will be replaced in the near future.

The pumps are controlled manually by the operations staff. Currently, all three pumps are in operation to maximize the recirculation to the trickling filters.

6.5.4.2 Recommendations

No problems were reported with this system. At this time, no improvements are recommended. Depending on the selected secondary treatment alternative, this pump station may actually be abandoned or modified. It is not recommended to replace the butterfly valves here because they have operated satisfactorily and are easily accessible should repairs be needed. These pumps should be placed on a replacement schedule.

6.5.5 Biofilter Effluent Pumps

6.5.5.1 Existing Conditions

Located on the opposite side of the wetwell from the Biofilter Circulation Pumps are the Biofilter Effluent Pumps. Two pumps are installed (as shown in Photo No. 6.33) with space to add an additional pump as flows increase. These pumps are of the vertical mixed flow

type that was installed in 1985. The design parameters for these pumps are shown in Table 6.9. Staff reports that the pumps are rebuilt approximately every seven years.

Photo No. 6.33

Table 6.9	**Biofilter Effluent Pumps WWTP Facility Master Plan MBCSD**		
Pump	**Capacity**	**TDH**	**Power**
P-4504	2,300 gpm	27 ft.	25 hp VFD
P-4505	2,300 gpm	27 ft.	25 hp VFD

The pumps are equipped with VFD drives. This allows them to speed up or slow down as needed to match the influent flows. The pump speed is controlled based on the liquid level in the wetwell. The ultrasonic level control was installed in 2002 as were the VFDs.

On the discharge side of each pump is a check valve and butterfly isolation valve. The pumps discharge into a common header that directs the biofilter effluent to the contact stabilization basin.

According to plant staff, these pumps work well and have not been a significant cause for operations or maintenance staff.

6.5.5.2 Recommendations

It is recommended that the third Biofilter Effluent pump be added with the next project. This will provide the MBCSD the ability to handle increasing flows while providing additional reliability and operating flexibility. The butterfly valves are being serviced and replaced by staff. These pumps should be placed on a replacement schedule.

6.5.6 Summary of Interstage Pump Station Recommendations

Overall the Interstage pump station appears to be well maintained and kept in good operating condition. An opinion of probable costs for the recommendations list above is outlined in Table 6.10. It should be noted that depending on the recommendations in the alternative analysis section of this report that the blending valve and/or Interstage pump station may actually be abandoned or modified to meet the future needs of the MBCSD.

Table 6.10 Opinion of Probable Interstage Pump Station Rehabilitation Costs WWTP Facility Master Plan MBCSD	
Parameter	**Value**
Remove and Replace Blending Valve	$50,000
Remove Primary Effluent Flow Meter and Valve	$20,000
Install the Third Biofilter Effluent Pump and VFD	$150,000
Modifications to Control Panel	$80,000
Subtotal	$300,000
Unidentified Items Contingency (20 percent)	$60,000
Subtotal Construction Cost 2006[1, 2]	$360,000
Engineering, Legal, and Administrative Contingency (35 percent)	$126,000
Total Project Cost 2006	$486,000
1. ENR (20 cities) June 2006 = 7700 2. Includes Contractor overhead and profit.	

6.6 SECONDARY TREATMENT

6.6.1 Current Operating Parameters

6.6.1.1 Trickling Filters/Solids Contact Process

Located hydraulically downstream from the Interstage pump station is the Secondary Treatment facilities. This process includes the trickling filters, solids contact basin, and the secondary sedimentation basin. These facilities are designed to operate in the trickling filter/solids contact mode. In this mode of operation the effluent from the trickling filters is pumped to the solids contact basin. In this basin the RAS is blended with the trickling filter effluent and aerated. The mixed liquor in the solids contact basin is kept at optimal levels by periodically wasting RAS. This facility was one of the early facilities built using this process. Subsequent designs incorporated improvements to the process.

Following the solids contact basin the mixed liquor flows by gravity to the secondary clarifier. The clarified secondary effluent flows by gravity to the chlorine contact basin while the settled sludge (RAS) is pumped back to the beginning of the solids contact basin. The major benefit of the trickling filter/solids contact process is lower power requirements than the activated sludge process due to a high dependence on the trickling filter to remove the majority of the soluble BOD_5. This process has also been associated with providing a better settling secondary sludge than what is generally realized in a trickling filter process without the solids contact basin. The trickling filters are operated in parallel, with the loading based on the size of the respective filter as shown in Table 6.11.

Table 6.11 Trickling Filters Operating Parameters WWTP Facility Master Plan MBCSD						
Filter	**Influent Flow PSDWF**	**Recirculation Flow[1]**	**Diameter**	**Depth**	**Surface Area**	**Volume**
No. 1	0.39 mgd	1.92 mgd	60 ft.	4.5 ft	2,820 ft^2	12,700 ft^3
No. 2	0.58 mgd	2.88 mgd	70 ft.	5.0 ft	3,770 ft^2	18,800 ft^3
Totals	0.97 mgd	4.80 mgd	-	-	6,590 ft^2	31,500 ft^3

Note:
1. Based on all three biofilter Circulation Pumps operating, Pump P-4503 at low speed, and an equal hydraulic loading based on influent loading.

The solids contact basin is approximately 58 feet long and 4 feet wide, with a liquid depth of about 4.25 feet. This results in a volume of approximately 986 ft^3 or 7,375 gallons. The RAS is pumped into the north end of the basin and the trickling filter effluent is pumped from the Interstage pump station and is introduced into the basin near the mid point. There is no baffling to keep the RAS separated from the trickling filter effluent. However, it is assumed that the RAS is aerated in the north end of the basin prior to being mixed, with the trickling filter effluent. At the location where the two flows are mixed the liquid is named mixed liquor.

As the mixed liquor travels through the solids contact basin it is aerated. Located along the entire length of the basin are diffusers to aerate and mix the RAS and mixed liquor. The air supply for the diffusers is supplied from one of two blowers. The blowers are equipped with 20 horsepower motors and are rated at 513 scfm at 3.9 psi. The blowers were installed in 2000. Generally, one blower can provide enough air to keep the dissolved oxygen (DO) in the basin above 3 mg/L. However there are certain times of the year when both blowers need to operate in parallel to keep the DO at the desired range.

Currently the operations staff controls the process by monitoring and adjusting the RAS concentration. Based on experience staff has determined that the best quality effluent is realized when the RAS is kept near 12,000 mg/L. The RAS air-lift pumps currently are operated at 340 gpm. Based on current conditions, the secondary process is operating as indicated in Table 6.12 below.

As shown above, the trickling filter solids contact process is operating slightly over generally accepted design values. Particularly, the solids contact basin, which does not provide adequate hydraulic detention time, and is operating below the optimum mean cell retention time (MCRT) range. Staff reports that the RAS has a black color rather than the traditional brown color of a healthy, aerated mixed liquor. This may be attributed to the operation of the rock trickling filters and the short solids retention time.

6.6.1.2 Secondary Clarifier

Hydraulically downstream from the solids contact basin is the single circular secondary clarifier. The clarifier is 55-feet in diameter with an average side water depth of 15 feet. The mixed liquor from the solids contact basin flows through 20-inch pipe into the center feed well of the clarifier. The clarified effluent flows over outboard weirs and launders to the chlorine contact basin through 30-inch piping. The sludge that settles to the bottom of the clarifier is vacuumed off the tank bottom and removed by the RAS pump. The current operating parameters for the secondary clarifier are outlined in the Table 6.13.

As shown in Table 6.12, the secondary clarifier is operating within generally accepted conditions at the stated conditions.

Table 6.12 Trickling Filter/Solids Contact Operating Parameters
WWTP Facility Master Plan
MBCSD

Parameter	Range[1]	Actual
Influent flow rate	-	1 mgd
Influent BOD_5	-	307 mg/L[1]
TF BOD_5 Loading	20 -75 lb BOD_5/day/1000 ft^3 media	81lb BOD_5/day/1000 ft^3 media
Recirculation pumping rage	-	4.8 mgd
TF Hydraulic Loading	0.1 -0.2 gpm/ft^2	0.51 gpm/ft^2
RAS Rate	-	340 gpm
RAS/WAS MLSS	-	12,000 mg/L
Solids Contact Basin MLSS	1,500 - 3,000 mg/L	3,963 mg/L
Solids Contact HRT	0.2 -0.5 hours	0.06 hours (3.5 min)[2, 3]
Solids Contact MCRT	0.2 - 0.5 days	0.09 days
Solids Contact Minimum Mixing	0.002 - 0.004 scf/min/gal	0.068 scf/min/gal

Notes:
1. Based on MMAD influent values
2. Based on a RAS flow of 0.49 mgd + trickling filter flow of 1.0 mgd which results in a mixed liquor flow through the contact basin of 1.49 mgd.
3. Based on using half of the solids contact basin volume due to the piping configuration of the RAS and trickling filter effluent lines.

Table 6.13 Secondary Clarifier Operating Parameters WWTP Facility Master Plan MBCSD		
Parameter	**Range**	**Actual**
Diameter	-	55 ft
SWD	-	15 ft
PSDWF	-	1.00 mgd
Overflow rate	400 - 600 gpd/ft^2	421 gpd/ft^2
Solids Loading	0.6 - 1.0 lbs/hr/ft^2	0.86 lbs/hr/ft^2
Weir Loading	10,000 gpd/ft (max)	5,787 gpd/ft
PWWF		2.20 mgd
Overflow rate at PWWF (gpd/ft^2)	1,000 - 1,200 gpd/ft^2	926 gpd/ft^2
Weir Loading at PWWF (gpd/ft)	20,000 (max)	12,732 gpd/ft

6.6.2 Trickling Filters

6.6.2.1 Existing Conditions

The rock trickling filters have provided relatively trouble free service for many years. The bearings on the rotary distributors were replaced approximately seven years ago. Other components such as the turnbuckles and supporting cables are also showing signs of wear as shown in Photo No. 6.34. The structural condition of the trickling filters should be addressed if they are to be kept in service. Trickling Filter No. 1 was built in 1953, and Trickling Filter No. 2 was built in 1964.

Photo No. 6.34

6.6.2.2 Recommendations

If the trickling filters are kept in operation, it is recommended that the mechanisms be overhauled to include new bearings and any corroded or wearing parts be repaired or replaced. As shown in Photo No. 6.35, the structural condition of the trickling filters should be carefully evaluated and repairs made.

Photo No. 6.35

6.6.3 Solids Contact Chamber

6.6.3.1 Existing Conditions

At the discharge end of the basin the mixed liquor travels through a Parshall flume before entering the secondary clarifier. The flume does not provide the recommended straight inlet channel conditions for Parshall flumes. The contact stabilization basin is designed for the addition of a second clarifier.

Originally the contact stabilization basin was equipped with 3-W spray system. This system was intended to keep the scum, foam, and other surface material from building on the contact basin. A chlorine feed was also provided to chlorinate the RAS. Both of these systems have been removed with no detrimental effects on the operation of the contact stabilization basin.

The diffused air for the solids contact chamber is supplied from two, 20 hp, centrifugal blowers. Each blower is rated at 513 scfm at 3.9 psi. The air is diffused in the mixed liquor using diffuser tubes. There are ten manifolds each with ten diffusers that are located along the length of the channel. During certain times of the year, one blower alone cannot maintain the required DO in the channel and both blowers are needed. This is understandable due to the very short hydraulic detention time noted in Table 6.12 and the very shallow liquid depth of the channel. Both which result in a low efficiency aeration system. The exposed air piping system was replaced in 2005.

As with other area of the facility the exterior lights are in a bad state of repair, or are gone completely resulting in inadequate workspace lighting as shown in Photo No. 6.36.

Photo No. 6.36

6.6.3.2 Recommendations

The solids contact basin is undersized for current operations, and should be expanded if it is to be kept in service as part of the expansion project. If the basin is kept in service the diffusers should be replaced to rememdy the low efficiency system referenced above.

The exterior lighting should be carefully evaluated and repairs, upgrades, and additions made.

6.6.4 Secondary Clarifier

6.6.4.1 Existing Conditions

The secondary clarifier was constructed as part of the 1984 expansion project. The drive unit on the secondary clarifier was replaced in 2002 with a new Westech drive similar to the primary clarifiers.

6.6.4.2 Recommendations

Overall the structure appears to be in relatively good condition. Regardless, the clarifier should be taken offline, drained, cleaned and its condition assessed. Improvements envisioned include rehabilitating the drive mechanism, refurbishing the scum removal equipment, and patching and coating the submerged concrete surfaces.

The weir show signs of wear and tear, and some of the individual weir teeth have broken and been replaced as shown in Photo No. 6.37. Additionally, it appears that the weir is not level. Due to these issues it is recommended that the old weir be removed and replaced with a new weir and baffle plate.

Photo No. 6.37

The center well of the clarifier is a collection place for fly larvae that slough from the trickling filters as shown in Photo No. 6.38. It is recommended that scum ports be installed in the center well to pass this floating material when the other improvements are made.

Photo No. 6.38

6.6.5 RAS Pumping

6.6.5.1 Existing Conditions

The RAS is drawn from the bottom of the clarifier using one of two air lift pumps as shown in Photo No. 6.39. The air is supplied using two Amtek Blowers which were installed in 2004 and 2002. The blower is rated at 185 scfm at 6 psi and is driven by a 10 hp motor. The RAS is discharged into the basin through a stainless steel baffle chamber as shown in Photo No. 6.40.

Photo No. 6.39

Photo No. 6.40

6.6.5.2 Recommendations

There are no specific upgrades or recommendations to this system at this time. The blowers should be placed on a replacement schedule.

6.6.6 WAS Pumping

6.6.6.1 Existing Conditions

The sludge wasting can either be accomplished by pumping RAS or MLSS. The WAS is pumped to the effluent end of the aerated grit chamber. At this location the WAS is mixed with the influent wastewater and is settled in the primary clarifiers. Two WAS pumps are installed. The WAS pumps are centrifugal solids handling pumps that are three hp belt driven units. Currently 24,000 gpd of WAS is being removed from the system to maintain the desired RAS concentration. The pumps are controlled by timers that can be manually adjusted by operations staff to maintain the desired wasting rates throughout the day.

6.6.6.2 Recommendations

It is recommended that a new Toshiba sludge flow meter be installed to match the other meters in the WWTP.

As shown in Photo No. 6.41, the marine environment is hard on ferrous metals. As part of the next improvement project the WAS piping and pumps should be evaluated for replacement and corrosion control improvements. As with the other areas of the facility the isolation and check valves should be upgraded and replaced.

Photo No. 6.41

6.6.7 Scum Pumping

6.6.7.1 Existing Conditions

The scum pumps have been removed, and the scum that is removed from the secondary clarifiers currently flows by gravity to the influent sewer. This revised method of operation is acceptable.

6.6.7.2 Recommendations

At this time there are no recommendations to this process.

6.6.8 Summary of Secondary Treatment Recommendations

During the treatment alternative evaluation, the actual secondary treatment process will be determined; if the existing facilities are kept in service, the opinion of probable costs for the

rehabilitation of these facilities is outlined in Table 6.14.

Table 6.14 Opinion of Probable Secondary Treatment Rehabilitation Costs WWTP Facility Master Plan MBCSD	
Parameter	**Value**
Rehabilitate Trickling Filter No. 1 - Mechanical	$25,000
Rehabilitate Trickling Filter No. 2 - Mechanical	$25,000
Rehabilitate Trickling Filter No. 1 - Structural	$50,000
Rehabilitate Trickling Filter No. 2 - Structural	$50,000
Replace Diffusers and Air Manifold Piping	$75,000
Drain, Clean and Sandblast Clarifier	$15,000
Patch and Coat Concrete Clarifier	$15,000
Sandblast and Repair Clarifier Mechanism, Scum Removal	$25,000
Repair and Re-Level Clarifier Weirs	$10,000
Modify Clarifier Walkway	$30,000
Allowance for Upgrading Lighting and Electrical	$25,000
Allowance for Replacing WAS Valves	$30,000
Allowance for Replacing Corroded Piping	$25,000
Subtotal	$400,000
Unidentified Items Contingency (20 percent)	$80,000
Subtotal Construction Cost 2006[1, 2]	$480,000
Engineering, Legal, and Administrative Contingency (35 percent)	$168,000
Total Project Costs	$648,000
Notes: 1. ENR (20 cities) June 2006 = 7700 2. Includes Contractor overhead and profit.	

6.7 DISINFECTION

6.7.1 Current Operating Parameters

The secondary effluent and any primary effluent that has passed through the blending valve are combined and flow by gravity to the chlorine contact basin. The chlorine contact basin was the original rectangular primary clarifier that was constructed as part of the 1953 wastewater treatment plant located at this site. In this configuration the chlorine contact chamber is comprised of two channels that are configured in series. Due to the original configuration, it is impossible to isolate one channel for maintenance for repairs. This results in a violation and mandatory fine each time the basin is drained which occurs

typically every three to five years. The physical characteristics of the chlorine contact chamber is outlined in Table 6.15.

Table 6.15 Chlorine Contact Chamber WWTP Facility Master Plan MBCSD	
Parameter	**Value**
Number of passes	2
Combined length	130 ft
Width	15 ft
Depth	7.5 ft
Volume	14,625 ft^3 (109,400 gal.)
Detention time at PSDWF of 2.4 mgd[1]	65 minutes
Detention time at PWWF of 6.6 mgd[1]	24 minutes
Note: 1. Flows taken from the 1982 design	

The actual capacity and efficiency is determined by many factors. One of the most common parameters used today to determine the capacity of the chlorine contact basin is the CT Value. Where “C” is the chlorine dose in mg/L and “T” is the detention time in minutes. A common CT value used for secondary effluent would be between 450 and 600 with the higher value being recommended for a blended effluent such as that produced at the MBCSD WWTP. A commonly accepted dosage range for a blended primary/secondary effluent is 5-20 mg/L as Chlorine. Assuming a CT of 800, and a minimum peak flow detention time of 15 minutes, and a maximum chlorine dose of 20 mg/L, the existing chlorine contact basin would have the capacity to disinfect an instantaneous peak flow of approximately 10 mgd.

6.7.2 Chlorine Contact Basin

6.7.2.1 Existing Conditions

Located at the entrance to the chlorine contact chamber is a propeller meter and rapid mixer. At this location the liquid sodium hypochlorite (NaOCl) is introduced into the effluent. The mixing is accomplished using a vertical mixer equipped with a 25 hp motor. The mixer was replaced in 2005.

Following the rapid mixer the wastewater enters the first channel of the chlorine contact basin as shown in Photo No. 6.42. Located in each channel is a chain and flight sludge removal mechanism. This feature is required to remove material that settles in the chlorine contact chamber. The drive for this feature is estimated to be from the original WWTP as shown in Photo No. 6.43. New drive units have been purchased and will be installed in

2006. The sludge that is collected from the bottom of the contact chambers is periodically sent to the headworks by opening drain valves located in the sludge collection sumps.

Photo No. 6.42

Photo No. 6.43

Prior to discharge, the chlorinated effluent is de-chlorinated using sodium bisulfite ($NaHSO_3$). This reaction is instantaneous and additional contact time is not required. The de-chlorinated effluent is discharged through the Air Release Structure to the Ocean Outfall.

6.7.2.2 Recommendations

The chlorine contact chamber will be 60 years old at startup of this project. It is nearing the end of its useful life and is in need of structural repair as shown in Photo Nos. 6.44, 6.45, and 6.46. In addition, the flow pattern through the structure is not the most desirable. For these reasons it is recommended that the addition of a new chlorine contact chamber be constructed as part of the upgraded facilities.

However, if it is determined that this structure will remain in service the structure should be evaluated by a structural engineer and repairs made as identified, In addition the chain and flight sludge collectors and the sludge collector drive should be replaced. As part of this process, a scum removal system should be incorporated. Structural modification would also be required to allow isolation of each chamber.

The existing propeller meter should be replaced with a new magnetic meter.

Photo No. 6.44

Photo No. 6.45

Photo No. 6.46

6.7.3 Sodium Hypochlorite Feed System

6.7.3.1 Existing Conditions

The disinfectant used by the MBCSD WWTP is liquid sodium hypochlorite (NaOCl). This liquid is stored in a tank that is provided by the chemical supplier. The NaOCl is delivered from the tank to the chlorine contact basin using LMI chemical feed pumps as shown in Photo No. 6.47. Three feed pumps are furnished, two for service and one as a standby.

Photo No. 6.47

To control the amount of NaOCl delivered to the system the chlorine is fed based on the chlorine residual, and adjusted based on the flow. The effluent propeller meter is used for this purpose. The chlorine residual is measured using a Wallace and Tiernan Micro 2000 as shown in Photo No. 6.48. This equipment has been a source of recurring operations and maintenance issues.

Photo No. 6.48

6.7.3.2 Recommendations

It is recommended that the controls and features of the chlorine residual analyzer be carefully reviewed and upgrades or equipment replacement made during the design of the future improvements.

6.7.4 Sodium Bisulfite Feed System

6.7.4.1 Existing Conditions

The MBCSD uses sodium bisulfite ($NaHSO_3$) for dechlorination prior to discharge. The $NaHSO_3$ is stored in a tank provided by the chemical supplier as shown in Photo No. 6.49. The $NaHSO_3$ is delivered from the tank to the chlorine contact basin using LMI chemical feed pumps as shown in Photo No. 6.50. Three feed pumps are utilized.

Photo No. 6.49

Photo No. 6.50

To control the amount of $NaHSO_3$ delivered to the system, it is fed based on the chlorine residual and adjusted based on the flow. The flow meter used for the flow pacing is the effluent propeller meter. As with the disinfection system, the chlorine residual is measured using a Wallace and Tiernan Micro 2000 which has been a source of recurring operations and maintenance reliability issues.

6.7.4.2 Recommendations

It is recommended that the controls and features of the chlorine residual analyzer be carefully reviewed and upgrades or equipment replacement made during the design of the future improvements.

6.7.5 Air Release Structure

6.7.5.1 Existing Conditions

Located downstream from the chlorine contact basin is the air structure as shown in Photo No. 6.51. This structure is located on the ocean outfall line and is where the effluent sampler is located. The sampler is used to collect effluent grab samples as well as 24-hour flowpaced effluent samples.

Photo No. 6.51

6.7.5.2 Recommendations

The sampler and other features located at this structure are reported to be in good operating condition and no recommendations for upgrades or rehabilitation are made at this time.

6.7.6 Summary of Disinfection Recommendations

An opinion of probable costs for the recommendations list above is outlined in Table 6.16.

Table 6.16 Opinion of Probable Disinfection Rehabilitation Costs
WWTP Facility Master Plan
MBCSD

Parameter	Value
Dewater, Clean, and Sandblast Structure	$25,000
Replace Chain and Flight Sludge Scrapers and Drives	$150,000
Repair and or Replace Chlorine Residual Analyzers	$50,000
Allowance for Piping and Valve Replacement	$50,000
Replace Propeller Meter with Mag Meter	$50,000
Allowance for Lighting and Electrical Upgrades	$25,000
Subtotal	$350,000
Unidentified Items Contingency (20 percent)	$70,000
Subtotals Construction Cost 2006[1, 2]	$420,000
Engineering, Legal, and Administrative Contingency (35 percent)	$147,000
Total Project Cost 2006	$567,000

Notes:
1. ENR (20 cities) June 2006 = 7700.
2. Includes Contractor overhead and profit.

6.8 ANAEROBIC DIGESTERS

6.8.1 Current Operating Conditions

The co-settled primary and waste sludge, and primary scum, are pumped to the anaerobic digesters. Two of the three digesters are of the fixed cover type, and the third digesters incorporates a floating cover. Of the three digesters, Digester No. 1 is the oldest and was constructed as part of the original WWTP in the 1950's. Digester No. 1 is always used as a secondary or settling digester. Digester No. 2 was constructed in the 1960's is operated as a primary digester. The newest digester, No. 3 was constructed in the 1984 expansion and is generally operated as a primary digester. The physical characteristics of these three digesters is outlined in Table 6.17.

In the current operating mode, sludge and scum from the primary clarifiers are pumped to either Digester No. 2 or 3 based on the position of the inlet sludge valves. To change which digester receives the primary sludge the valves are manually changed. As the sludge enters the digester, an equal amount of sludge passes to Digester No. 1. Digester No. 1 operates in the secondary mode therefore, as the sludge from the upstream digesters enters this tank, supernatant flows out of the digester and is directed to one of the sludge drying beds.

Table 6.17 Anaerobic Digesters
WWTP Facility Master Plan
MBCSD

Digester	Diameter	Side Water Depth	Volume
No.1	40 ft	16 ft	22,200 ft^3
No. 2	40 ft	19 ft	25,600 ft^3
No. 3	35 ft	22.5 ft	28,400 ft^3
Total			76,200 ft^3

Digester gas mixers are used to mix Digesters No. 2 and 3. Each digester is equipped with a dedicated digester gas blower. The blowers are operated continuously and draw digester gas from the top of the digesters, compress it and discharge it through mixing tubes to the bottom of the digesters. As the digester gas rises to the surface of the digesters it mixes the contents of the tank. Since Digester No. 1 is operated as a secondary digester it is not mixed and the digester gas mixing piping is being removed due to its deteriorated condition.

As part of the anaerobic digestion process waste gas is produced. This waste gas generally has a low heat content that ranges from 500 to 650 BTU/ft^3, with a typical value of 600 BTU/ft^3. The typical characteristics of this waste gas are outlined in Table 6.18.

Table 6.18 Waste Gas Composition WWTP Facility Master Plan MBCSD	
Constituent	**Typical Concentration**
Methane	55 - 75 percent
Carbon Dioxide	25 - 45 percent
Hydrogen Sulfide	0.01 - 1.00 percent
Nitrogen	2 - 6 percent
Hydrogen	0.1 - 2.0 percent

For the anaerobic digestion process to be effective, the contents of the digesters should be maintained between 95 and 98 degrees Fahrenheit. To maintain this temperature in the digesters the MBCSD employs the use of hot water boilers. The digesters are heated by pumping the cold sludge from the digesters through a heat exchanger. Also passing through the heat exchanger is hot water from the boilers. The heat from the hot water is transferred to the sludge, which in turn heats the digesters. Mixing pumps are used to pump the sludge from the digesters through the heat exchangers and back into the digesters.

Currently the MBCSD pumps 8,000 gpd of sludge and scum from the primary clarifiers. This sludge has an average solids concentration of approximately 3.5 percent. This equates to a raw sludge loading to the digesters of 2,350 lbs/day.

There are several important design and operating parameters associated with anaerobic digesters. The two most important are: volatile solids loading expressed in lbs VSS/ ft^3-day and detention time expressed in days. The minimum recommended solids retention time is 20 days. Based on current operating conditions and applying an 80 percent useable volume factor, results in the operating conditions outlined in Table 6.19.

As shown in Table 6.18, the digesters in their current configuration have the capacity needed to efficiently treat the sludge currently generated at the WWTP.

6.8.2 Digester No. 1

6.8.2.1 Existing Conditions

This digester has been in service for over 50 years. Although the digester appears to be well maintained it is in need of attention. The gas mixing system is not used and part of the system has been removed. The concrete shows signs of cracking, spalling, and general deterioration in several areas as shown in Photo No. 6.52. The concrete cover has been repaired in areas with a concrete patch to maintain the airtight integrity of the system as shown in Photo No. 6.53.

Table 6.19 Anaerobic Digesters Operating Parameters WWTP Facility Master Plan MBCSD		
Parameter	**Range**	**Actual**
Total Volume		76,200 ft^3
Useable Volume		61,000 ft^3
Total Solids Loading		2,350 lbs/day
Assumed Volatile Fraction of Solids		70 percent
Volatile Solids Loading Rate	40 -100 lbs VSS/1000 ft^3/day	27 lbs VSS/1000 ft^3/day
Volatile Solids Destroyed (Assumed)		50 percent
Volatile Solids Destroyed		823 lbs/day
Digested Solids Production		1,528 lbs/day
Hydraulic Retention Time	20 days min.	57 days
Gas Production Rate		18 ft^3/lb VSS destroyed
Estimated Gas Production		14,805 ft^3

Photo No. 6.52

Photo No. 6.53

This digester has a heat mixing pump that was used to heat the digester when it was operated in the primary mode. Although the pumps is not used to heat the digester it is kept in operating condition and is used to periodically mix the contents of the digester to

enhance the settling of the contents. This pump is a Wemco Torque Flow solids handling pump. The pump is rated at 480 gpm at a TDH of 28 feet. The pump is controlled manually.

6.8.2.2 Recommendations

The digester has been in service for over 50 years and is nearing its expected lift span. The cover has been patched to prevent gas from leaking to the atmosphere. These cracks through the roof may have exposed the reinforcing steel to the corrosive nature of the digester gas, rain water, and other undesirable conditions. These conditions would lend themselves to corrosion and possible deterioration of the reinforcing steel. Due to the age and condition of the digester it may be advisable that it be taken out of service and possibly be demolished. However, if the tank is kept in service, it is recommended that it be drained, cleaned, and sandblasted. Any cracks and spalling concrete should be repaired. While the digester is out of service for cleaning and repairs any un-used piping and equipment should be removed. Prior to the tank being placed back into service the interior should be re-coated with a protective coating.

Located on the top of the digester is a pressure and vacuum relief valve. It is recommended that two valves be installed on the cover of the digesters. This will allow one valve to remain in operation in the event that a valve is out of service for maintenance.

Due to the age and condition of the mixing pumps, it is suggested that they be replaced.

During the same time that the digester is out of service, the piping systems in and out of the digester should be evaluated for corrosion. Valves, both buried and exposed, should be replaced.

6.8.3 Digester No. 2

6.8.3.1 Existing Conditions

This digester has been in service for over 40 years. Based on a visual observation of the exterior of the tank this digester appeared to be in better condition than Digester No. 1. However there are some minor cracks on the exterior of the walls as shown in Photo No. 6.54. No severe cracks were noticed on the concrete cover.

Photo No. 6.54

The mixing is accomplished using compressed digester gas. The gas is compressed using a three hp compressor. This compressor takes gas from the top of the digester, compresses, and delivers it through discharge tubes to the bottom of the digester. As the gas bubbles rise they mix the contents of the digester. This equipment was replaced in 2003.

To keep the contents of the digester at the optimum temperature of 95 to 98 degrees Fahrenheit, the contents of the digester are heated. This is accomplished by pumping the contents of the digester through the heat exchangers. The pump that performs this work is a Wemco Torque Flow solids handling pump. The pump is rated at 480 gpm at a TDH of 28 feet. These pumps run continuously and are turned on and off manually. This pump is reaching the end of its useful life and shows signs of severe corrosion. It has been in service since the 1980s, and is showing signs of wear and corrosion as shown in Photo No. 6.55.

Photo No. 6.55

6.8.3.2 Recommendations

Located on the top of the digester is a pressure and vacuum relief valve. It is recommended that this valve be replaced with two valves. This will allow one valve to remain in operation in the event that a valve is out of service for maintenance.

The digester has been in service for over 40 years. It is recommended that the digester be taken out of service, cleaned, and inspected. This inspection should include special attention to the cover. Based on the results of the inspection, concrete repairs should be made, any corroded metal components should be replaced, and protective coatings should be applied.

Due to the age and condition of the mixing pumps it is suggested that they be replaced.

During the same time that the digester is out of service the piping systems in and out of the digester should be evaluated for corrosion. Valves, both buried and exposed, should be replaced.

6.8.4 Digester No. 3

6.8.4.1 Existing Conditions

This digester has been in service for over 20 years. This structure incorporates a floating digester gas holding cover. This cover is constructed from steel and is designed to move up and down based on the volume of gas and sludge in the tank. Based on a visual observation, no structural cracks were noticed. However there was some concrete cracking around the top of the tank as shown in Photo No. 6.56.

Photo No. 6.56

The mixing is accomplished using a digester gas compressor as shown in Photo No. 6.57. This compressor takes gas from the top of the digester, compresses it, and delivers it through discharge tubes to the bottom of the digester. As the gas bubbles rise they mix the contents of the digester. This equipment was replaced in 2003 and is powered by a three hp electric motor.

Photo No. 6.57

To keep the contents of the digester at the optimum temperature of 95 to 98 degrees Fahrenheit, the contents of the digester are heated. This is accomplished by pumping the contents of the digester through the heat exchangers. The pump that performs this work is a Wemco Torque Flow solids handling pump.The pump is rated at 480 gpm at a TDH of 28 feet. These pumps run continuously and are turned on and off manually. Like the other mixing pumps, this pump is showing signs of wear and corrosion.

No current problems were noticed regarding the cover. However, it was noted that there were operating problems with the cover when it was first put into service. Due to the movement of the cover the gas piping into and out of the top of the digester is accomplished with rubber hoses as shown in Photo No. 6.58.

Photo No. 6.58

6.8.4.2 Recommendations

The digester has been in service for over 20 years. It is recommended that the digester be taken out of service, cleaned, and inspected. This inspection should include special attention to the cover. Based on the results of the inspection concrete repairs should be made, any corroded metal components should be replaced, and protective coatings should be applied.

Located on the top of the digester is a pressure and vacuum relief valve. It is recommended that this valve be replaced with two valves. This will allow one valve to remain in operation in the event that a valve is out of service for maintenance.

Due to the age and condition of the mixing pumps it is suggested that they be replaced.

During the same time that the digester is out of service the piping systems in and out of the digester should be evaluated for corrosion. Valves, both buried and exposed, should be replaced.

6.8.5 Sludge Heating and Mixing Area

6.8.5.1 Existing Conditions

Located outside between the three digesters is where the heat exchangers, gas mixers, and sludge heating pumps are located. Also located in this area are the sludge piping manifolds that allow the operations staff the flexibility to change the locations where the sludge is introduced and removed from each digester as shown in Photo Nos. 6.59 and 6.60. The sludge heat exchangers were reported by staff as not being an area of ongoing operations and maintenance issues.

Photo No. 6.59

Photo No. 6.60

Located both above and below the ground is a myriad of sludge piping and valves. This piping has been prone to corrosion and valve failures have been reported. Staff have installed additional valves and piping to enhance the ability to transfer sludge by gravity from any three of the digesters. The maintenance staff has done a good job of repairing and replacing valves and appurtenances to keep the systems working.

As with other areas in the WWTP the outdoor lighting and other electrical components show signs of sever corrosion and is in need of attention

6.8.5.2 Recommendations

Like the other exposed piping systems in the WWTP this piping is showing signs of corrosion due to the salty marine environment. It is recommended that the valves and exposed piping be replaced. This is a large undertaking since there are approximately 120 sludge valves in this area, of which 20 are below grade. At the time of upgrade, an evaluation should be performed to determine which valves should actually be replaced.

The metallic 3-W valves should also be replaced.

6.8.6 Hot Water Boilers

6.8.6.1 Existing Conditions

The hot water boilers that are used to provide heat to keep the contents of the digesters at the proper operating temperature are located in the Boiler Room of the Shop Building.

There are two boilers installed at the WWTP. One is piped so that is only burns digester gas as the fuel source, the other is plumbed to use natural gas as the fuel source. Each boiler is rated at 836,000 BTU/hr. The boilers were in a good condition and no operating problems with this equipment was noted.

The hot water from the boilers is pumped to the heat exchangers using in line centrifugal water pumps. Like the other equipment located in the Boiler Room no operating or maintenance problems were identified with this equipment.

6.8.6.2 Recommendations

No recommendations to this area is noted at this time.

6.8.7 Digester Gas Systems

6.8.7.1 Existing Conditions

The digester gas system collects the digester gas from the top of the digesters and directs it to either the waste digester gas flare or the boilers as required. The system is controlled on operating pressure. Pressure control valves are strategically located in the system such that the pressure is kept high enough to keep the gas moving to the boilers and flare, but low enough so that gas does not escape through the pressure relief valves on top of the digesters.

The original system was installed in the 1950s when Digester No. 1 was constructed. Since that time the system has been expanded and upgraded as Digesters No. 2 and 3 were constructed. Operations staff has indicated several operating and maintenance problems with the existing gas handling system. The main problem is associated with the gas piping configuration which is partially buried. Since the gas is very moist, water tends to condense as the gas cools. This water will accumulate in low spots in the piping system. A common location for this to occur is at areas where the gas piping travels between above ground and below ground locations such as at the gas regulator station shown in Photo No. 6.61. At locations similar to these drip traps should be installed at the low points in the piping.

Another area of concern is the gas pit located near Digester No. 1 as shown in Photo No. 6.62. According to discussion with operating staff this is the location where the gas from all three digesters has been collected and the gas is directed to the digester gas fired boiler. As shown in the photo there is a drip trap located here, however due to the depth of the groundwater it is generally submerged. This makes using the drip trap virtually inoperable. Furthermore, due to the configuration of this pit it is a confined space requiring special entering procedures. It has been reported that there have been instances where it has been difficult to get adequate amounts of digester gas to the digester gas boilers. It is areas such as the piping in this pit, that likely are the primary cause of this situation.

Photo No. 6.61

Photo No. 6.62

To monitor the amount of gas produced, each digester has recently been equipped with a new digester gas meter. When these meters were installed, a portion of the existing gas piping was replaced with stainless steel gas piping. An example of this piping upgrade is shown above the sediment can in Photo No. 6.63 below.

Photo No. 6.63

Located throughout the system is digester gas safety and control equipment. Including thermal valves, flame traps, sediment cans, manometers, gas valves, and similar features. The life expectancy of this equipment is generally in the range of 10 to 20 years. As shown in Photo No. 6.64, this has been well maintained but is nearing the end of its useful life.

Photo No. 6.64

The digester gas flare is used to burn the excess gas that is not used by the boilers. The control features of this flare do not function as originally intended and have been modified by staff to keep the flare in service.

6.8.7.2 Recommendations

The main gas piping system to and from the boiler and flare do not incorporate gas isolation valves. As portions of the gas piping systems are exposed and upgraded isolation valves should be installed in strategic locations to allow operations to isolate portions of the systems for maintenance and repairs.

Expose and replace corroded gas piping and relocate piping to minimize low spots. One way to accomplish such a large undertaking is to perform this work in phases that correspond with other construction projects. This will minimize the amount of digester gas piping that is removed and replaced at any time and minimize any downtime.

The recommendation is also made to replace the gas safety and control equipment as well as the gas flare as part of the WWTP upgrade

6.8.8 Summary of Anaerobic Digestion Recommendations

An opinion of probable costs for the recommendations discussed above is outlined in Table 6.20.

Table 6.20	**Opinion of Probable Anaerobic Digestion Rehabilitation Costs WWTP Facility Master Plan MBCSD**
Parameter	**Value**
Dewater, Clean, and Sandblast Digester No. 1	$50,000
Structural Rehabilitation for Digester No. 1	$150,000
Apply Protective Coatings to Interior of Digester No. 1	$150,000
Replace Mixing Pump No. 1	$50,000
Replace and Install new Pressure/Vacuum Release Valves Dig No. 1	$50,000
Dewater, Clean, and Sandblast Digester No. 2	$50,000
Structural Rehabilitation for Digester No. 2	$75,000
Apply Protective Coatings to Interior of Digester No. 2	$150,000
Replace Mixing Pump No. 2	$50,000
Replace and Install new Pressure/Vacuum Release Valves Dig No. 2	$50,000
Dewater, Clean, and Sandblast Digester No. 3	$50,000
Structural Rehabilitation for Digester No. 3	$75,000
Apply Protective Coatings to Interior of Digester No. 3	$150,000
Replace Mixing Pump No. 3	$50,000
Replace and Install new Pressure/Vacuum Release Valves Dig No. 3	$50,000
Allowance for Upgrading Electrical and Lighting Systems	$50,000
Allowance for Piping Replacement	$250,000
Replacing 120 Sludge Valves	$750,000
Allowance for Replacing Gas Piping	$500,000
Replacing Gas Safety and Control Equipment	$250,000
Replace Gas Flare	$35,000
Subtotal	$3,035,000
Unidentified Items Contingency (20 percent)	$607,000
Subtotal Construction Cost 2006[1, 2]	$3,642,000
Engineering, Administrative, and Legal Costs (35 percent)	$1,275,000
Total Project Cost 2006	$4,917,000

Notes:
1. ENR (20 cities) June 2006 = 7700.
2. Includes Contractor overhead and profit.

6.9 CONTROL BUILDING

6.9.1 Main Electrical Transformer

The main transformer for the facility is located adjacent to the control Building. As shown in Photo No. 6.65, the transformer shows signs of sever corrosion and should be evaluated and replaced as soon as practical. The utility replaced the transformer in 2006.

Photo No. 6.65

6.9.2 MCC-A

6.9.2.1 Existing Conditions

Located in the Control Building is MCC-A. This space houses the main utility breakers, several MCCs and 110-volt lighting panels. As with the other MCC's in the WWTP, the MCCs show signs of corrosion as shown in Photo Nos. 6.66 and 6.67. In an effort to slow the corrosion the supply and exhaust air-handling units have been removed.

Photo No. 6.66

Photo No. 6.67

6.9.2.2 Recommendations

It is recommended that the equipment controls be replaced with new state of the art control system using PLC and PC technology with local and remote indication. The 120-volt LP panels have visible signs of corrosion and breakers and parts have failed and been used in other locations. This panel should be considered for rehabilitation.

It is recommended that the new closed ventilation system incorporating a filtration system be installed that is constructed completely from corrosion resistant materials such as aluminum and FRP. The system should be designed to meet the requirements of NFPA 820. Any duct work and appurtenances should be constructed from corrosion resistant materials. The ventilation system will be designed to only use a minimum of outside make up air, and will be controlled using a simple thermostat. The system will include an air conditioner that will function as a dehumidifier and keep the space at tolerable temperatures for both personnel and electronic equipment.

6.9.3 Standby Generator

6.9.3.1 Existing Conditions

Located adjacent to the MCC-A is the Standby Generator Room. The generator is a diesel fueled unit rated at 250 kW. The unit has been well maintained as shown in Photo No. 6.68, and only has 500 hours of operation time. Although the run time is low, the stator has been replaced twice and the radiator has been replaced once. According to the APCD, the generator can only be run 20 hours per year for non emergency (general operation) use.

Photo No. 6.68

Also located in this room is the day tank, battery charger and batteries to start the generator, water softening equipment, and miscellaneous janitorial supplies.

6.9.3.2 Recommendations

The existing unit is in good condition and no specific recommendations for replacement are made at this time. During final design of the next expansion, it is suggested that the electrical requirements of the WWTP be determined and compared to the capacity of this unit. Regardless, it may be advantageous for the MBCSD to explore options of acquiring a unit that is natural gas fired to allow the District more flexibility with the local APCD requirements.

6.9.4 Laboratory

6.9.4.1 Existing Conditions

The laboratory is used to perform most of the testing required at the WWTP. The lab is of standard design and configuration constructed from common materials used in laboratories. The laboratory and equipment have been in service for over 20 years. Located next to the door for lab is an emergency eyewash and shower.

6.9.4.2 Recommendations

It is recommended that the laboratory be upgraded to include new storage areas, proper chemical storage areas such as acid storage cabinets, new refrigerators, and similar features. One feature that may prove beneficial is to upgrade the emergency eyewash and shower with a newer unit that incorporates an activation switch. The switch would issue an alarm if the shower or eyewash is used. The actual extent of the improvements will be determined during the design phase of the project, therefore, an allowance will be included in the probable opinion of estimated costs to account for these features.

The existing ceiling tiles show signs of water leaks and other deterioration. It is suggested that ceiling tiles be replaced with new tiles.

6.9.5 Main Graphic Panel Area

6.9.5.1 Existing Conditions

Located near the front of the building is the Main Graphic Control Panel and associated electronic cabinets as shown in Photo No. 6.69. The features of this graphic control panel are outdated and parts availability is becoming non existence. Also located in this area is the telephone dialer system.

Photo No. 6.69

6.9.5.2 Recommendations

The existing graphics panel should be removed and replaced with a plant wide SCADA System. The new SCADA system should be designed and constructed to be easily expandable as the components and equipment in the WWTP are replaced, expanded, and modified. During the final design phase of the project the actual configuration and capabilities of the SCADA system will be jointly determined with operating staff. The

SCADA system costs will be included as part of the alternative analysis and not included as a rehabilitation item.

6.9.6 Miscellaneous Improvements

Other areas of the building include office space, water heater closet, locker rooms, and a training room. Based on a preliminary review items such as windows, doors, hardware, lockers, and similar appurtenances need to be replaced or upgraded. These areas need to be evaluated during the design phase to determine the extend of the improvements desired.

6.9.7 Summary of Control Building Recommendations

An opinion of probable costs for the recommendations discussed above is outlined in Table 6.21 below.

Table 6.21 Opinion of Probable Control Building Rehabilitation Costs
WWTP Facility Master Plan
MBCSD

Parameter	Value
Main Electrical Transformer	$250,000
Replace MCC's and Electrical Gear	$500,000
Replace Ventilation System in MCC-A Area	$50,000
Laboratory Upgrades	$300,000
New Laboratory Ceiling	$10,000
Allowance for Miscellaneous Improvements	$50,000
Subtotal	$1,160,000
Unidentified Items Contingency (20 percent)	$232,000
Subtotal Construction Cost 2006[1, 2]	$1,392,000
Engineering, Legal, and Administrative Contingency (35 percent)	$487,000
Total Project Cost	$1,879,000

Notes:
1. ENR (20 cities) June 2006 = 7700
2. Includes Contractor overhead and profit.

6.10 OTHER BUILDING

6.10.1 MCC-B

6.10.1.1 Existing Conditions

Located in the MCC-B Building are the MCC's for the Interstage Pumps, 3-W Pumps, Chemical Feed Systems and other equipment located in this area. As with the other MCC's at the WWTP this area shows signs of corrosion as evidenced by the ventilation ductwork shown in Photo No. 6.70. The outside air-handling units have been removed.

Photo No. 6.70

Also located in this MCC are the controls for the Interstage Pump Station, including the VFDs for the effluent pumps and the Interstage Pump Station wetwell liquid level controls. The Interstage Pumping equipment is controlled by an Eagle EPTAK PLC system. This system is out dated and according to operating staff has never functioned as intended. There are empty spaces in the electrical cabinets that are not used due to a change in the chemical feed systems.

6.10.1.2 Recommendations

It is recommended that the new closed ventilation system incorporating a filtration system be installed that is constructed completely from corrosion resistant materials such as aluminum and FRP. The system should be designed to meet the requirements of NFPA 820. Any duct work and appurtenances should be constructed from corrosion resistant materials. The ventilation system will be designed to only use a minimum of outside make up air, and will be controlled using a simple thermostat. The system will include an air conditioner that will function as a dehumidifier and keep the space at tolerable temperatures for both personnel and electronic equipment.

During final design the MCCs should be evaluated and where required replaced with new upgraded equipment. It is recommended that a new state of the are control system using PLC and PC technology with local and remote indication be provided for the equipment in this area. The 120-volt LP panels have visible signs of corrosion and should be considered for replacement.

The structure appeared to be in fair condition. However, an allowance for replacing architectural features and general maintenance and upkeep has been added to the estimated costs.

6.10.2 MCC-D

6.10.2.1 Existing Condition

Located in this building is the MCC for the Secondary Clarifier and Solids Contact Areas. The condition of the MCC is the same of the other MCCs at the facility. In an effort to slow the corrosion the supply and exhaust air handling units have been removed.

6.10.2.2 Recommendations

It is recommended that the new closed ventilation system incorporating a filtration system be installed that is constructed completely from corrosion resistant materials such as aluminum and FRP. The system should be designed to meet the requirements of NFPA 820. Any duct work and appurtenances should be constructed from corrosion resistant materials. The ventilation system will be designed to only use a minimum of outside make up air, and will be controlled using a simple thermostat. The system will include an air conditioner that will function as a dehumidifier and keep the space at tolerable temperatures for both personnel and electronic equipment.

During final design the MCCs should be evaluated and where required replaced with new upgraded equipment. It is recommended that a new state of the are control system using PLC and PC technology with local and remote indication be provided for the equipment in this area. The 120-volt LP panels have visible signs of corrosion and breakers and parts have failed and been used in other locations. This panel should be considered for replacement.

The structure appeared to be in fair condition. However, an allowance for replacing architectural features and general maintenance and upkeep has been added to the estimated costs.

6.10.3 MCC-E and Shop

6.10.3.1 Existing Condition

This structure houses the hot water boilers used to heat the digesters (previously discussed in Section 6.8.6, a compressor room, an oil storage room, MCC-E, and a shop area. The compressor room houses the two service air compressors as well as two instrument air compressors. An air dryer and water softener unit was located in this space are not currently used. No operations or maintenance issues were noted with this equipment.

The oil storage room is where lubricants, paint and similar materials are stored. The ventilation system has been removed from this area.

The boiler room houses the hot water boilers and equipment to heat the digesters. The ventilation system has been removed from this area.

The largest area housed the shop, welder, and MCC-E equipment. The corrosion in this area is less than other areas around the WWTP. A new heater and ventilation system has been recently added to this space.

6.10.3.2 Recommendations

Operations has indicated that there is a need for additional compressed air storage at the site. In an attempt to provide this storage, the out of service hydropneumatic tank was modified to act as a compressed storage tank. This modification revealed that the hydropneumatic tank has leaks and is not suitable for use as a compressed storage tank. It is suggested that additional compressed air storage be provided at key locations in the WWTP.

An isolated ventilation system should be considered for the oil storage area. In addition the ventilation requirements for the compressor and boiler rooms should be finalized during the design process.

During final design the MCCs should be evaluated and where required replaced with new upgraded equipment. It is recommended that a new state of the art control system using PLC and PC technology with local and remote indication be provided for the equipment in this area.

The structure appeared to be in fair condition. However, an allowance for replacing architectural features and general maintenance and upkeep has been added to the estimated costs.

6.10.4 Old Cl_2 Building

6.10.4.1 Existing Condition

This building used to house the one-ton chlorine and sulfur dioxide tanks and equipment. To move the one-ton cylinders in and out of the building an overhead crane was supplied. Currently the area is used primarily for storage and shop functions. The chlorine and sulfur dioxide feed equipment have been removed from the area. The electrical panels for this equipment are still in place and show signs of corrosion. An example of this corrosion is the 120-volt lighting panel as shown in Photo No. 6.71.

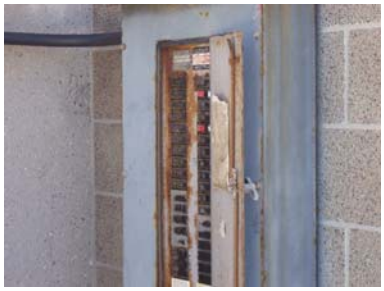


Photo No. 6.71

6.10.4.2 Recommendations

At this time it is unsure what the future use of this space will be. This decision will be made during final design. Regardless it is recommended that the 120-volt lighting panel be replaced.

The structure appeared to be in fair condition. However, an allowance for replacing architectural features and general maintenance and upkeep has been added to the estimated costs.

6.10.5 Summary of Other Building Recommendations

An opinion of probable costs for the Other Buildings is outlined in Table 6.22.

6.11 SITE AND MISCELLANEOUS FACILITIES

6.11.1 3-W Pumps

6.11.1.1 Existing Conditions

The two 3-W pumps are located in the effluent end of the chlorine contact basis as Shown in Photo No. 6.72. The pumps are of the vertical turbine type and are driven by 15 hp motors. According to the O&M manual each pump is designed to pump between 150 to 300 gpm at a TDH of 106 and 162 feet. Each pump is outfitted with a discharge check and isolation valve prior to discharging into a common header. Typically only one pump is operated at a time to supply the 3-W needs.

Photo No. 6.72

Table 6.22 Opinion of Probable Other Buildings Rehabilitation Costs WWTP Facility Master Plan MBCSD	
Parameter	**Value**
Replace MCCs and Electrical Equipment in MCC-B	$500,000
Replace Ventilation System in MCC-B Area	$50,000
Allowance for MCC-B Bldg. Repairs, Painting, etc.	$25,000
Replace MCC's and Electrical Equipment in MCC-D	$500,000
Replace Ventilation System in MCC-D Area	$50,000
Allowance for MCC-D Bldg. Repairs, Painting, etc.	$25,000
Replace MCCs and Electrical Equipment in MCC-E	$250,000
Ventilation Improvements	$75,000
Allowance for Shop Bldg. Repairs, Painting, etc.	$25,000
Replace Lighting Panel in the Old Cl_2 Bldg	$25,000
Allowance for MCC Bldg. Repairs, Painting, etc.	$25,000
Subtotal	$1,550,000
Unidentified Items Contingency (20 percent)	$310,000
Subtotal Construction Cost 2006[1, 2]	$1,860,000
Engineering, Legal, and Administrative Contingency (35 percent)	$651,000
Total Project Cost 2006	$2,511,000
Note: 1. ENR (20 cities) June 2006 = 7700 2. Includes Contractor overhead and profit.	

Located downstream from the 3-W pumps is a hydropneumatic tank. The original purpose for the hydropneumatic tank was to provide a method to keep an acceptable operating pressure in the system without the 3-W pumps continuously running and/or cycling on and off. This system has not worked properly and the hydropneumatic tank was isolated from the 3-W system. Current operations are based on one pump running continuously.

The 3-W piping was originally routed throughout the WWTP to provide wash down water. Since then the use of 3-W for wash down has been discontinued due to health and safety concerns associated with the use of a blended primary and secondary effluent. Currently the main use for the 3-W is to provide flushing water in the digested sludge transfer lines between the digesters and the sludge beds. The system was installed without isolation valves. Due to the lack of isolation valves the whole system needs to be taken off line in the event that a repair is needed.

6.11.1.2 Recommendations

The pumps appear to be well maintained and kept in good operating condition. Therefore, no recommendations for rehabilitation are noted at this time.

A decision should be made as to the long-term use for the 3-W water at the facility. If it is determined that there is a need for the system, isolation valves should be strategically located to provide for component isolation. Based on the determined need, the addition of a new hydropneumatic tank, or comparable method of maintaining system pressure and controlling the pumps should be considered.

6.11.2 Sludge Drying Beds

6.11.2.1 Existing Conditions

The digested sludge that leaves the digesters flows by gravity to one of the twelve sludge drying beds. The sludge drying beds are each 162 feet long by 32 feet wide. This results in each bed having 5,184 ft^2 per bed with a total drying bed area of 62,208 ft^2. Current operation is to rotate the beds each month. Based on current the current sludge production of 1,582 lbs/day as identified in Table 6.19, the beds are loaded at a rate of 8.97 lbs of solids/ft^2/year.

The main mechanism for drying the digested sludge is evaporation. To aid in the drying the sludge beds have a perforated, center drain pipe located below the surface of the beds. This perorated pipe is designed to collect liquids that percolate into the soil. The collected percolate flows by gravity back to the influent sewer just upstream from the Headworks.

Currently about 60 percent of the dried sludge is sent to the Central Valley for composting. The remain 40 percent of digested and dried sludge is composted on site. The sludge that is composted is mixed with green waste and placed in static windrows. The temperature of the windrows is periodically checked. During the composting process the windrows are turned five to six times. The finished compost product has been documented to meet the requirements for a Class A, exceptional quality biosolids, and is given to local residents.

6.11.2.2 Recommendations.

At this time no rehabilitation of upgrades to the sludge drying beds are noted. However, as sludge production increases additional sludge drying beds and composting area will be required. Alternatively, sludge dewatering equipment may be used to minimize the amount of sludge drying bed area needed. If composting is continued and expanded at the WWTP a new sludge loader, turner and compost screen are suggested.

6.11.3 Plant Drains

6.11.3.1 Existing Conditions

Located throughout the site are area drains. These drains are designed to catch runoff and direct them off site. The discharge location for these plant drains is the creek that flows to the Ocean.

6.11.3.2 Recommendations

With the current system if wastewater or sludge would overflow a tank it would flow into the drains and to the creek. The same is true for the use of 3-W water for general site wash down. To mitigate this problem the drain system should be modified to direct the incidental surface drainage to the headworks for treatment. This can be accomplished in two ways, by gravity or strategically located sumps with pumps that would pump the collected drainage to the headworks.

6.11.4 Electrical Pull Boxes

The electrical pull boxes at the facility are for the most part submerged in the groundwater as shown in Photo No. 6.73. A visual inspection of two of the pull boxes revealed that no wire splices were made at these locations. Installing sumps and pumps would likely be impractical since the pumps would likely be pumping groundwater indefinitely. At this time it is suggested that the situation be monitored and the condition of the wire insulation be periodically checked to determine its condition.

Photo No. 6.73

6.11.5 Yard Piping

6.11.5.1 Existing Conditions

The groundwater at the site is within a couple of feet of the ground surface. The presence of the groundwater and the use of ferrous metal piping provides ideal conditions for corrosion.

Due to the history of underground pipe and valve corrosion the condition of the 3-W piping system should be determined as part of an overall corrosion evaluation.

6.11.5.2 Recommendations

6.11.6 Summary of Recommended Site and Miscellaneous Facilities

An opinion of probable costs for the recommendations discussed above is outlined in Table 6.23 below.

Table 6.23 Opinion of Probable Site and Miscellaneous Rehabilitation Costs WWTP Facility Master Plan MBCSD

Parameter	Value
3-W System Upgrades	$50,000
Upgrade Plant Drain System	$200,000
Allowance for Yard Piping	$400,000
Subtotal	$650,000
Unidentified Items Contingency (20 percent)	$130,000
Subtotal Construction Cost 2006[1, 2]	$780,000
Engineering, Legal, and Administrative Contingency (35 percent)	$273,000
Total Project Cost 2006	$1,053,000

Notes:
1. ENR (20 cities) June 2006 = 7700.
2. Includes Contractor overhead and profit.

6.12 DEMOLITION OF EXISTING FACILITIES

6.12.1 Background

Although the equipment at the WWTP appears to be in a well-maintained condition, several facilities have been targeted as candidates for removal. These facilities were constructed with the original plant in 1953, and in 1964 when the plant was first upgraded. Many of these structures have been in service for 50 years or more and are nearing their expected life spans. Therefore, it probably is cost effective to take these units out of service and have them demolished, rather than include them in a rehabilitation schedule. The following treatment units have been included in this demolition analysis: Trickling Filter No. 1, Trickling Filter No. 2, Primary Clarifier No. 1, Primary Clarifier No. 2, Digester No. 1, Digester No. 2, and the Chlorine Contact Basin.

6.12.2 1953 Facilities

Four structures from the original construction of the WWTP in 1953 are currently operational including Digester No. 1, Trickling Filter No. 1, the Chlorine Contact Basin, and Primary Clarifier No. 2. These structures are showing signs of significant corrosion and deterioration, and in order to bring these structures back to a like new condition, significant

rehabilitation is necessary. If however, the decision is made to take these structures out of service, demolition of these structures is necessary to gain valuable space at the WWTP site.

The demolition process would include the removal of concrete, rock, and assorted metals from the appropriate structures. The estimated unit costs of removing this material for each of the structures previously listed are detailed in Table 6.24.

Table 6.24 Estimated Costs for Demolition of 1953 Facilities
WWTP Facility Master Plan
MBCSD

Parameter	Value
Demolition of Chlorine Contact Basin	$48,000
Demolition of Trickling Filter No. 1	$38,000
Demolition of Digester No. 1	$46,000
Demolition of Primary Clarifier No. 2	$31,000
Subtotal	$163,000
Unidentified Item Contingency (20 percent)	$33,000
Subtotal Construction Cost 2006[1, 2]	$196,000
Engineering, Legal, and Administrative Contingency (35 percent)	$69,000
Total Project Cost	$265,000

Notes:
1. ENR (20 cities) June 2006 = 7700
2. Includes Contractor overhead and profit.

6.12.3 1964 Facilities

In 1964, the original WWTP was upgraded with new a new primary clarifier, trickling filter, and digester. Several of these structures may need to be taken out of service and demolished if they are not needed in the recommended treatment alternatives. These structures include: Digester No. 2, Primary Clarifier No. 1, and Trickling Filter No. 1.

The demolition process would include the removal of concrete, rock, and assorted metals from the appropriate structures. The estimated unit costs of removing this material for each of the structures previously listed are detailed in Table 6.25.

Table 6.25 Estimated Costs for Demolition of 1964 Facilities WWTP Facility Master Plan MBCSD	
Parameter	**Value**
Demolition of Digester No. 2	$51,000
Demolition of Primary Digester No. 1	$45,000
Demolition of Trickling Filter No. 1	$51,000
Subtotal	$147,000
Unidentified Item Contingency (20 percent)	$29,000
Subtotal Construction Cost 2006[1, 2]	$176,000
Engineering, Legal, and Administrative Contingency (35 percent)	$62,000
Total Project Cost	$238,000
Notes: 1. ENR (20 cities) June 2006 = 7700 2. Includes Contractor overhead and profit.	

6.12.4 Summary

The estimated combined total costs for the demolition and removal of the 1953 and 1964 facilities listed above is shown in Table 6.26. The estimated total cost for the demolition of these structures is $502,000. These costs include contingency, contractor overhead and profit, and design. It should be noted that these costs are initial estimates based on existing design criteria and site visits. If the decision is made to take these treatment units out of service, additional work will be done to develop more accurate demolition costs that can be incorporated into the design process.

Table 6.26 Estimated Costs for 1953 and 1964 Facilities Demolition WWTP Facility Master Plan MBCSD	
Parameter	**Value**
1953 Facilities	$163,000
1964 Facilities	$147,000
Subtotal	$310,000
Unidentified Items Contingency (20 percent)	$62,000
Subtotal Construction Cost 2006[1, 2]	$372,000
Engineering, Legal and Administrative Contingency (35 percent)	$130,000
Total Project Cost	$502,000
Notes: 1. ENR (20 cities) June 2006 = 7700 2. Includes Contractor overhead and profit.	

BIOSOLIDS TREATMENT AND DISPOSAL

7.1 SUMMARY

This chapter gives an overview of the current biosolids handling practice at the City of Morro Bay Cayucos Sanitary District (MBCSD) Wastewater Treatment Plant (WWTP), a discussion of possible treatment processes that have been considered for use in the future, the costs associated with these processes for different configurations of the WWTP, and biosolids management recommendations for a 20-year planning period for the facility at build-out conditions.

The MBCSD WWTP currently treats and stabilizes biosolids using anaerobic digestion. After digestion, the biosolids are applied to sludge drying beds, where they are dried to an average solids concentration of 80 percent. These dried solids meet the requirements for Environmental Protection Agency (EPA) Class B biosolids, and are hauled away by San Joaquin Composting for further treatment and land application in Kern County or composted at the plant site.

Table 7.1 summarizes the project costs and 20-year present value (PV) for the six options described in detail in this chapter. Based on the analysis, the most economically favorable biosolids management practice for the MBCSD with extended aeration activated sludge (EAAS) in the future is Option 6, which involves sending undigested waste activated sludge (WAS) from an EAAS process to a centrifuge for dewatering, and directly to a container for offsite disposal. The difference in project cost between offsite disposal of this product and onsite composting is relatively small, and the ultimate solution for the MBCSD may be a combination of several of the options that have been presented.

The recommendations made in this section of the chapter are intended to inform the MBCSD of the possible costs associated with the treatment of biosolids produced at the WWTP.

7.2 INTRODUCTION

The purpose of this chapter is to review biosolids handling and disposal options for the MBCSD WWTP over the 20-year planning period. An overview of the existing practices at the facility will first be discussed, which will include the existing anaerobic digesters and sludge drying beds. Following this overview will be an analysis of future biosolids production. After the future biosolids production at the WWTP has been determined, several treatment alternatives and their associated costs will be discussed in detail. Based on the treatment alternatives presented in this chapter, Carollo Engineers, P.C. (Carollo) will recommend several biosolids management plans that include a combination of these alternatives for the MBCSD.

Table 7.1	Summary of Estimated Present Value Costs (20 Years) WWTP Facility Master Plan MBCSD				
			Estimated Costs		
		Classification	Project	O&M Present Value (20 Years)	Total Present Value
Option 1	TFSC - Composting	Class A	$6,001,000	$3,652,000	$9,653,000
Option 2	TFSC - Sludge Beds	Class B	$5,219,000	$3,104,000	$8,323,000
Option 3	TFSC - No Sludge Beds	Class B	$5,219,000	$4,287,000	$9,506,000
Option 4	Extended Aeration - Composting	Class A	$6,268,000	$3,970,000	$9,768,000
Option 5	Extended Aeration - Sludge Beds	Class B	$5,486,000	$3,464,000	$8,950,000
Option 6	Extended Aeration - Without Digestion	Sub-Class B	$3,488,000	$5,125,000	$8,613,000

Sludge stabilization is currently achieved at the MBCSD WWTP by anaerobic digestion. Settled sludge from the primary clarifiers is pumped to one of two primary anaerobic digesters (Digester No. 2 and 3) on the plant site. During wasting, sludge from the secondary clarifiers is sent back to the headworks so it can be thickened in the primary clarifiers. The primary digesters are heated to a temperature between 96 and 98 degrees Fahrenheit and mixed with digester gas. The primary digesters, which are also heated by digester gas, are operated in series with a secondary digester (Digester No. 1). Sludge is allowed to settle in the secondary digester and the supernatant is sent back to the headworks of the WWTP.

Stabilized sludge is drawn from Digester No. 1 and sent to one of twelve sludge-drying beds where it is allowed to solar dry to a solids concentration between 75 to 90 percent. Dried solids are removed from the sludge drying beds and stored in a concrete containment area. Since 1998, the MBCSD has been disposing of the bulk of its biosolids by having a permitted land applier, San Joaquin Composting, haul biosolids to their facility in the Central Valley for further treatment and land application.

In 2002, the MBCSD staff began composting approximately 30 percent of its digested biosolids onsite following the EPA 40 CFR 503 Process to Further Reduce Pathogens (PFRP) with windrow composting. Since the pilot test began, the MBCSD WWTP has produced Exceptional Quality (EQ) biosolids compost that is consistent with EPA Class A

pathogen requirements. Public response to the composting operation has been positive, and WWTP staff has expressed their desire to continue composting onsite. However, space limitations at the facility and access to an adequate volume of green waste have been identified as obstacles to full-scale onsite composting. These obstacles, as well as the uncertainties associated with land application of biosolids in California, illustrate the need for a biosolids handling and disposal option for the MBCSD facility, which allow maximum operational flexibility, over the future twenty-year planning period.

The current biosolids management practice at the MBCSD is the product of experimentation and input from plant operators and staff. In addition to the creation of the composting program, staff's decision to operate three digesters in a primary and secondary configuration has improved biosolids quality and given the current process operational flexibility, especially when digesters are periodically taken offline for cleaning. By using two primary digesters, staff has significantly reduced the cost of digester cleaning.

This analysis considers several alternatives including producing EPA Class A (unrestricted use) biosolids, producing EPA Class B (restricted use) biosolids, as well as transporting unstablized sludge to an offsite composting facility for further treatment and land application.

7.3 HISTORICAL AND PROJECTED BIOSOLIDS PRODUCTION

This section provides a summary of future projections of biosolids production for the MBCSD as well as a description of the methods used to determine these projections.

Before biosolids handling and disposal alternatives can be accurately developed and compared, the amount of sludge production anticipated at the WWTP in the future must be determined. For the purpose of this report, biosolids production is presented for the 20-year planning period at build-out flow conditions discussed in a previous chapter of this report. The data used to prepare biosolids projections was taken from Annual Sewage Sludge Reports (Sludge Reports) prepared for the EPA for the years 1996 to 2005. Additional information not included in the Sludge Reports was provided by WWTP staff.

For the purposes of this analysis, two operating scenarios will be considered for the future at the WWTP. These conditions are based on the type of secondary treatment that will be used at the plant. The two options for secondary treatment will be EAAS and the existing practice of TFSC. These two scenarios will provide a range of costs and include the viable treatment components for whatever final treatment option is ultimate chosen.

7.3.1 Historical Biosolids Production

Future biosolids production projections for the WWTP are based on an analysis of historical sludge production for the years 2002 to 2005 as well as information obtained from process modeling done by Carollo. These figures are based on the current practice of using TFSC for secondary treatment. Annual sludge production and annual average daily flow (AADF)

at the MBCSD WWTP for 2002 to 2005 are shown in Table 7.2. Values for annual dry sludge production were obtained from the Sludge Reports.

Table 7.2 Sludge Production per Million Gallons
WWTP Facility Master Plan
MBCSD

Year	Sludge Production[1] (lbs/year)	Flow (MG/year)	Sludge per Flow (lbs/MG)
2002	421,965	416	1,015
2003	654,063	386	1,695
2004	394,186	400	986
2005	497,804	458	1,088
4-Year Average			**1,186**

Note:
1. Sludge production is based on dry weight following digestion.

It should be noted that there is significant variation for sludge production figures within the four-year period used in this analysis. This variation can be attributed to the practice of regular digester cleaning at the facility. Each of the three digesters is cleaned on approximately a five-year cycle. For example, sludge production in 2003 increased by nearly 50 percent due to the cleaning of Digester No. 1. In order to get an accurate representation of historical sludge production at the WWTP, an average for the years 2002 to 2005 will be used.

The relationship most often used to predict future biosolids production at a treatment facility is sludge production to five-day biochemical oxygen demand (BOD_5) removal. The use of this relationship for predicting future projections is especially useful for the MBCSD because modified waste discharge requirements (WDR) for BOD_5 will soon become more stringent, resulting in mandated higher BOD_5 removal.

The current biosolids management practice at the MBCSD is the product of experimentation and input from plant operators and staff. In addition to the creation of the composting program, staff's decision to operate three digesters in a primary and secondary configuration has improved biosolids quality and given the current process operational flexibility, especially when digesters are periodically taken offline for cleaning. By using two primary digesters, staff has significantly reduced the cost of digester cleaning.

7.3.2 Biosolids Production Projections

Since the future treatment processes that will be implemented at the WWTP are still unknown at this time, biosolids production projections will be presented for two different scenarios. First, the assumption will be made that the facility will continue to operate using the Trickling Filter/Solids Contact (TFSC) process. Co-thickened primary sludge and waste

activated sludge (WAS) will be pumped from the primary clarifiers. As an alternative, biosolids production figures will be projected using an EAAS process such as the use of oxidation ditches, which is the case for the City of Pismo Beach. It should be noted that the oxidation ditches at the City of Pismo Beach WWTP are operated without primary clarifiers.

Sludge production quantities, prior to anaerobic digestion, are presented in Table 7.3. Although secondary treatment alternatives will be investigated in depth in subsequent chapters of this report, in order to assess possible future biosolids production, the only option to TFSC will be an EAAS process. While this type of suspended growth treatment would be used to produce a higher quality effluent, it also results in the production of comparatively more biosolids to TFSC.

Table 7.3 Sludge Production Prior to Digestion
WWTP Facility Master Plan
MBCSD

Process	Sludge Production (ppd)
TFSC	4,575
EAAS	4,800

Note:
1. Sludge production figures are based on quantities of both primary and waste activated sludge prior to digestion.

In addition to the secondary treatment changes expected for the WWTP in the future, effluent requirements for BOD_5 are also expected to change. Between 2002 and 2006, the WWTP discharged effluent with an annual average BOD_5 concentration of 54 milligrams per liter (mg/L). For the purposes of this biosolids analysis, future effluent concentrations of 5 mg/L for EAAS and 20 mg/L for TFSC will be assumed. These concentrations are inline with full secondary treatment and the demonstrated capabilities of these processes.

7.3.2.1 TFSC Biosolids Projections

As mentioned previously, changes in the discharge requirements and the type of secondary treatment used at the WWTP will have significant impacts on the amount and solids concentration of the sludge produced. In order to assess continued use of the TFSC process an effluent BOD_5 concentration of 20 mg/L will be used to project future biosolids production.

7.3.2.2 EAAS Biosolids Projections

In order to establish a range of biosolids production figures for the WWTP in the future, it has been assumed for this analysis that the alternative secondary treatment option for the WWTP upgrade will be EAAS. In order to determine future biosolids production with EAAS, an effluent BOD_5 concentration of 5 mg/L will be used.

Based on the above assumptions, the annual quantity of sludge produced at the WWTP is shown in Table 7.4. At build-out conditions, the WWTP will produce approximately 1,070,000 pounds of dry sludge per year using TFSC with anaerobic digestion. If the WWTP were to change to EAAS, 1,191,000 or 1,789,000 pounds of dry sludge would be produced annually depending on the extent of solids stabilization done at the facility.

Table 7.4 Sludge Production Projections WWTP Facility Master Plan MBCSD

	Sludge Production (lbs/year)		
	TFSC	Extended Aeration	
Year	Digested[1]	Digested[1]	Undigested
2006	929,000	1,034,000	1,553,000
2007	939,000	1,045,000	1,570,000
2008	950,000	1,057,000	1,588,000
2009	960,000	1,069,000	1,605,000
2010	971,000	1,080,000	1,623,000
2011[2]	982,000	1,092,000	1,641,000
2015[3]	1,024,000	1,140,000	1,712,000
2021[4]	1,070,000	1,191,000	1,789,000
2026[5]	1,070,000	1,191,000	1,789,000

Notes:
1. Sludge production is based on dry weight following digestion.
2. Anticipated design start date.
3. Build-out of 2,865 connections for the CSD reached.
4. Build-out population of 12,500 for Morro Bay reached.
5. End of 20-year planning period.

In order to simplify biosolids production projections for the MBCSD before selection of a treatment alternative, Carollo has modeled TFSC and an EAAS process. TFSC is the treatment process currently used at the facility, and EAAS represents all the activated sludge processes that will be considered in the treatment alternatives chapter of this report. These alternatives include both secondary and tertiary treatment processes such as an oxidation ditch, membrane bioreactor (MBR), or an oxidation ditch coupled with tertiary filtration.

7.4 EXISTING ANAEROBIC DIGESTION PROCESS

This section discusses the current anaerobic digestion process used at the WWTP for the stabilization of solids. As noted in Chapter 6 (Rehabilitation) of this report, several changes

will need to be made to the digesters if the facility continues to utilize anaerobic digestion. In addition to these improvements, a discussion of other sludge treatment components that aid digestion such as digester pump mixing, thickening, and dewatering are also discussed. The costs associated with digester rehabilitation, thickening, and dewatering are included in a later section of this chapter.

As discussed previously, sludge from the primary clarifiers is stabilized in a series of primary and secondary digesters before it reaches the sludge drying beds. During anaerobic digestion, approximately 50 percent of the volatile suspended solids in the sludge are destroyed. The condition of the three digesters, as well as the costs associated with rehabilitation or demolition of these structures and associated support facilities, was discussed in Chapter 6 of this report. Based on the experience of Carollo staff and the cost of rehabilitation of the oldest of these structures, the recommendation has been made to retire and demolish existing Digester No. 1. For the purpose of this biosolids analysis, it is assumed that Digester No. 1 will not be used for future anaerobic digestion.

7.4.1 Digester Operating Parameters

The important design and operating parameters associated with anaerobic digesters are volatile solids loading and retention time. With the demolition of Digester No. 1, the available digester volume at the plant will be 43,200 cubic feet (ft^3), assuming 80 percent of the digesters are usable. Both the hydraulic retention time (HRT) and volatile solids loading rate are dependent on the amount and condition of sludge that will be sent to the digesters in the future. While the minimum HRT stipulated by EPA regulations 40 CFR Part 503 is 15 days, the recommended design HRT for digestion is 20 days and the maximum volatile solids loading rate is 0.10 lbs. VSS/ft^3/day. As discussed previously, these sludge parameters will differ based on applicable effluent quality and the secondary treatment process. The impact on these operating parameters is analyzed below for both the existing practice of using TFSC and Extended Aeration.

7.4.1.1 <u>Digester Operation with TFSC</u>

Based on the current composition of sludge sent to the primary digesters, with Digester No. 1 out of service, the minimum and recommended HRT would continue to be met and the volatile solids loading to the digesters would be approximately 0.061 lbs. VSS/ft^3/day at build-out conditions. With Digester No. 2 and No. 3 in service, the MBCSD would also be able to maintain an HRT of 20 days. Based on these findings, it would not be required to construct another digester at the WWTP to replace Digester No. 1 if TFSC continues to be used. Photo No. 7.1 shows the current condition of Digester No. 1.

Photo 7.1

7.4.1.2 Digester Operation with Extended Aeration

Using extended aeration at the WWTP will result in the wasting of a greater volume of sludge with a lower solids concentration. Because a greater volume is being wasted, the HRT at build-out will be only four days, and the volatile solids loading rate will be 0.054 lbs. VSS/ft^3/day. Because of the low solids concentration in the WAS sent the primary digesters, the solids retention time is well below the 15-day minimum operating HRT. The volatile solids loading rate is below the recommended loading rate of 0.10 lbs. VSS/ft^3/day with EAAS.

Sludge thickening upstream of the digesters will need to be used if the WWTP goes to EAAS in order to increase the HRT to a minimum of 15 days. Sludge thickening to a solids concentration of 4 percent would increase the HRT at the digesters to 32 days. Sludge thickening ahead of anaerobic digestion is a common practice done at many municipal WWTPs, and it will be discussed in detail in the following section of this chapter. Sludge thickening before digestion, would allow for the demolition of Digester No. 1 with no replacement.

However, it should be noted that WAS thickening will only be needed if an EAAS process is implemented at the WWTP in the future. The primary sludge and WAS currently sent to the digesters from the primary clarifiers has a solids concentration of 3.5 percent.

7.4.2 Thickening

The purpose of sludge thickening is to increase solids concentration prior to sludge stabilization, thereby reducing the required tank volume or chemical requirements. Recent studies have indicated that pre-thickening provides for a more stable digestion or stabilization process. Currently, all the sludge being pumped to the primary digesters at the WWTP comes from the primary clarifiers. Because of the low concentration of solids in the WAS leaving the secondary clarifier, WAS is sent back into the treatment train at the headworks where it can be co-thickened with the primary sludge in the primary clarifiers.

7.4.2.1 Thickening of TFSC Sludge

According to WWTP staff, the solids concentration of sludge entering the digesters from the primary clarifiers averages approximately 3.5 percent. Therefore, the need for sludge

thickening ahead of anaerobic digestion has not been necessary. If the WWTP continues to treat wastewater with TFSC, sludge thickening ahead of the digesters will be not be needed.

7.4.2.2 Thickening of EAAS Sludge

For EAAS, the assumption was made that WAS will be sent directly to the primary digesters. As mentioned previously, if EAAS was used at the WWTP with Digesters No. 2 and 3, a minimum HRT of 15 days could not be achieved. Sludge thickening of the WAS before the digesters would decrease the volume of sludge sent to the digesters and significantly increase the HRT.

Sludge thickening design is based on the hydraulic loading rate coupled with the average solids concentration. With EAAS, the WWTP is expected to waste approximately 75,000 gallons per day (gpd) at build-out conditions. The only sludge thickening devices considered for MBCSD are gravity belt thickeners (GBTs). It should be noted that other sludge thickening methods such as the use of centrifuges produce similar results with comparable operating and capital costs. The analysis done for the use of GBTs is representative of all the possible thickening technologies that may be implemented at the WWTP in the future.

7.4.2.3 Gravity Belt Thickeners

GBTs have been widely used at municipal wastewater treatment plants for thickening of slurries generated in many different processes. Cities in California's Central Valley that use GBTs for thickening include Visalia and Tulare. The GBT is essentially the first stage or "gravity table" of the belt filter press commonly used for sludge dewatering. A target of 2 to 5 percent thickened sludge concentration is recommended for anaerobic digestion. A polymer feed system, sludge pumping, and possibly odor control equipment, and other ancillary appurtenances are needed for this process.

7.4.3 Pump Mix Retrofit

The existing primary digesters at the WWTP are equipped with gas mixing equipment that utilizes gas produced from the anaerobic digestion process to agitate and mix the sludge. This type of mixing is an antiquated practice, and most modern digesters achieve mixing with the use of a pump. An external pump draws sludge from the bottom of the digester and discharges it back into the digester through a pipe near the top. Not only does this method provide better mixing, but it also helps to minimize the scum layer that can form on the surface of the sludge in the digester. For these reasons, a new sludge mixing pump and piping are recommended for both Digesters No. 2 and 3. The existing gas mixing equipment in both digesters will need to be demolished, and new 12-inch diameter mixing pump suction and discharge lines would be installed on the floor and near the top of the digester. While a pump recirculation system is currently used to maintain the temperature of the digester, a larger pump is needed to adequately mix the digester without the gas mixing

system. A chopper pump for pump mixing is recommended. The chopper pump will discharge 1,500 gpm of recirculated sludge through an upper and lower nozzle to thoroughly mix the sludge.

7.4.4 Dewatering

There are many process benefits to dewatering stabilized biosolids prior to disposal. Dewatering digested sludge further reduces the sludge volume following the stabilization process, therefore reducing the costs for chemicals, hauling, and disposal. In addition, dewatered sludge is in general, easier to transport as it may be handled as a solid. Finally, dewatering sludge reduces odors and minimizes leachate potential.

Sludge dewatering design is based on the source and type of sludge to be dewatered, as well as the capacity of the plant and the space available onsite. The dewatering processes discussed here vary in placement in the treatment schemes and incoming WAS characteristics. Two mechanical dewatering processes are commonly used to dewater liquid sludges to approximately 18 percent solids. These two processes are belt filter presses and centrifuges. The City of Paso Robles currently uses belt presses to dewater their sludge. The design literature and other planning documents reveal that based on a 20-year PV analysis between belt filter presses and centrifuges they have very similar life costs associated with them. In the analysis of the options discussed in this document, the centrifuge will be used as the mechanical dewatering method. After the desired biosolids management option is identified and the decision is made to whether or not include mechanical dewatering, a more detailed analysis including operational and maintenance issues is recommended to select the actual dewatering process.

7.4.4.1 Centrifuge Dewatering

Sludge dewatering using a centrifuge employs centrifugal force to achieve the separation, sedimentation, and compression of sludge solids desired. The sludge is separated based on density difference between the solid and liquid phases into dewatered cake and clarified centrate. Of the three basic types of centrifuges (disk nozzle, imperforate basket, and solid bowl), the solid bowl centrifuge is the preferred type for municipal sludge dewatering applications. As sludge is pumped into the solid bowl centrifuge, the sludge solids separate, thicken, and the dewatered sludge is removed along the outside wall of the rotating bowl while the centrate is discharged from the fluid surface near the bowl's center. Dewatering centrifuges can normally achieve a 15 to 30 percent cake solids concentration with a 90 to 95 percent solids capture. However, the efficiency of dewatering is very sensitive to sludge characteristics, sludge conditioning, and sludge feed rate. A community that uses centrifuge dewatering is the City of Reedley.

7.5 CLASS A TREATMENT OPTIONS

The MBCSD has the option to produce either Class A or Class B biosolids at the WWTP for land application in the future as defined by the pathogen level requirements detailed in the 40 CFR 503 regulations. While Class B requires the least treatment for land application, this category of biosolids will shortly be unaccepted in any nearby county for reuse. The MBCSD WWTP currently produces Class B biosolids that are sent to San Joaquin Composting for further treatment. The WWTP also composts sludge at the WWTP site into Class A, EQ, co-composted biosolids. The detailed regulations governing biosolids can be seen in the Chapter 5 (Regulations) of this report. Several options available to the MBCSD for the production of both Class A and Class B biosolids are also presented below.

Two Class A pathogen reduction alternatives are identified as potential onsite processes to broaden future biosolids options for the WWTP. The processes are composting and heat drying, each of which is discussed below. As mentioned previously, the MBCSD has been producing a high quality compost onsite for the past several years. Therefore, pilot testing would only be needed to assess the marketability and public acceptance of the biosolids products from heat drying.

7.5.1 Composting

Composting is a proven technology to produce a soil conditioner and has a demonstrated operating history. This is the process currently used by San Joaquin Composting, where MBCSD trucks the majority of its dewatered biosolids, for further treatment prior to land application at McCarthy Farms or other acceptable location. San Joaquin Composting is located in Kings County, California. The biosolids not hauled to McCarthy Farms are also composted onsite by WWTP staff and distributed to both public and private entities for use on public parks and private flowerbeds.

Three common types of composting processes are windrows, aerated piles, and in-vessel systems. Green waste or wood chips are most commonly used as bulking agents and carbon sources for the process. The windrow system is the most common form of composting, where the biosolids and bulking agents are formed into long, open-air piles that are turned frequently. Aerated piles are rectangular piles of compost mixture that are supplied with air through blowers connected to perforated pipes running under the piles. In-vessel systems are enclosed reactors and have the benefit of strict odor, process, and emission controls.

Since 2002, staff at MBCSD has been developing a beneficial reuse program for the biosolids generated at MBCSD, through a program of composting. The goal of the composting program has been to develop and implement a cost effective technique for producing EQ compost that meets the metals standards, Class A pathogen reduction standards, and vector attraction reduction standards contained in EPA 40 CFR Part 503.13 (Table 7.3), EPA 40 CFR Part 503.32, and EPA 40CFR Part 503.33, respectively. The

resulting product is high quality compost that meets all the EPA 40 CFR Part 503 requirements for EQ compost that can be beneficially reused in the local community. The production of high quality compost has allowed the MBCSD to reuse a portion of its biosolids within San Luis Obispo County without relying on a third party. The ultimate goal of the program is to make the EQ compost available to the public for use as a high quality soil amendment.

The composting program utilizes windrow composting; an EPA recognized method for the Processes to Further Reduce Pathogens (PFRP, 40 CFR Part 503 Appendix B). MBCSD has been windrow-composting biosolids produced at MBCSD with green waste generated in the local community. During 2006, approximately 800 cubic yards (yd^3) of composted biosolids were produced at MBCSD.

7.5.2 Heat Drying

Heat drying reduces the moisture content and the pathogens in the biosolids by evaporation, producing a Class A biosolids product that is comparable to that of composting. Heat drying may be accomplished by indirect or direct means, referring to whether or not the biosolids come into direct contact with the heat source. Heat drying has advantages to composting including much smaller land requirements and significantly more volume reduction since it does not require the addition of bulking material.

There are several manufacturers of heat drying systems. Mobile pilot-sized units are available from some manufacturers. The process has primarily been used in large facilities in the northeast United States. However, facilities are becoming more common as the process gains acceptance and the biosolids rules become more stringent.

7.6 CLASS B TREATMENT OPTIONS

The three most common technologies for producing a Class B biosolids product onsite are anaerobic digestion, aerobic digestion, and solar drying. The MBCSD WWTP currently produces Class B biosolids utilizing anaerobic digestion and solar drying in sludge drying beds. While aerobic digestion is a viable option for the production of a Class B product, it requires an open, unheated tank and either conventional air diffusers or surface aeration equipment. Since the site already includes two anaerobic digesters that can be rehabilitated, the construction of new aeration basins makes aerobic digestion an unattractive option for the MBCSD. The use of solar drying is often not an option for a WWTP in close proximity to residential development because of odor concerns. However, the WWTP currently dewaters its biosolids using sludge drying beds with few local complaints. Therefore, anaerobic digestion and solar drying are included in the biosolids analysis for the MBCSD and are summarized below.

As mentioned previously, initial thickening of the WAS to at least its current solids concentration of 3.5 percent solids prior to treatment is desired if the WWTP continues to

utilize anaerobic digestion. The thickening of the WAS has several benefits including requiring less digestion volume and lower energy requirements. It is assumed that for both of these Class B technologies, the WAS will be thickened to at least 3.5 percent solids prior to treatment.

7.6.1 Anaerobic Digestion

The anaerobic digestion process is a proven method of reducing the volatile solids content of the waste sludge. This process is currently used at the WWTP before sludge reaches the sludge drying beds. The use of anaerobic digestion decreases the amount of solids that are sent to the beds thereby decreasing the area needed for drying. Digestion also helps to minimize odor problems that are often associated with raw sludge.

Since the WWTP currently has the digesters and other support facilities necessary for anaerobic digestion at the site, the majority of proposed biosolids management scenarios will incorporate anaerobic digestion. This is especially true if the MBCSD decides to continue the current trend of TFSC treatment at the WWTP where primary sludge is being produced. The costs associated with the rehabilitation of Digester No. 2 and 3, and the demolition of Digester No. 1, will be discussed in the alternatives analysis section of this chapter.

7.6.2 Solar Drying

Solar drying of sludge is a simple yet time consuming method of sludge dewatering. This method relies on the slow, sun-induced processes of moisture evaporation from the sludge. There are four categories of sludge drying beds: conventional sand, paved, artificial media, and vacuum-assisted. Of these four, the first two are the most widely used for communities similar in size to MBCSD, however to prevent percolation paved sludge drying beds are recommended.

Typically, digested sludge is discharged to the beds and allowed to air dry. Evaporation into the overlying atmosphere is the main dewatering mechanisms. The RWQCB has determined that all sludge beds will be lined to prevent percolation. The sludge shall be kept in the drying beds until it has reached a solids content of approximately 75 percent. At this level of dryness, the cake should be able to be hauled and should have a coarse dark surface.

There are several ways to determine the area of sludge beds needed. Three common methods are: mass loading represented as pounds of solids applied per year per unit area, unit area of sludge drying beds per mgd of influent flow, and liquid depth of sludge applied per unit area. For the purpose of this analysis, the mass loading method is used.

Based on drawings from the 1984 upgrade to the MBCSD WWTP obtained from Brown and Caldwell, the design loading criteria for the sludge beds is 16 pounds of dry sludge per square foot per year (lbs. dry sludge/ft^2-year). This loading rate is slightly below the range

recommended by Metcalf and Eddy (2003) for primary and trickling filter, digested sludge of 18 to 25 lbs. dry sludge/ft^2-year. The WWTP currently has twelve paved sludge drying beds, each with an area of 5,184 ft^2 available for solar drying.

7.7 OFFSITE DISPOSAL OPTIONS

Based on the type of biosolids produced by the WWTP, the MBCSD has several options for offsite disposal. The WWTP currently produces a Class B sludge that is handled by San Joaquin Composting or directly land applied at McCarthy Farms.

7.7.1 McCarthy Farms

For MBCSD to dispose of their biosolids offsite at McCarthy Farms, a facility located in Kings County, the MBCSD must comply with the 40 CFR 503 regulations as they pertain to biosolids generators and the WDR specifications for proper treatment and disposal (WDR Sludge Specifications, Provision D). McCarthy Farms is fully permitted to receive any Class B biosolids, and currently charges a tipping fee of approximately $21.00 per wet ton for biosolids handling. McCarthy farms also strictly adheres to the EPA 40 CFR 503 Regulations. Including transportation, the total cost for biosolids is in the range of $40.00 per ton.

7.7.2 San Joaquin Composting

San Joaquin Composting will accept dewatered WAS and/or sludge that has undergone anaerobic digestion. This product will be different in classification than the sludge product delivered to McCarthy Farms due to the lack of sufficient treatment to meet 40 CFR 503 regulations. However, by strictly adhering to the EPA 40 CFR 503 regulations, the composting facilities will achieve either Class A or Class B sludge, which will then be suitable for land application. The operation is fully permitted to compost biosolids and charges a tipping fee of $25.00 per wet ton to handle sludge for these services. The MBCSD currently contracts with San Joaquin Composting to either further treat or directly land apply their Class B biosolids.

It should be noted that producing a product that does not meet the requirements for Class B biosolids will result in increased hauling costs due to additional water in sludge that has not been solar dried. These cost differences will be discussed in a later section of this chapter.

7.8 ALTERNATIVE ANALYSIS

The sludge thickening, stabilization, dewatering, and disposal processes previously discussed in this chapter will be analyzed for the MBCSD WWTP in the following section. Since the ultimate direction of future WWTP design is to incorporate tertiary treatment in the form of an oxidation ditch with filtration, a number of options are analyzed as potential

components of a complete biosolids management plan for the MBCSD over the 20-year planning period.

7.8.1 Thickening

As mentioned previously, the cost of thickening sludge prior to digestion at the MBCSD WWTP will be presented for GBTs only. The design criteria for sizing of GBTs are based on hydraulic loading rates. A hydraulic loading rate of 250 gallons per minute (gpm) per meter of belt width is appropriate for design. GBTs are available in sizes of one meter, one and one-half meters, two meters, and three meters. Due to the operating frequency, the hydraulic loading to the GBT increases as the desired operating hours during the week decrease.

The GBT design capacity for the EAAS scenario is shown below in Table 7.5. Based on the operating schedule, sludge wasting volume, and hydraulic loading rate criteria, 1-M GBT would be required to accommodate the sludge produced at build-out by an EAAS process. As mentioned previously, since the solids concentration of the sludge being wasted from the primary clarifiers generated by the TFSC under current conditions is approximately 3.5 percent, sludge thickening upstream of the digesters is not necessary. During actual design, the GBT sizing criteria should be reviewed and the capacity and subsequent size of the GBT finalized.

Table 7.5 GBT Design Criteria for Extended Aeration WWTP Facility Master Plan MBCSD

Criteria	Value
Influent Sludge Concentration (%)	0.7
Thickened Sludge Concentration (%)	5.0
Volume of wasted sludge (gpd)	75,000
Dry TSS wasted (ppd)	4,800
No. of GBTs	1
Size of GBTs (m)	1
Operating Hydraulic Loading Per Unit (gpm)	250
Solids Handling Capacity Per Unit (lbs/hr)	960
Operating Cycle (days/week)	5
Operating Cycle (hrs/day)	7
Polymer Solution Feed Rate (lbs/dry ton)	14

This process will be located in a building with the associated polymer feed (sludge conditioning), pumping, electrical, and control equipment. The building will include odor control and incorporate an electrical room. Based on the GBT criteria, associated

structures, and support equipment necessary for thickening of the sludge produced from extended aeration, associated construction and project costs have been determined.

An initial estimate of the cost associated with thickening WAS from an EAAS process is detailed below in Table 7.6. The costs included in this section take into account the capital costs of the GBT unit, support equipment, and thickening building. A 20-year PV analysis will be performed in a later section of this chapter for the recommended biosolids management alternatives.

Table 7.6 GBT Cost Estimate
WWTP Facility Master Plan
MBCSD

Components	Estimated Costs
One1-M GBT unit	$125,000
Polymer Feed Equipment	$12,500
Thickening/Dewatering Building	$300,000
Yard Piping/Sitework	$22,000
Electrical and Instrumentation	$66,000
Solids Thickening Subtotal	**$526,000**
Estimating Contingencies (20 percent)	$105,000
Subtotal Construction Cost 2006	$631,000
Engineering/Admin/Legal (35 percent)	$221,000
Total Project Cost	**$852,000**

7.8.2 Digestion

The plant site currently includes three digesters. Digester No. 1 will be more than 50 years old at the time of construction and should be retired. The digesters constructed in 1964 and 1984 will also require significant rehabilitation to extend their useful life over the 20-year planning period. In addition to structural modifications that must be made to return Digester No. 2 and 3 to like-new condition, Carollo also suggests converting these digesters to pump mix rather than the existing gas mix configuration.

Table 7.7 shows the cost associated with the rehabilitation and demolition of the existing digesters. In order to rehabilitate Digester No. 2 and 3 to like new conditions and upgrade them to external pump mix, the construction cost would be approximately $714,000. The total cost of the project including the demolition of Digester No. 1, improvement to Digester No. 2 and 3, and improvements to piping and other support facilities would be $3,100,000. It should be noted that Digester No. 1 would continue to be used during the rehabilitation of the other digesters.

Table 7.7 Digester Rehabilitation and Demolition Costs WWTP Facility Master Plan MBCSD	
Parameter	**Value[1]**
Digester No. 1 Demolition	**$46,000**
Dewater, Clean, and Sandblast Digester No. 2	$50,000
Structural Rehabilitation for Digester No. 2	$75,000
Apply Protective Coatings to Interior of Digester No. 2	$150,000
Install new mixing pump Digester No. 2	$32,000
Replace and Install new Pressure/Vacuum Release Valves Digester No. 2	$50,000
Digester No. 2 Rehabilitation	**$357,000**
Dewater, Clean, and Sandblast Digester No. 3	$50,000
Structural Rehabilitation for Digester No. 3	$75,000
Apply Protective Coatings to Interior of Digester No. 3	$150,000
Install new mixing pump Digester No. 3	$32,000
Replace and Install new Pressure/Vacuum Release Valves Digester No. 3	$50,000
Digester No. 3 Rehabilitation	**$357,000**
Allowance for Upgrading Electrical and Lighting Systems	$40,000
Allowance for Piping Replacement	$200,000
Replacing Sludge Valves	$300,000
Allowance for Replacing Gas Piping	$400,000
Replacing Gas Safety and Control Equipment	$200,000
Replace Gas Flare	$35,000
Support Facilities Rehabilitation	**$1,175,000**
Subtotal	**$1,935,000**
Unidentified Items Contingency (20 percent)	$387,000
Subtotal Construction Cost 2006[1, 2]	$2,322,000
Engineering, Administrative, and Legal Costs (35 percent)	$810,000
Total Project Cost 2006	**$3,100,000**

Notes:
1. ENR (20 cities) June 2006 = 7,700
2. Includes Contractor overhead and profit.

7.8.3 Dewatering

Following anaerobic digestion, several options exist for continued biosolids treatment. Sludge can be sent either to the sludge drying beds or to a dewatering facility to increase the solids content to an acceptable level for hauling and disposal. The viability of dewatering at the MBCSD WWTP depends on several factors, including the type of secondary treatment process that will be implemented in the future and the method of sludge disposal.

Centrifuge dewatering units were analyzed for the WWTP at build-out conditions for both the existing TFSC process and an EAAS process with and without anaerobic digestion. The costs and design criteria associated with each scenario are detailed below.

7.8.3.1 Dewatering TFSC Sludge

Currently, digested primary and secondary sludge, from the TFSC process, leaves the digesters and is applied directly to one of 12 sludge drying beds on the plant site. Sending the sludge to a centrifuge for dewatering, as an intermediate step, would decrease the volume of sludge applied to the beds significantly from 16,000 gpd to 3,100 gpd based on a build-out flow condition of 1.5 mgd. Since the sludge has been dewatered to a solids concentration that allows it to be easily handled, it could also be hauled from the site without the use of sludge drying beds. In addition, mechanical dewatering could increase the amount of space available in the existing sludge drying beds for composting.

Based on the solids concentration and volume of sludge leaving the secondary digester under the plant's current operating conditions, the WWTP would need two centrifuges capable of handling a flow of approximately 35 gpm based on the operating schedule previously mentioned. During normal operation, both centrifuges would be used to dewater the sludge. However, the total amount of sludge could be processed by a single centrifuge by increasing its run time to more than seven hours each day. Two centrifuges add redundancy to the biosolids dewatering process and also increases operational flexibility each day. Table 7.8 summarizes the design criteria associated with the centrifuges needed for the TFSC process.

7.8.3.2 Dewatering EAAS

As mentioned previously, if the decision is made to switch the secondary treatment method at the WWTP to an EAAS process, additional sludge would need to be handled at the site. One of the benefits of using an EAAS process is that it makes the anaerobic digestion process used for solids stabilization optional. Since the SRT during EAAS is much longer than in a typical trickling filter, the solids have been partially digested and stabilized before they are wasted. Therefore, some of the concerns over undigested sludge such as odors are mitigated. Undigested sludge from an EAAS process could be sent directly to a centrifuge, dewatered to approximately 18 percent solids and piped directly to a truck or bin for offsite disposal.

Based on this property of EAAS treated biosolids, sludge dewatering has been analyzed for both digested and undigested sludge produced from a treatment system such as an oxidation ditch. The design criteria for EAAS both with and without anaerobic digestion have been summarized with those for TFSC in Table 7.8. Two different systems are included in this analysis. Based on the volume and solids concentration of both the digested and undigested sludge, either a centrifuge with a flow capacity of 35 gpm or 100 gpm would be needed to adequately handle all solids at the plant at build-out conditions.

Table 7.8 Centrifuge Design Criteria WWTP Facility Master Plan MBCSD

	Value		
	TFSC	Extended Aeration	
Criteria	Digested	Undigested	Digested
Influent Sludge Concentration (%)	5.0	0.7	5.0
Dewatered Sludge Concentration (%)	18.0	18.0	18.0
No. of centrifuges	2	2	2
Size of centrifuges (gpm)	35	100	35
Operating Hydraulic Loading Per Unit (gpm)[1]	27	125	17
Solids Handling Capacity Per Unit (lbs/hr)[1]	288	481	320
Operating Cycle (days/week)	5	5	5
Operating Cycle (hrs/day)	7	7	7
Polymer Solution Feed Rate (lbs/dry ton)	30	30	30

Note:
1. Conditions are given with both units in service.

Like the thickening process, an enclosed building has been included to house the centrifuge and support facilities, such as conveyors, to minimize the impact of odor on the surrounding area and to prevent corrosion of the equipment and extend its useful life. A summary of the costs associated with sludge dewatering at the WWTP for both TFSC and EAAS treatment options is presented in Table 7.9.

7.8.4 Solar Drying

Under the WWTP's current operating conditions, the solar drying beds have been sufficient to completely dry all the solids produced at the WWTP to an average solids concentration of 80 percent. Since 2002, the MBCSD has even been able to use two solar drying beds to build windrows for aerobic composting. Based on the opinion of Carollo at this time, no new drying beds will be needed at the WWTP site to accommodate additional solids from any potential secondary or tertiary treatment option. An analysis that encompasses all of these operating scenarios is detailed below for the solar drying beds.

Table 7.9 Centrifuge Cost Estimates WWTP Facility Master Plan MBCSD			
	Estimated Costs		
	TFSC	**Extended Aeration**	
Components	**Digested**	**Undigested**	**Digested**
Two Centrifuge units[1]	$450,000	$870,000	$450,000
Thickening/Dewatering Building	$300,000	$300,000	$300,000
Yard Piping/Sitework	$38,000	$59,000	$38,000
Electrical and Instrumentation	$113,000	$176,000	$113,000
Solids Dewatering Subtotal	**$901,000**	**$1,405,000**	**$901,000**
Estimating Contingencies (20%)	$23,000	$35,000	$23,000
Subtotal Construction Cost 2006	$924,000	$1,440,000	$924,000
Engineering/Admin/Legal (35%)	$323,000	$504,000	$323,000
Total Project Cost	**$1,247,000**	**$1,944,000**	**$1,247,000**

Note:
1. Cost includes support equipment such as polymer feed system and conveyor.

7.8.4.1 Sludge Drying Bed Requirements for TFSC

If the WWTP continues to operate using TFSC, at build-out conditions, approximately 1,049,000 lbs. of dry, digested sludge will need to be applied to the drying beds annually. Based on the current drying bed area, the solids loading rate will be 17 lbs. dry sludge/ft^2-year. Since this loading rate is less than the recommended and design loading rates for the sludge drying beds, no additional beds would be required during the WWTP upgrade.

7.8.4.2 Sludge Drying Bed Requirements for Extended Aeration

If the secondary treatment process at the WWTP is modified to EAAS, a greater amount of sludge production is expected at the facility. Based on the parameters used to project sludge production figures for EAAS 1,666,000 lbs. of dry sludge annually at build-out after digestion. This results in a solids loading rate of 19 lbs. dry sludge/ft^2-year, which is within the design and recommended solids loading range for digested WAS. The existing 12 beds at the WWTP will be sufficient to handle the sludge produced at build-out conditions from EAAS treatment.

The possibility also exists to dewater and apply undigested solids produced from EAAS directly to the drying beds. Since these solids have not been digested and a significant amount of volatile suspended solids still exist, a greater quantity of sludge will be applied to the beds. Using an EAAS treatment process without anaerobic digestion, the WWTP will

produce 1,752,000 lbs. of dry sludge at build-out. This would result in a solids loading rate of 28 lbs. dry sludge/ft^2-year. While this solids loading rate is greater than the design criteria used in the 1984 WWTP upgrade, it is only slightly above the range recommended by Metcalf and Eddy of 18 to 25 lbs. dry sludge/ft^2-year (2003). Although this option exists, it will not be included in the detailed costing analysis. Because of the WWTPs proximity to residential development, it is the opinion of Carollo that undigested sludge should not be applied to the beds due to odor and vecter concerns.

The solids loading rates and number of solar drying beds needed at the WWTP at build-out conditions are summarized in Table 7.10.

Table 7.10 Solar Drying Beds Design Criteria
WWTP Facility Master Plan
MBCSD

	Value		
	TFSC	Extended Aeration	
Criteria	Digested	Digested	Undigested
Dry solids production (lbs/year)	1,049,000	1,166,000	1,752,000
No. of beds	12	12	12
Total area of beds (ft^2)	62,208	62,208	62,208
Solids loading rate (lbs/ft^2-year)[1]	17	19	28

Note:
1. Suggested solids loading rates 18-25 lbs/ft^2-year (Metcalf & Eddy 2003).

7.8.5 Heat Drying

While heat drying was described above as an alternative for the production of Class A biosolids, the decision has been made by Carollo, with direction from City staff, to eliminate it from the list of future treatment recommendations. The land application of biosolids is currently governed in San Luis Obispo County by a temporary ordinance that restricts the amount of Class A biosolids that can be land applied. One caveat of this ordinance is that composted biosolids are exempt from this limitation. Therefore, based on the local uncertainties associated with the fate of the land application of Class A biosolids in the County, including heat drying as a recommendation for long-term biosolids management would pose a significant risk for the MBCSD.

7.8.6 Composting

Composting represents the most promising method for onsite production of Class A biosolids for the MBCSD at this time. Since 2002, biosolids have been used to produce EQ composted biosolids that meet Class A pathogen reduction requirements as defined in the EPA 40 CFR 503 regulations. For this analysis, the assumption has been made that composting will continue to be done using windrows, which is the method already being

used at the WWTP. Photo No. 7.2 shows a window being constructed from biosolids and green waste in a sludge drying bed at the WWTP site. While the ability to produce high quality compost has been demonstrated by the ongoing pilot project, one apparent obstacle to the full-scale composting of all the biosolids produced at the WWTP is the existing space constraints. A detailed discussion of the different aspects of a large-scale composting operation on the plant site will be given below along with an estimate of the necessary equipment and site improvement costs.

Photo 7.2

7.8.6.1 Space Requirements

MBCSD currently works with windrows in the existing sludge drying beds at the WWTP. A single windrow is capable of converting approximately 30 yd^3 of digested biosolids at a time to an EQ Class A product. In order to expand the current composting program onsite, additional space will be needed. Based on the current layout of the site and the uncertainties associated with future treatment facilities, this space will most likely need to expand outside of the existing footprint of the WWTP to accommodate a larger composting operation. An area to the east of the existing site has been identified by WWTP staff as a potential location for expansion. The area is approximately 150 by 250 feet and is jointly-owned by the MBCSD. It is currently being leased for use by a third-party.

Table 7.11 summarizes the design criteria used to analyze a full-scale composting operation at the WWTP including the expected biosolids production and number of windrows needed. Based on current practices, the composting process takes approximately 16 weeks to complete. Therefore, it is possible for the MBCSD to complete two rounds of composting annually, while avoiding the wettest periods during the year that make sludge handling and composting difficult for WWTP staff. In order to accommodate the total number of windrows that must be constructed at one time, a composting staging area would need to be constructed in the new area identified previously that is approximately 220 feet by 120 feet. The staging area would be lined with 10-inch concrete and include drainage that would carry any leachate back to the headworks of the WWTP. With this additional area, the MBCSD would be able to compost a total of 12 windrows a year in the composting area, with the ability to compost additional windrows in available sludge drying beds. This area would also provide for green waste and biosolids storage. The costs associated with the construction of a new compost staging area are summarized in Table 7.12.

Table 7.11 Composting Design Criteria WWTP Facility Master Plan MBCSD		
	Value	
Criteria	TFSC	EAAS
Solar dried solids production (yd^3/year)	606	673
Volume ratio (green waste: biosolids)	5:1	5:1
Green waste requirements (yd^3/year)	3,000	3,400
Windrow Volume (yd^3)	407	407
No. of Windrows	9	10

Table 7.12 Composting Cost Estimate WWTP Facility Master Plan MBCSD	
Components	Estimated Costs
Front End Loader	$70,000
Turner	$50,000
Screen	$30,000
10-in. Concrete Slab (815 yd^3 * $269.21/$yd^3$)	$223,000
Yard Piping/Sitework	$11,000
Composting Subtotal	**$384,000**
Estimating Contingencies (20%)	$77,000
Subtotal Construction Cost 2006	$461,000
Engineering/Admin/Legal (35%)	$161,000
Total Project Cost	**$622,000**

7.8.6.2 Equipment Requirements

In addition to the new space and facilities needed at the WWTP to accommodate a full-scale composting operation, the MBCSD will also need to purchase equipment to construct windrows and condition the finished compost. The WWTP staff currently constructs and turns windrows using a front end loader that is owned by the City. While this equipment has been adequate to maintain a few windrows a year onsite, the MBCSD should purchase its own front end loader if the decision is made to expand the current composting operation.

In addition to a new front end loader, a new turner is needed to more efficiently handle the number of windrows that must be used to further stabilize the total volume of biosolids produced at the plant annually. The benefits of using a turner for windrow turning instead of

a normal front end loader are twofold. The turner will reduce the time needed to turn the windrows, and allow a single full-time operator to handle all aspects of the composting operation. It will also reduce the amount of space needed between windrows. Under the MBCSD's current composting practice, only a single windrow can be constructed in a sludge drying bed due to the space requirements of the front end loader. Placing the windrows in closer proximity to each other will reduce the amount of area that must be concrete lined for a new compost staging area, and maximize the available space in the sludge drying beds.

In addition to a new front end loader and turner, the MBCSD would also need a screen to improve the quality of the composted final product. Screening the compost will produce a higher quality product that will be more attractive for local reuse. A portion of the green waste added during the composting process will also be removed by the screens and can be used in the construction of additional windrows. Photo No. 7.3 shows a windrow of completed compost and green waste storage. The capital and project costs associated with the expansion of the composting process are summarized in Table 7.11.

In order to improve the efficiency of the current composting process before upgrade to the WWTP, it is recommended that the MBCSD purchase a front end loader, turner, and screen in the near term.

Photo No. 7.3

7.8.7 Storage

The MBCSD currently has approximately 3,150 square feet of stockpile area onsite capable of storing the total current annual production of biosolids. As is the case with the drying beds, the stockpile area is paved in order to prevent groundwater infiltration. The biosolids are transferred from the drying beds to the stockpile one to three times per year, depending on the operating demand. Front end loaders are used to complete this transfer. It should be noted that the biosolids already meet the Class B pathogen requirements via the 90-day air-drying in the sludge beds. Therefore, the lengthy stockpiling is not necessary from a treatment standpoint, although it is advantageous as a storage mechanism until San Joaquin Composting is ready to receive the product or additional windrows are constructed.

At this point in the planning process, it is difficult to determine the amount of area necessary or available for the storage of biosolids and/or green waste for composting. Following the selection of a treatment alternative for the wastewater stream and biosolids, the configuration of the plant site will be clearer, and potential storage areas can be more accurately assessed. Based on Carollo's experience however, the WWTP will most likely need an area that is the size of one existing drying bed to store additional biosolids.

7.8.8 Hauling

Four options were analyzed to determine potential solids disposal costs for the MBCSD at build-out conditions. These options are based on the type of secondary treatment that will be implemented at the plant in the future and the solids concentration of the sludge that will be disposed of offsite. Hauling and handling information and costs were obtained from Gary Bruggeman at San Joaquin Composting for both a Class B and sub-Class B product in August 2006. Below is a description of the costs associated with both TFSC and EAAS.

7.8.8.1 Hauling of TFSC Biosolids

As mentioned previously, any biosolids produced from the existing TFSC must first be anaerobically digested before they are hauled or applied to the existing sludge drying beds at the plant site. Since these biosolids will be digested before hauling, the biosolids will be considered Class B quality and the tipping fee for San Joaquin Composting will remain at $21.00 per ton. With a transportation cost of $20.00 per ton, the total hauling cost for TFSC is $41.00 per ton. For the TFSC scenario, the difference in hauling is the result of the solids concentration of the sludge. For the purpose of this analysis, it is assumed the MBCSD will have the option to either mechanically dewater the biosolids or fully dry them in a bed before disposal in the future. The costs associated with each option are summarized in Table 7.13.

7.8.8.2 Hauling of Extended Aeration Biosolids

One of the benefits of the use of an EAAS process is that solids stabilization is not a necessary component of treatment prior to disposal. However, the production of biosolids that do not meet the requirements for Class B results in an increase in the tipping fee charged by San Joaquin Composting and there is an increased volume of sludge. Since the product is sub-Class B, it cannot be directly land applied to McCarthy Farms or other permitted location and must first be composted at San Joaquin Composting's facility. For this reason, the tipping fee for undigested biosolids is $25.00 per ton. Since undigested biosolids, which are solar dried for at least 90 days meet Class B requirements, only undigested biosolids that are dewatered are considered sub-Class B for the purpose of this analysis. A summary for the disposal of biosolids produced in an EAAS process both with and without anaerobic digestion is presented in Table 7.13.

7.9 RECOMMENDED ALTERNATIVES

The following recommendations have been developed using the processes described in the previous section of this chapter. Although the treatment alternative for upgrade of the WWTP will be EAAS, several recommendations have been made for both TFSC and EAAS.

All of the options discussed below, with the exception of Option 6, produce at least a Class B biosolids product, and can be expanded in the future to produce Class A biosolids with the addition of a large-scale composting practice. Option 6 relies on San Joaquin Composting to further process the biosolids to a Class A or B product, as they desire.

Table 7.13 Summary of Estimated Biosolids Disposal Costs
WWTP Facility Master Plan
MBCSD

	Solids Concentration			
	Dewatered (18%)		Solar Dried (80%)	
Condition	**Solids Production (tons/year)**	**Estimated Cost**	**Solids Production (tons/year)**	**Estimated Cost**
TFSC[1]	2,600	$110,000	660	$28,000
Extended Aeration (Digested)[1]	2,900	$122,000	730	$31,000
Extended Aeration (Undigested)[2]	4,400	$202,000	1,100	$46,000

Notes:
1. Cost to haul Class B biosolids is $21/ton and $21/ton for tipping fee.
2. Cost to haul dewatered, undigested biosolids is $21/ton and $25 /ton for tipping fee.

7.9.1 Option 1 - TFSC (with Composting)

This option incorporates secondary treatment using the existing TFSC process, anaerobic digestion, dewatering, solar drying, and onsite composting as outlined below and depicted in Figure 7.1.

H:\Client\MBCSD_FNO\7087B00\Graphics\FIG5-1

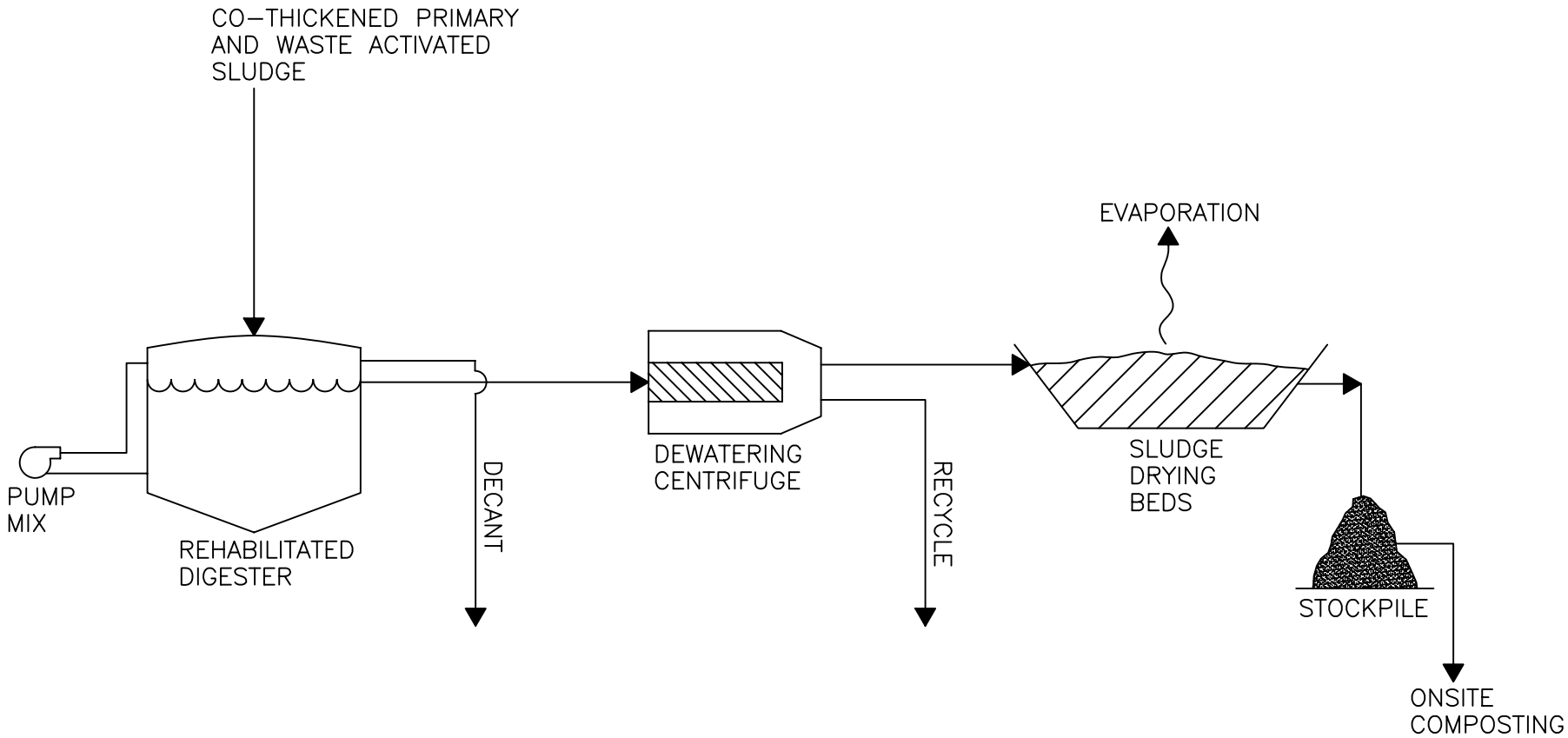


Figure 7.1

BIOSOLIDS SCHEMATIC

OPTION 1-TFSC (WITH COMPOSTING)

WWTP FACILITY MASTER PLAN

MBCSD

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- Digested No. 1 will be retired and demolished.
- Digesters No. 2 and 3 will be rehabilitated and converted to pump mix.
- Co-thickened WAS and primary sludge will be pumped from the primary clarifiers to Digester No. 2 or 3 for anaerobic digestion.
- Two 35 gpm capacity centrifuges will be used to dewater the digested sludge before it is applied to the existing sludge drying beds.
- After solar drying, the sludge will be combined with green waste and formed into windrows on a new concrete-lined composting site and in vacant sludge drying beds.

Support facilities include a structure to house the centrifuges, chemical feed, conveyors, control, electrical, and other equipment. A new concrete pad to accommodate the expanded composting process onsite is also included in this option.

The cost estimate and 20-year PV analysis are located in Appendix I. An example of PV calculations for operations and maintenance costs are located in Appendix J. A summary of the estimated costs for the alternative is shown below in Table 7.14.

Table 7.14 Option 1 - TFSC (with Composting) Biosolids Disposal Estimated 20-Year Present Value
WWTP Facility Master Plan
MBCSD

Description	20-Year Present Value
Project Cost	$6,001,000
Operation and Maintenance (20-Year PV)	$3,652,000
Estimated Total Present Value	$9,653,000

7.9.2 Option 2 - TFSC (with Sludge Drying Beds)

This option incorporates secondary treatment using the existing TFSC process, anaerobic digestion, dewatering, solar drying, and offsite land disposal by San Joaquin Composting as outlined below and depicted in Figure 7.2:

- Digested No. 1 will be retired and demolished.
- Digesters No. 2 and 3 will be rehabilitated and converted to pump mix.
- Co-thickened WAS and primary sludge will be pumped from the primary clarifiers to Digester No. 2 or 3 for anaerobic digestion.
- Two 35 gpm capacity centrifuges will be used to dewater the digested sludge before it is applied to the existing sludge drying beds.
- After solar drying, the final product will be hauled offsite by San Joaquin Composting for further treatment or direct land application.

H:\Client\MBCSD_FNO\7087B00\Graphics\FIG5-2

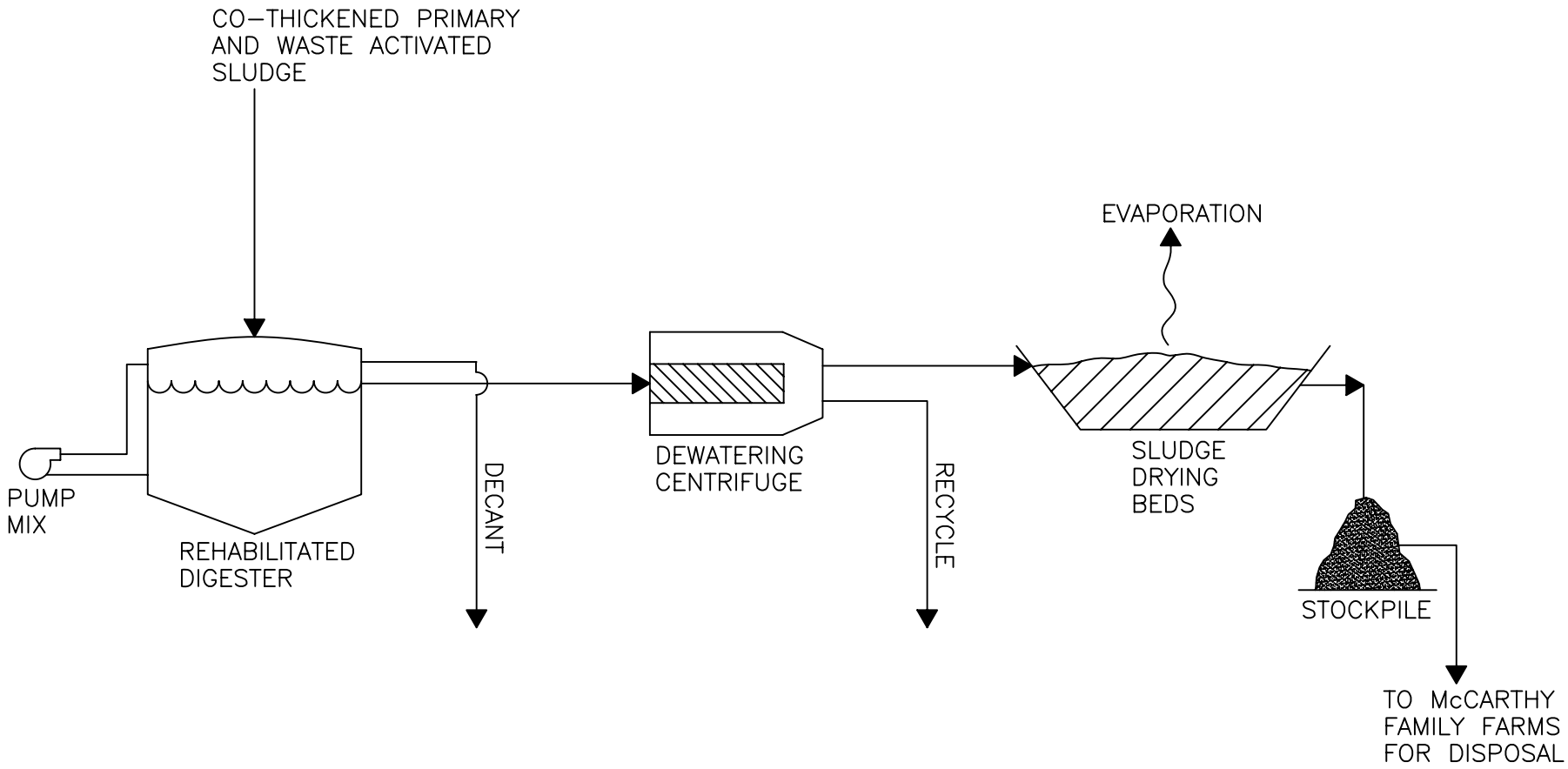

Figure 7.2

BIOSOLIDS SCHEMATIC

OPTION 2-TFSC (WITH SLUDGE DRYING BEDS)

WWTP FACILITY MASTER PLAN

MBCSD

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- Support facilities include a structure to house the centrifuges, chemical feed, conveyors, control, electrical, and other equipment.

A summary of the estimated costs for the alternative is shown in Table 7.15.

Table 7.15 Option 2 - TFSC (with Sludge Beds) Biosolids Disposal Estimated 20-Year Present Value
WWTP Facility Master Plan
MBCSD

Description	20-Year Present Value
Project Cost	$5,219,000
Operation and Maintenance (20-Year PV)	$3,104,000
Estimated Total Present Value	$8,323,000

7.9.3 Option 3 - TFSC (with Direct Haul)

This option incorporates secondary treatment using the existing TFSC process, anaerobic digestion, dewatering, and offsite land disposal by San Joaquin Composting as outlined below and depicted in Figure 7.3.

- Digested No. 1 will be retired and demolished.
- Digesters No. 2 and 3 will be rehabilitated and converted to pump mix.
- Co-thickened WAS and primary sludge will be pumped from the primary clarifiers to Digester No. 2 or 3 for anaerobic digestion.
- Two 35 gpm capacity centrifuges will be used to dewater the digested sludge to an acceptable solids concentration for immediate handling and disposal.
- After dewatering, the wet sludge will be stored in bins or containers for hauling by San Joaquin Composting for further treatment.
- Support facilities include a structure to house the centrifuges, chemical feed, conveyors, control, electrical, and other equipment.

A summary of the estimated costs for the alternative is shown below in Table 7.16.

Table 7.16 Option 3 - TFSC (with Direct Haul) Biosolids Disposal Estimated 20-Year Present Value
WWTP Facility Master Plan
MBCSD

Description	20-Year Present Value
Project Cost	$5,219,000
Operation and Maintenance (20-Year PV)	$4,287,000
Estimated Total Present Value	$9,506,000

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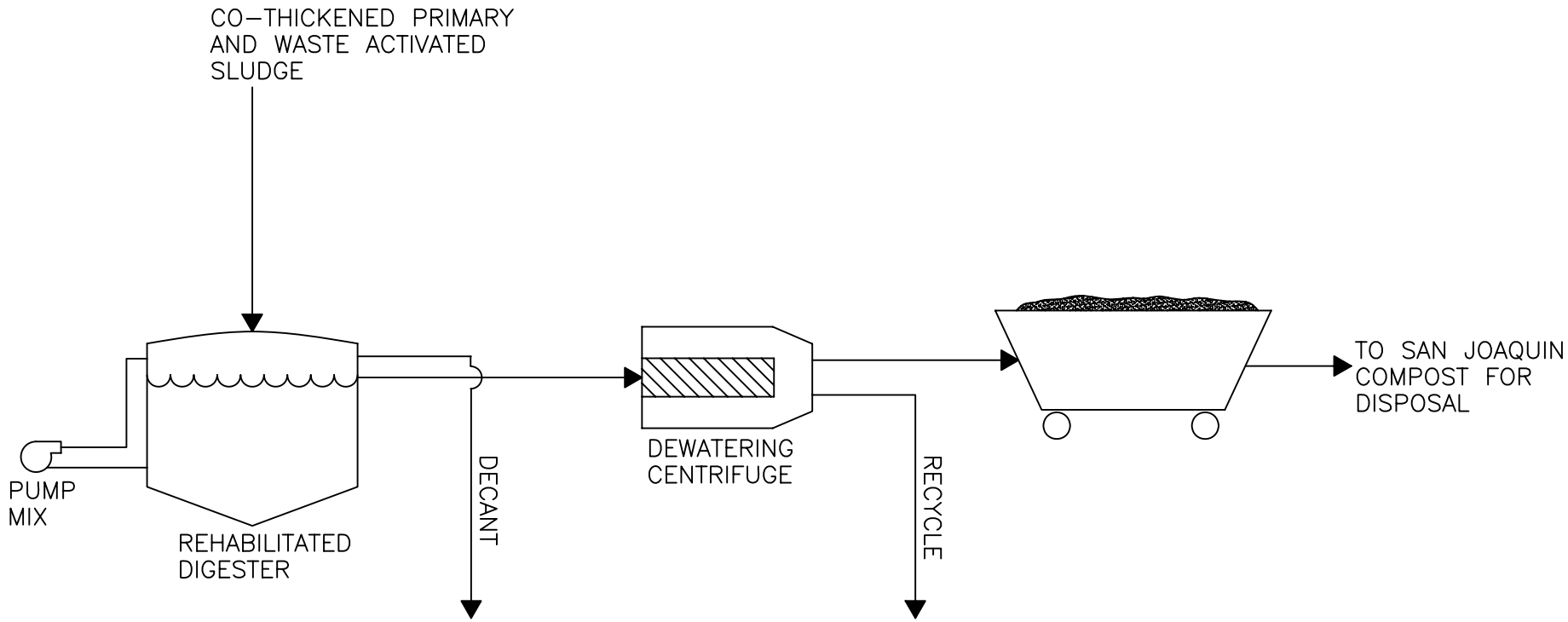

Figure 7.3

BIOSOLIDS SCHEMATIC

OPTION 3-TFSC (WITH DIRECT HAUL)

WWTP FACILITY MASTER PLAN

MBCSD

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7.9.4 Option 4 - EAAS (with Composting)

This option incorporates secondary treatment using an EAAS process, thickening, anaerobic digestion, dewatering, and onsite composting as outlined below and depicted in Figure 7.4.

- One, 1-M gravity belt thickener will be provided to thicken WAS prior to anaerobic digestion.
- Digester No. 1 will be retired and demolished.
- Digesters No. 2 and 3 will be rehabilitated and converted to pump mix.
- Two 35 gpm capacity centrifuges will be used to dewater the digested sludge before it is applied to the existing sludge drying beds.
- After solar drying, the sludge will be combined with green waste and formed into windrows on a new concrete-lined composting site.
- Support facilities include a structure to house the GBT and centrifuges, chemical feed, conveyors, control, electrical, and other equipment. A new concrete pad to accommodate the expanded composting process onsite is also included in this option.

A summary of the estimated costs for the alternative is shown below in Table 7.17.

Table 7.17 Option 4 - EAAS (with Composting) Biosolids Disposal Estimated 20-Year Present Value
WWTP Facility Master Plan
MBCSD

Description	20-Year Present Value
Project Cost	$6,268,000
Operation and Maintenance (20-Year PV)	$3,970,000
Estimated total Present Value	$9,768,000

H:\Client\MBCSD_FNO\7087B00\Graphics\FIG5-4

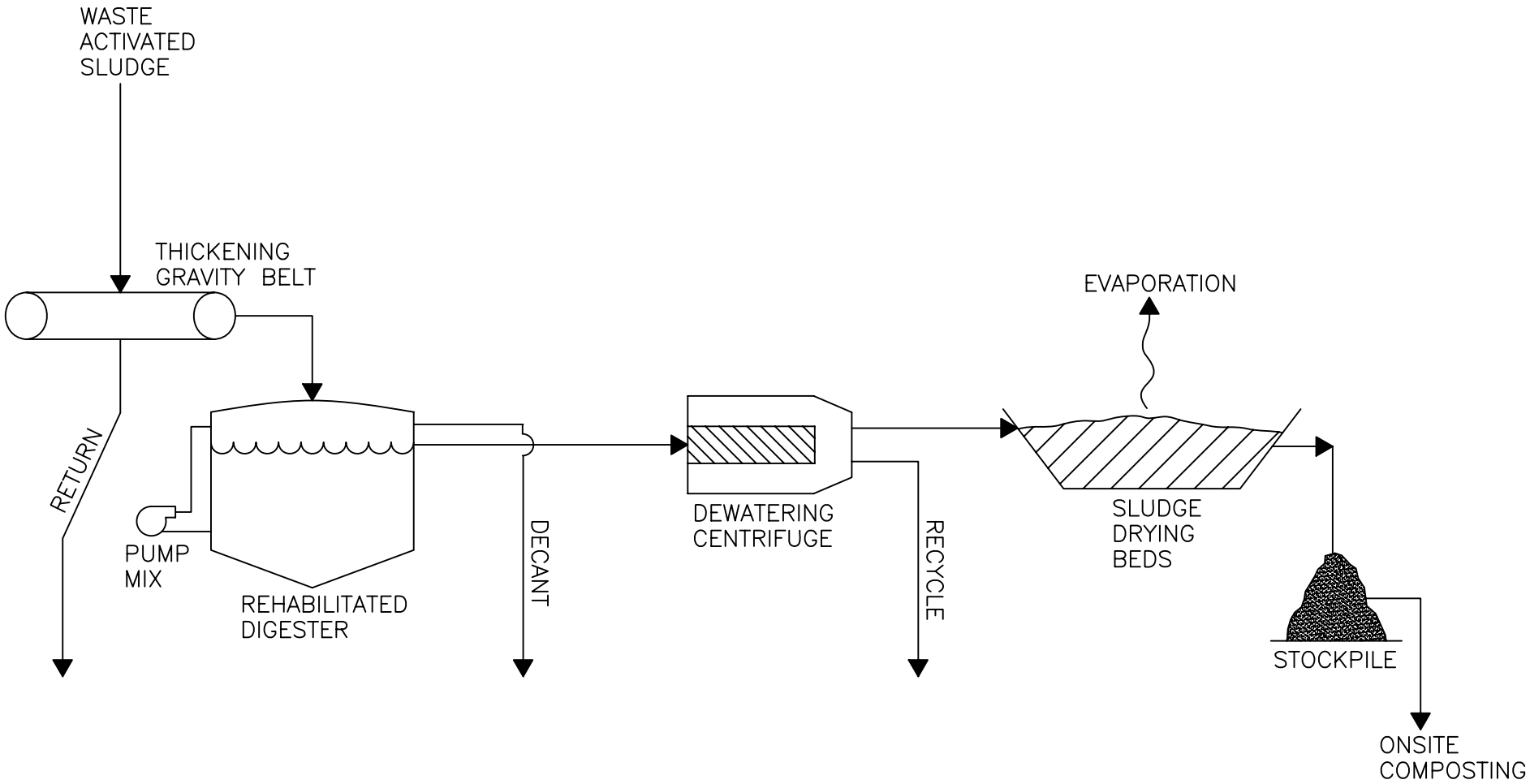

Figure 7.4

BIOSOLIDS SCHEMATIC

OPTION 4– EXTENDED AERATION (WITH COMPOSTING)

WWTP FACILITY MASTER PLAN

MBCSD

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7.9.5 Option 5 - EAAS (with Sludge Drying Beds)

This option incorporates secondary treatment using an EAAS process, thickening, anaerobic digestion, dewatering, and offsite land disposal by San Joaquin Composting as outlined below and depicted in Figure 7.5.

- One, 1-M gravity belt thickener will be provided to thicken WAS prior to anaerobic digestion.
- Digester No. 1 will be retired and demolished.
- Digesters No. 2 and 3 will be rehabilitated and converted to pump mix.
- Two 35 gpm capacity centrifuges will be used to dewater the digested sludge before it is applied to the existing sludge drying beds.
- After solar drying, the final product will be hauled offsite by San Joaquin Composting for further treatment or direct land application.
- Support facilities include a structure to house the GBT and centrifuges, chemical feed, conveyors, control, electrical, and other equipment.

A summary of the estimated costs for the alternative is shown below in Table 7.18.

Table 7.18 Option 5 - EAAS (with Sludge Beds) Biosolids Disposal Estimated 20-Year Present Value
WWTP Facility Master Plan
MBCSD

Description	20-Year Present Value
Project Cost	$5,486,000
Operation and Maintenance (20-Year PV)	$3,464,000
Estimated Total Present Value	$8,950,000

7.9.6 Option 6 - EAAS (with Direct Haul)

As mentioned previously, Option 6 results in a biosolids product that does not meet the pathogen reduction requirements for Class B biosolids outlined in EPA 40 CFR 503 regulations. In order to meet the Class B requirements, the sludge must be either stabilized using a process such as anaerobic digestion or dried in a solar drying bed for 90 days or more, and Option 6 does not include the full rehabilitation of the digesters or the use of the existing sludge beds. Rather, this option includes secondary treatment with EAAS, dewatering with a centrifuge, and direct hauling by San Joaquin Composting.

H:\Client\MBCSD_FNO\7087B00\Graphics\FIG5-5

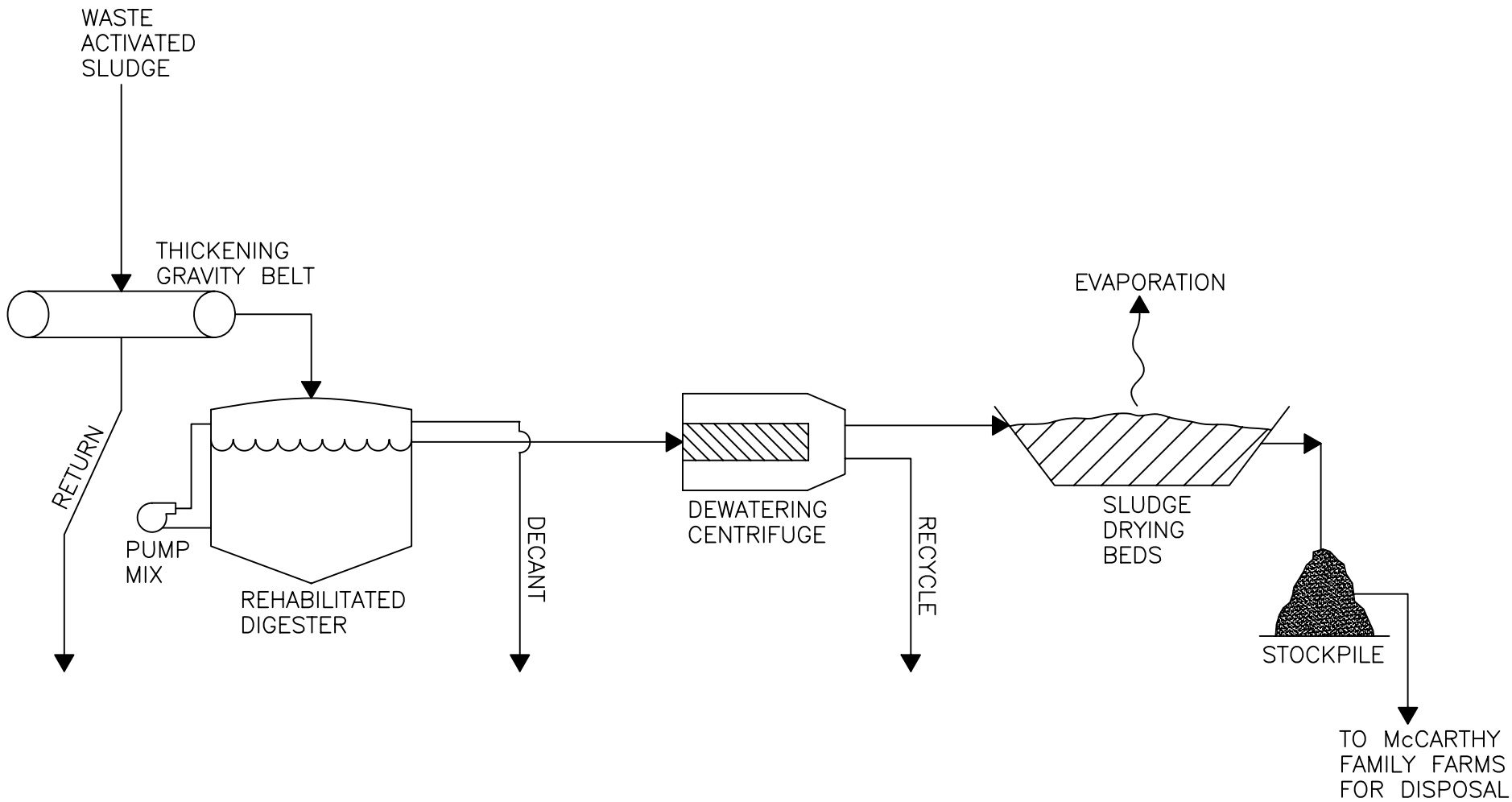

Figure 7.5

BIOSOLIDS SCHEMATIC
OPTION 5– EXTENDED AERATION
(WITH SLUDGE DRYING BEDS)

WWTP FACILITY MASTER PLAN
MBCSD

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- Many facilities that directly waste sludge to a dewatering process utilize an upstream sludge holding tank to ensure a constant flow of sludge to the centrifuges when they are in operation. In order to accomplish this task for the MBCSD WWTP, the newest digester constructed in 1984, Digester No. 3 will be partially rehabilitated to act as a holding tank. The rehabilitation of Digester No. 3 will include the repair of the digester structure, the conversion of the digester to pump mix, and the removal of gas production and existing gas mixing equipment. Digester No. 3 will not longer be heated, produce any appreciable amount of digester gas, or function to stabilize the biosolids. The HRT in this single digester will not satisfy the minimum of 15 days required by the EPA to achieve a Class B biosolids designation. Table 7.19 summarizes the costs associated with this partial digester rehabilitation and the demolition of Digesters No. 1 and 2.

Table 7.19 Partial Digester Rehabilitation
WWTP Facility Master Plan
MBCSD

Parameter	Value[1]
Digester No. 1 Demolition	**$46,000**
Digester No. 2 Demolition	**$51,000**
Dewater, Clean, and Sandblast Digester No. 3	$50,000
Structural Rehabilitation for Digester No. 3	$75,000
Apply Protective Coatings to Interior of Digester No. 3	$150,000
Install new mixing pump Digester No. 3	$32,000
Replace and Install new Pressure/Vacuum Release Valves Digester No. 3	$50,000
Digester No. 3 Rehabilitation	**$357,000**
Allowance for Upgrading Electrical and Lighting Systems	$25,000
Allowance for Piping Replacement	$125,000
Allowance for Removal of Gas Piping	$25,000
Removing Gas Safety and Control Equipment	$25,000
Support Facilities Rehabilitation	**$200,000**
Subtotal	**$654,000**
Unidentified Items Contingency (20 percent)	$131,000
Subtotal Construction Cost 2006[1, 2]	$785,000
Engineering, Administrative, and Legal Costs (35 percent)	$275,000
Total Project Cost 2006	**$1,060,000**

Notes:
1. ENR (20 cities) June 2006 = 7,700
2. Includes Contractor overhead and profit.

The solids treatment process for Option 6 will proceed as detailed below and as depicted in Figure 7.6.

- Digester No. 1 will be retired and demolished.
- Digester No. 2 will be retired and demolished.
- Digester No. 3 will be partially rehabilitated and converted to pump mix, and will act as a sludge holding tank upstream of the dewatering process.
- Two 100 gpm capacity centrifuges will be used to dewater the undigested sludge before it is loaded into bins or containers for offsite disposal.
- After dewatering, the wet sludge will be loaded into bins and hauled by San Joaquin Composting for conversion to a Class A or B product before it is land applied.
- Support facilities include a structure to house the centrifuges, chemical feed, conveyors, control, electrical, and other equipment.

A summary of the estimated costs for the alternative is shown below in Table 7.20.

Table 7.20 Option 6 - EAAS (with Direct Haul) Estimated 20-Year Value WWTP Facility Master Plan MBCSD

Description	20-Year Net Present Value
Project Cost	$3,488,000
Operation and Maintenance (20-Year PV)	$5,125,000
Estimated Total Present Value	$8,613,000

7.9.7 Conclusion

The 20-year PV for the options that were analyzed are summarized in Table 7.21. The 20-year PV analysis revealed that Option 6, EAAS without anaerobic digestion and sludge drying beds has the lowest 20-year PV. It is apparent that Option 6 is the most cost effective of the options because it does not include the full rehabilitation of Digesters No. 2 and 3, which represents $3,100,000 in capital costs.

It should be noted that the above costs are considered planning level and are preliminary in nature. The actual capital, operating, and present worth costs will depend on many factors including the construction and manufacturing climate at the time of construction. Furthermore, the cost of power, chemicals, and the labor industry is continually changing and these costs will fluctuate during the life of the project.

H:\Client\MBCSD_FNO\7087B00\Graphics\FIG5-6

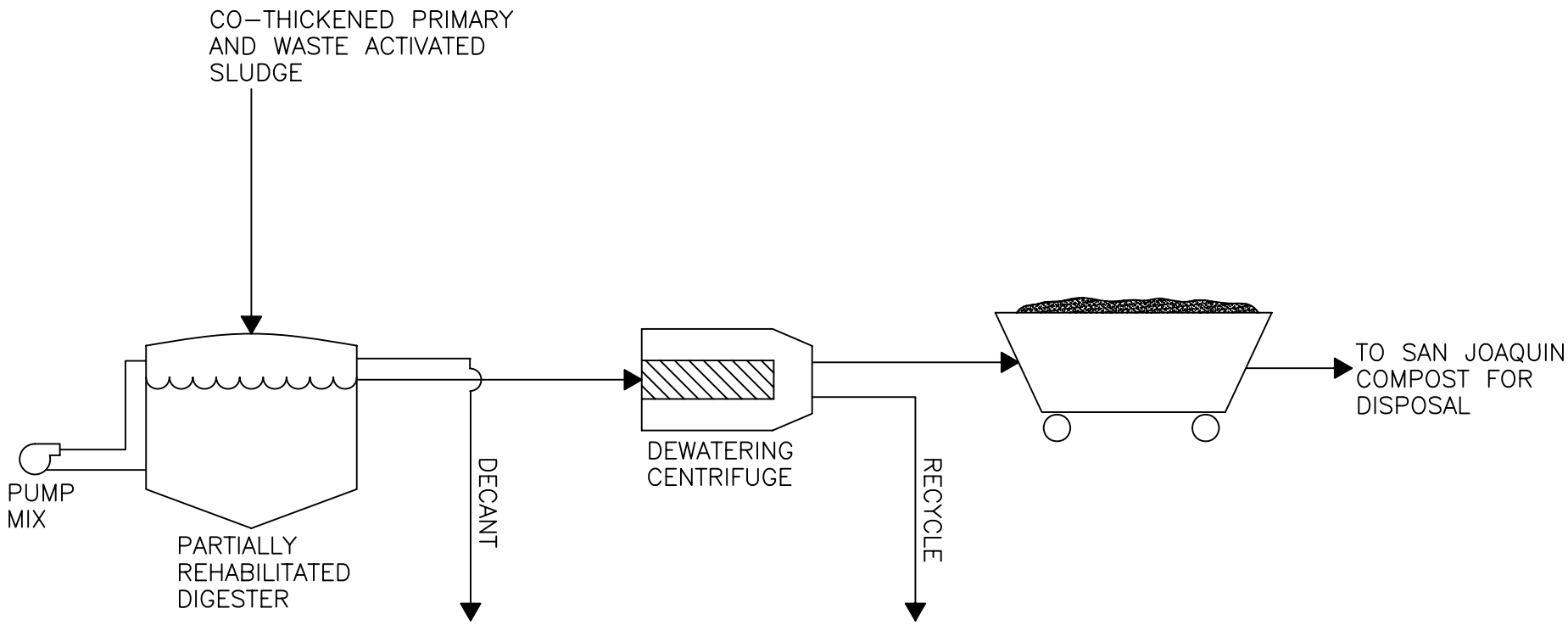

Figure 7.6

BIOSOLIDS SCHEMATIC
OPTION 6- EXTENDED AERATION
(WITH DIRECT HAUL)

WWTP FACILITY MASTER PLAN
MBCSD

carollo engineers

At this point in the planning process, it is difficult to give a single recommendation for a long-term biosolids management plan. After the selection of a treatment process for the wastewater stream is complete, the solids treatment options can be immediately reduced to only those for TFSC or EAAS. Rather, the goal of this analysis is to inform the MBCSD and present a range for the possible costs associated with solids treatment for the WWTP when it reaches build-out capacity. Since the difference in cost between the competing scenarios is relatively small, the ultimate recommendation may be a combination of several options that have been presented. For example, rather than implement full-scale composting at the MBCSD WWTP site, staff may continue to compost a portion of their biosolids and haul the remaining biosolids offsite for further treatment. The amount of biosolids composted onsite would depend on the available space in the existing sludge drying beds, the quantity of green waste onsite and available man hours.

Table 7.21 Summary of Estimated Present Value Costs (20 Years)
WWTP Facility Master Plan
MBCSD

			Estimated Costs		
		Classification	**Project**	**O&M Present Value (20-Years)**	**Total Present Value**
Option 1	TFSC - Composting	Class A	$6,001,000	$3,652,000	$9,653,000
Option 2	TFSC - Sludge Beds	Class B	$5,219,000	$3,104,000	$8,323,000
Option 3	TFSC - No Sludge Beds	Class B	$5,219,000	$4,287,000	$9,506,000
Option 4	EAAS - Composting	Class A	$6,268,000	$3,970,000	$9,768,000
Option 5	EAAS - Sludge Beds	Class B	$5,486,000	$3,464,000	$8,950,000
Option 6	EAAS- Without Digestion	Sub-Class B	$3,488,000	$5,125,000	$8,613,000

ALTERNATIVES ANALYSIS

8.1 SUMMARY

Based on an evaluation of the current facility done by Carollo Engineers, P.C. (Carollo) as a part of the alternatives analysis process, the secondary treatment capacity of the existing wastewater treatment plant (WWTP) was found to be approximately 0.5 million gallons per day (mgd). This reduced capacity can be attributed to the effluent requirements used to evaluate the facility and the increased strength of the wastewater entering the plant. The effluent requirements used to evaluate the WWTP include both a five-day biochemical oxygen demand (BOD_5) and total suspended solids (TSS) concentration of 20 milligrams per liter (mg/L). The concentrations of both BOD_5 and TSS currently entering the WWTP are significantly higher than the design criteria used to design the last expansion of the WWTP.

The treatment alternatives evaluated for this report can be divided into two categories. The first category includes improvements to the WWTP that would continue the current use of trickling filters and solids contact basins to produce an effluent that will meet full secondary requirements without the current modified permit. The second category includes both secondary and tertiary treatment alternatives that represent processes that are different from those currently used at the WWTP. These alternatives include the demolition of the existing TFSC basins following construction of the new secondary or tertiary treatment facilities.

Only the headworks and components of the secondary and/or tertiary facilities have been included in order to develop an accurate comparison between the alternatives. Parts of the complete WWTP upgrade that have been excluded from this analysis are the new disinfection and solids handling facilities. All components of the upgrade are combined in Chapter 9 (Recommendations) of this report.

A detailed comparison of Alternative No. 3 (Membrane Bioreactors) and No. 4 (Extended Aeration Activated Sludge/Filtration) is first presented. The criteria used to compare these alternatives include costs, regulatory compliance, and operational factors.

The cost components evaluated for these alternatives include construction, operations, maintenance, and present value (PV) costs. The PV cost represents the cost in today's dollars for the construction of the WWTP upgrades as well as operations and maintenance costs for a 20-year period. Based on the initial planning done for these alternatives, the total project costs for a membrane bioreactor (MBR) and extended aeration activated sludge/filtration (EAAS/Filtration) are $23.6 and $15.6 million respectively. These project costs are in June 2006 dollars, and include contingencies and fees for administration, engineering, and legal.

A MBR is an advanced technology that provides an effluent of higher quality than the activated sludge/filtration option. While both provide tertiary treatment as required for unrestricted reuse, a MBR may have the added benefit of removing a wider array of pathogens and emerging contaminants such as personal care products and pesticides. The benefits of both options will be discussed in this report.

One important aspect of the EAAS/Filtration process is that the amount tertiary effluent that is produced can be tailored to fit the needs of the City of Morro Bay (City) and Cayucos Sanitary District (CSD). With this option, filters can be initially installed to receive only a portion of the daily flow. Units can be easily added in the future to increase the tertiary capacity of the facility.

The two secondary alternatives that have been evaluated for upgrade of the Morro Bay Cayucos Sanitary District (MBCSD) WWTP are also compared in this report. A detailed comparison of Alternative No. 1 (Trickling Filter/Solids Contact) and No. 2 (Extended Aeration Activated Sludge) is included. The Trickling Filter/Solids Contact (TFSC) alternative is the process currently used at the MBCSD WWTP.

The EAAS process evaluated in this chapter is an oxidation ditch that is very similar to what was recently designed by Carollo for the City of Pismo Beach and the California Men's Colony in the City of San Luis Obispo. Alternative No. 2 is also the same as Alternative No. 4 (EAAS/Filtration) without the inclusion of cloth-media disk filters or any other type of tertiary filtration.

The cost components evaluated for these alternatives include construction, operations, maintenance, and present value costs. Based on the initial planning done for these alternatives, the total project costs for TFSC and EAAS are both $13.2 million. The difference in cost between these two alternatives is less than 1 percent; that is to say, both alternatives have the same cost based on Carollo's cost estimating abilities during the facilities planning process.

Unlike the tertiary options that were previously discussed, both the secondary alternatives will meet the future anticipated regulations, but will not produce an effluent that meets unrestricted reuse under Title 22. They will both meet the secondary treatment standards as presented in the proposed ocean discharge permit. Two levels of secondary treatment are represented with these alternatives. The TFSC process will meet the design criteria of 20 mg/L BOD_5 and TSS, but not significantly better. The EAAS process will treat the wastewater to "advanced" secondary. For example, the effluent quality discharged by the oxidation ditches at the City of Pismo Beach has a BOD_5 and TSS concentration of between 1 and 5 mg/L.

Several operational factors must be considered when comparing the available secondary alternatives for upgrade of the MBCSD WWTP including ease of operation, biosolids

management, and odors. While plant staff is familiar with the TFSC process, oxidation ditches are easier to operate and have fewer associated facilities.

Biosolids management, discussed at length in Chapter 7 (Biosolids Treatment and Disposal), is dependent on the type of secondary treatment method employed at the WWTP in the future. Continued use of trickling filters will require the rehabilitation of the anaerobic digesters. However, the primary and TFSC sludge is slightly easier to digest, and may be more suitable for composting. The economic and non-economic impacts of different secondary treatment options on biosolids management must be considered when deciding on the new treatment processes that will be implemented at the WWTP.

While odor has not been a particular problem for the WWTP up to this point, trickling filters and primary clarifiers are known for their potential odor and vector problems. If trickling filters are incorporated into this phase of expansion, the trickling filters and primary clarifiers may need to be covered in the future at a significant cost to the City and CSD. These costs have not been included in the TFSC alternative.

8.2 SCOPE

The scope of this chapter includes the comparison of viable treatment alternatives for reliable long-term compliance with the current and anticipated future WWTP discharge requirements and 20-year flows and loadings. Initially, several upgrade options were identified for this evaluation, which included full secondary treatment, full tertiary treatment, and full secondary treatment with partial (0.5 mgd) tertiary treatment. When these upgrade options were first developed, the assumption was made that the existing TFSC facilities at the WWTP had the ability to effectively treat 1 mgd to the anticipated secondary waste discharge requirements (WDRs) without the modified permit. Carollo has since found this is not the case.

Based on the current flow conditions at the WWTP, and the design criteria used to evaluate the existing facility, Carollo has found that the existing TFSC treatment capacity, without the modified permit, would be approximately 0.5 mgd. The effluent requirements used to evaluate the WWTP include a BOD_5 and TSS concentration of 20 mg/L. While the anticipated future discharge requirements will be for BOD_5 and TSS concentrations of 30 mg/L, limits that are more conservative are used in the planning and design process to ensure the alternatives presented will consistently meet the future requirements in the permit. The concentrations of both BOD_5 and TSS currently entering the WWTP are also significantly higher than the design criteria used to design the last expansion of the WWTP. For the planning process, BOD_5 and TSS concentrations of 410 mg/L and 420 mg/L respectively, were used. These values were determined in the flows and loadings analysis presented in Chapter 3 of this report.

The partial tertiary option was based on using the existing secondary treatment processes at the WWTP to treat 1 mgd of future flows. Any flows in excess of 1 mgd would be treated

to tertiary standards by newly constructed facilities. Because it would now be required to tertiary treat close to 1 mgd, the full secondary treatment with partial tertiary treatment upgrade option is no longer feasible, and will not be evaluated for the purposes of this report.

Biosolids handling is a vital portion of the overall future upgrades at the WWTP. Several biosolids management options were previously developed in Chapter 7 of this report. The viable sludge handling and disposal options will be combined with the viable secondary or tertiary treatment option, and evaluated in Chapter 9 of this report.

8.3 VIABLE WASTEWATER TREATMENT ALTERNATIVES - TRICKLING FILTERS AND ACTIVATED SLUDGE

This section provides a brief description and comparison of the two secondary treatment processes that are considered for the upgrade to the WWTP. These processes are trickling filters and activated sludge.

The activated sludge process is generally used to produce an effluent with a BOD_5 and a TSS concentration of 20 mg/L or less. Trickling filters are generally designed to produce an effluent BOD_5 and TSS concentration of 40 mg/L. When trickling filters are combined with a short duration activated sludge process, termed TFSC the effluent quality can approach that of an activated sludge plant.

The activated sludge process is a suspended growth system where the microorganisms break down and consume the waste that is suspended in the liquid or mixed liquor. There are many variations in the activated sludge process including standard rate activated sludge, extended aeration, step feed, solids contact, and others.

In addition to better effluent quality, the activated sludge process has several other advantages over trickling filters. With the addition of extended aeration, activated sludge can be easily adapted to reduce the total nitrogen level in the wastewater stream, and has shown to be more effective at treating emerging contaminants. The nitrification/denitrification process produces an effluent with a total nitrogen concentration of less than 10 mg/L. While total nitrogen levels are not regulated by the current WDRs, removing nitrogen may be beneficial in the future, if reuse is pursued. An additional benefit of an EAAS process is its potential to remove emerging contaminants. Recently emerging contaminants such as pharmaceuticals and pesticides have been targeted as areas for possible future regulation. Studies have shown that increasing the solids retention time (SRT) increases the degradation of these constituents. These longer retention times can be achieved with both an oxidation ditch or MBR. Adding an oxidation ditch or MBR would position the MBCSD to handle requirements that target these emerging contaminants if they were to arise in the future.

8.4 DESCRIPTION OF TREATMENT ALTERNATIVES

The treatment alternatives considered for the MBCSD WWTP for the next 20 years can be divided into two categories. The first alternative is based upon continuing to use the existing TFSC basin and providing additional capacity to handle the ultimate peak seasonal dry weather flow (PSDWF) of 1.5 mgd. This peak season condition represents the maximum solids and organic loadings experienced at the facility during the months of July and August.

The second category of treatment alternatives examined in this chapter is based on retiring the existing TFSC secondary treatment process, and implementing an activated sludge process. This group of treatment alternatives includes both secondary and tertiary treatment options, and will be sized to adequately handle a PSDWF of 1.5 mgd. Because of the similarities in cost with an EAAS/Filtration process, a TFSC/Filtration option was not included in this analysis. However, it can be evaluated at a later time if TFSC remains the secondary treatment practice at the WWTP as part of the upgrade.

In addition to the secondary and tertiary treatment alternatives that will be discussed in this chapter, necessary support facilities common to all treatment alternatives that must be rehabilitated to increase the capacity of the plant to treat flows anticipated in the next 20 years will also be discussed. These facilities will represent part of the total cost for each treatment alternative.

There are four alternatives developed for the MBCSD to consider in order to expand the capacity of the existing wastewater treatment facilities to 1.5 mgd. All four alternatives consider the retention of the existing headworks structure with major upgrades to the existing equipment.

Alternative 1 - Trickling Filter/Solids Contact (TFSC): This alternative includes the installation of additional trickling filters and solids contact basins. Also included as part of this alternative, is the construction of a new primary clarifier and secondary clarifier. In addition to these new facilities, the existing headworks, solids contact basin, Trickling Filter No. 2, secondary clarifier, and Primary Clarifier No. 1 will be rehabilitated. When combined with the rehabilitated facilities, the new TFSC process will have the capacity to treat 1.5 mgd to full secondary treatment standards.

Alternative 2 - Extended Aeration Activated Sludge (EAAS): This alternative includes the installation of an extended aeration activated sludge process (oxidation ditch) to treat the entire flow with the retention of the existing headworks. The existing trickling filters, solids contact basin, and primary clarifiers would be retired. Rehabilitation of the existing secondary clarifier and RAS/WAS pump station are presented as part of this alternative.

Alternative 3 - Membrane Bioreactor (MBR): This is the first tertiary treatment option. The alternative includes the installation of an MBR plant with the retention of the existing headworks. The existing secondary clarifier and Primary Clarifier No. 1 would be converted

to equalization basins. Structural rehabilitation of these basins is presented as part of this alternative. This alternative allows for the unrestricted reuse of the plant effluent.

Alternative 4 - Extended Aeration Activated Sludge/Filtration (EAAS/Filtration): This is a second tertiary treatment option. The alternative includes the installation of an EAAS process (oxidation ditch) and cloth-media disk filters with the retention of the existing headworks. The existing trickling filters, solids contact basin, and Primary Clarifier No. 2 would be retired. Rehabilitation of both the existing secondary clarifier and Primary Clarifier No. 1 are presented as part of this alternative. This alternative allows for the unrestricted reuse of all or a portion of the plant effluent.

8.4.1 Alternative No. 1 - TFSC

TFSC is a combination of a traditional trickling filter process followed by a short activated sludge process known as solids contact. The use of the solids contact basin following the trickling filters allows for the production of better quality effluent than with trickling filters alone. The MBCSD WWTP currently utilizes these processes, and this alternative includes adding new trickling filters and solids contact basins to increase the secondary treatment capacity of the WWTP to 1.5 mgd. The new TFSC basins are described in detail below.

While the existing trickling filters currently in operation at the MBCSD WWTP are rock trickling filters, the new trickling filters that will be added as part of this alternative will be high-rate plastic media trickling filters. These trickling filters can accept higher organic loading than conventional rock trickling filters, and include recirculation of the filter effluent to return soluble BOD to the organisms on the media, which improves treatment efficiency. To accommodate this higher organic loading, high rate filters incorporate plastic media. This media varies in depth from 8 feet to over 20 feet. In designing a high rate trickling filter process, the organic and hydraulic loadings are among the important factors that must be considered. The typical design parameters for a high-rate, plastic media filter are presented in Table 8.1.

In order to have an effective trickling filter process, several processes must be in place upstream of the filters. A preliminary treatment process, including bar screens and/or grit removal, is necessary to remove trash and other items from the influent stream before the filter process. Poor removal of rags and debris in the preliminary treatment process can have detrimental effects on the operation of the trickling filter. If not removed, the material will be deposited on the surface of the filter and plug the media and orifices of the trickling filter mechanism.

Table 8.1	**Plastic Media Trickling Filter Typical Design Parameters WWTP Facility Master Plan MBCSD**
Parameter	**Value**
Hydraulic Loading, gal/ft^2/min	0.16 - 0.64
BOD_5 Loading, lbs/1000 ft^3/day	30 - 60
Depth, ft	3 - 6
Recirculation Ratio	1 - 2
Sloughing	Continuous
BOD_5 Removal Efficiency, %	65 - 95
Effluent	Little Nitrification

Primary clarification is also required upstream of the trickling filters to remove settleable solids, trash, and grease, and their excessive organic loading. An increase in organic loading increases the potential for filter media plugging, higher concentration of secondary sludge, and decreased BOD removal efficiency. In addition, if grease and scum are not removed prior to filter absorption, the treatment efficiency of the media is greatly hindered. With the use of primary clarifiers, anaerobic digestion will be required to digest the raw primary sludge. Therefore, if Alternative No. 1 is chosen for the WWTP upgrade, the existing anaerobic digesters and primary clarifiers must be rehabilitated and remain in service.

Table 8.2 lists the advantages and disadvantages to using trickling filters as the secondary treatment process for the MBCSD WWTP.

As mentioned previously, the trickling filters are primarily used to produce an effluent with a BOD_5 and TSS concentration of 40 mg/L. In order to improve the effluent quality produced by the trickling filters at the MBCSD WWTP, a solids contact process will be used following the trickling filters. The solids contact process is a very short hydraulic retention time (HRT) activated sludge process that follows the trickling filter process. Due to the short HRT, the secondary sludge will require additional stabilization before being delivered to the sludge drying beds. With the use of TFSC, the sludge will continue to be stabilized using the existing anaerobic digesters. The costs associated with the rehabilitation of these digesters were discussed in both Chapter 6 and 7 of this report.

Table 8.2 Advantages and Disadvantages of Trickling Filter Process WWTP Facility Master Plan MBCSD	
Advantages	**Disadvantages**
Consistent treatment efficiency.	Recirculation pumps are required to recirculate effluent.
Low operator attention.	Primary clarifiers would be required upstream of the filter process.
Generally lower power costs than an activated sludge process.	Trickling filters are often the source of odor complaints from neighbors.
	Anaerobic digesters are recommended to digest raw primary sludge.

Finally, this process may have difficulty meeting the 20 mg/L BOD_5 effluent concentration without close supervision and operational attention. These operational issues will be considered in the final evaluation of all the treatment alternatives in a later section of this chapter.

8.4.2 Alternative No. 2 - EAAS

This alternative is another secondary treatment option that is being evaluated for the MBCSD. While the TFSC process is a continuation of the existing practice at the WWTP, EAAS would require the retirement of the existing primary clarifiers, trickling filters, and solids contact basin, and the construction of two parallel aeration basins sized to treat the full design flow of 1.5 mgd.

The EAAS process often is accomplished in an oval shaped channel equipped with mechanical aeration devices such as an oxidation ditch. These ditches are being used at the City of Pismo Beach and the California Men's Colony in the City of San Luis Obispo. Pre-screened wastewater enters the aeration basin or reactor, where it is aerated as it circulates around the basin. The extended aeration process is characterized by a long HRT between 15 and 24 hours and a long SRT between 20-30 days. Due to the long HRT and SRT, the process generally is very efficient at nitrifying the ammonia. Depending on the relative locations of wastewater input and removal, sludge return, and the aeration equipment, oxidation ditches can also achieve denitrification. To aid in the denitrification process a mixed non-aerated zone can be easily installed to provide the conditions needed for denitrification. Secondary clarifiers are used in conjunction with the oxidation ditches to provide for separation and return of the mixed liquor suspended solids (MLSS) to the oxidation ditch. Typical design values for the extended aeration process are shown in Table 8.3.

Table 8.3	Extended Aeration Activated Sludge Typical Design Parameters WWTP Facility Master Plan MBCSD
Parameter	**Value**
Hydraulic Retention Time, hrs	18 - 36
BOD_5 Loading, lbs/1000 ft^3/day	10 - 25
Sludge Age, days	20 - 30
MLSS, mg/L	1,500 - 5,000

Some advantages and disadvantages of an extended aeration process are presented in Table 8.4.

Table 8.4	Advantages and Disadvantages of Extended Aeration Process WWTP Facility Master Plan MBCSD
Advantages	**Disadvantages**
The racetrack type design promotes plug flow. BOD_5 removal is typically (greater than 98 percent).	Energy costs are slightly higher than for trickling filters/solids contact.
Recent studies have concluded that the high SRT enhances emerging contaminants removal (hormones, pharmaceuticals, pesticides, etc.)	If Title 22 unrestricted reuse water is required in the future, filtration is needed at an additional cost.
Extended aeration can be easily adapted to provide for nitrification and denitrification.	
Effluent quality is generally very good with BOD_5 less than 10 mg/L and TSS less than 15 mg/L.	
Very easy to operate and maintain.	
Extended aeration is very forgiving and is able to handle shock loadings and wide variations in flows with little impact to the effluent quality.	

As indicated, the oxidation ditch can produce an effluent low in total nitrogen. Although this is currently not an issue with the practice of ocean discharge at the WWTP, it could be valuable once reuse is considered.

8.4.3 Alternative No. 3 - MBR

In addition to the secondary treatment options that have been developed for the MBCSD to consider, several tertiary options have also been developed for this report. In addition to producing an effluent that is capable of meeting the anticipated effluent requirements

without the modified permit, these tertiary processes can also produce an effluent suitable for unrestricted reuse in accordance with Title 22 requirements. Based on where the effluent is reused, additional treatment may be required to remove other constituents such as dissolved solids. The MBR process can also remove other wastewater constituents such as viruses and other pathogens.

MBR technology has gained interest and popularity in the last decade. This wastewater treatment system combines an activated sludge process and solids separation by either low-pressure microfiltration or ultrafiltration membranes. The MBR configuration possesses several advantages over conventional wastewater treatment such as higher effluent quality and reduction in process footprint. The physical separation barrier provided by the membranes is the most effective and reliable treatment mechanism to meet requirements in sensitive environments and is less susceptible to turbidity spikes during process upsets. Conversely, MBR equipment requires fine screening (2-3 mm) upstream to prevent damage to the membranes, a nitrified stream feeding the membranes, and higher skilled maintenance than conventional activated sludge basins.

Membranes use polymeric filtration media with pore sizes in the range of 0.04 (hollow fiber) to 0.4 (flat plate) microns to sieve and separate solids. Unlike a clarifier, which utilizes settling to separate the solids from the liquid, the physical membrane barrier prevents TSS breakthrough, regardless of the characteristics of the mixed liquor. In addition, the membrane pores exclude finer particles, thereby reducing the TSS and turbidity levels in the effluent. The physical separation barrier provided by the membranes can also be an effective treatment mechanism for *Giardia and Cryptosporidium*. Figure 8.1 shows the pore sizes associated with different types of membranes and the sizes of typical wastewater constituents.

The biological side of the process is controlled similarly to conventional activated sludge, where SRT is adjusted to achieve desired removal efficiencies and sludge characteristics.

Historically, MBR systems have been designed for small-scale wastewater treatment applications with less than 5 mgd capacity, but it has become a cost competitive option for larger facilities. Table 8.5 summarizes the benefits and drawbacks of the MBR technology.

As discussed previously, the aeration basins of the MBR can also be modified to produce an effluent low in total nitrogen. Based on the current effluent disposal practice, nitrogen removal is not required at this time. However, there may be benefits to nitrogen removal in the future if the City of CSD chooses to pursue reuse.

In addition to producing an effluent that can be utilized for unrestricted reuse, the MBR process has other potential benefits. One benefit previously mentioned is the ability to remove emerging contaminants. Compared to tertiary filters studies have shown the MBR is better at removing emerging contaminants such as pharmaceuticals and pesticides from the wastewater stream. It should be noted that these compounds are not a problem for the

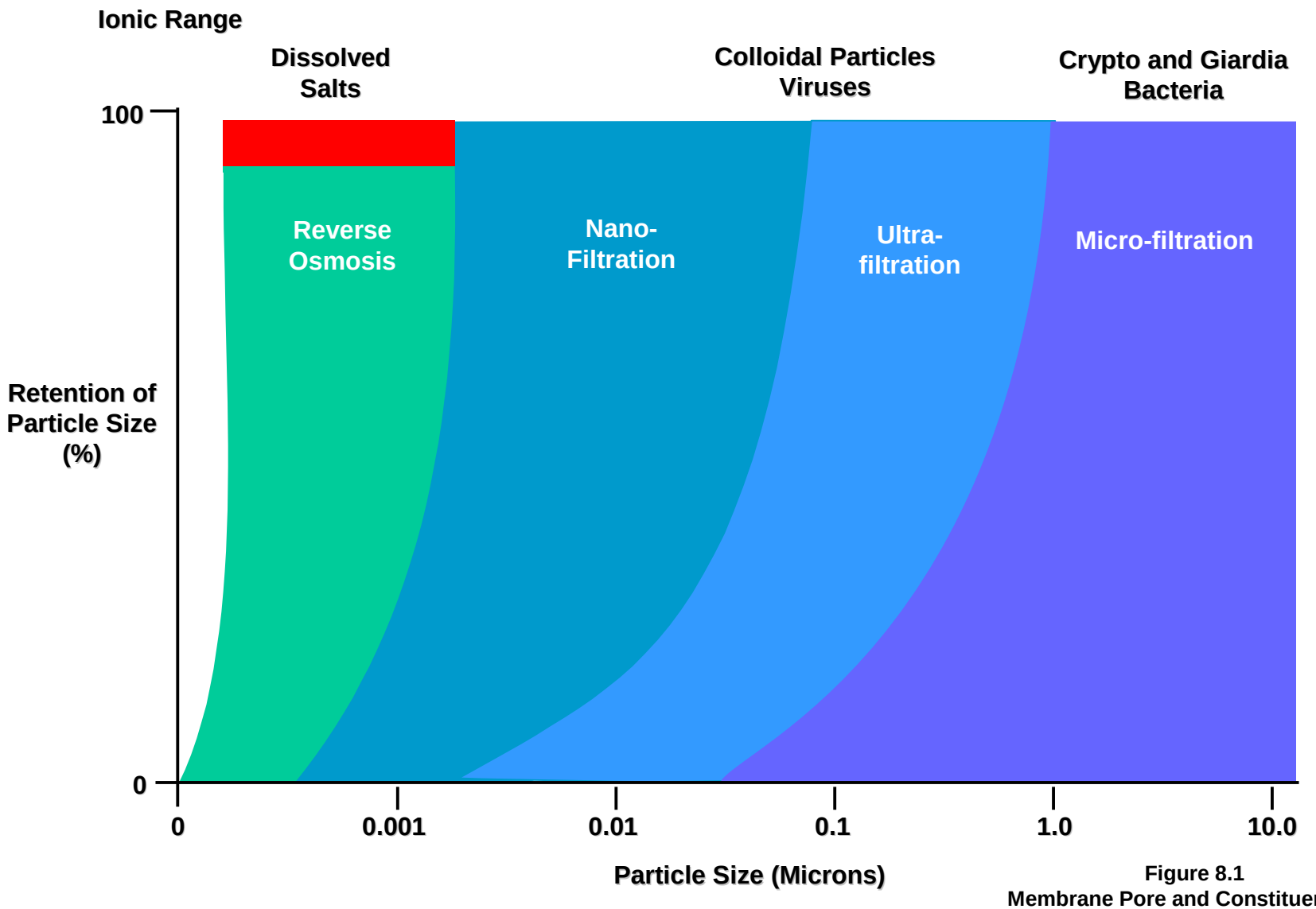

Figure 8.1
Membrane Pore and Constituent Size
WWTP Facility Master Plan
MBCSD

MBSCD or regulated by the current WDRs, but they have recently received attention from the EPA as areas for possible future regulation.

Table 8.5 Advantages and Disadvantages of the MBR Process WWTP Facility Master Plan MBCSD	
Advantages	**Disadvantages**
Eliminates secondary clarifiers.	Requires redundant fine screening.
High mixed liquor suspended solids concentrations and high solids retention time without large aeration volumes resulting in a small footprint.	High power costs. Requires nitrification prior to membranes, resulting in increased aeration.
Automated and flexible operation.	Limited capacity to handle peak flows.
Turbidity as low as 2 NTU and TSS less than 5 mg/L.	Complex and proprietary design.
Requires a lower disinfection dosage as compared to more conventional technologies.	Higher capital costs. Skilled maintenance required.
Will effectively remove additional pathogens from the wastewater stream.	Chemical cleaning required.
Same benefit as EAAS for emerging contaminants removal.	Requires membrane replacement within the 20-year planning period.

8.4.4 Alternative No. 4 - EAAS/Filtration

This alternative is similar to Alternative No. 2 that has been described previously. This alternative is a combination of secondary and tertiary treatment processes. The combination of these processes with disinfection results in an effluent eligible for unrestricted reuse.

This alternative would include secondary treatment with EAAS (oxidation ditches) followed by tertiary filtration. The secondary treatment portion of this alternative would be identical to the process described previously for Alternative No. 2. The tertiary filtration process considered for this alternative has the ability to produce tertiary quality effluent eligible for unrestricted reuse, based on Title 22 regulations, when coupled with an appropriate disinfection process.

Tertiary filtration can be achieved with a variety of technologies, such as continuous backwash (CBW) sand filters, cloth-media disk filters, or deep bed sand filters. For the purposes of this analysis, the cloth-media disk filter was assumed. To determine the preliminary sizing of the filtration system, a filter feed rate of 3 gallons per minute per square foot (gpm/sf) was assumed. If this alternative is selected, a further review of the various tertiary filtration technologies should be conducted during preliminary design.

Effluent filtration (sand or cloth-media disk filters) has a lower operating cost than membrane filtration, and it is relatively simple to operate, but they do not have the additional pathogen removal capabilities of a MBR. Table 8.6 summarizes the advantages and disadvantage of the tertiary filtration option.

Table 8.6 Advantages and Disadvantages of the Filtration Process
WWTP Facility Master Plan
MBCSD

Advantages	Disadvantages
Lower power costs than MBR.	May require chemical addition.
Produces tertiary quality effluent.	
Small footprint.	
Easy to operate and maintain.	

8.5 EVALUATION OF TREATMENT ALTERNATIVES

The following section describes the new facilities and rehabilitation of existing facilities necessary to implement the four secondary and tertiary treatment alternatives previously described. The detailed design criteria that have been included for each alternative has been used to develop budgetary project costs that will be presented in a later section of this chapter. These project costs will be considered, along with other economic and non-economic factors, to compare each alternative and ultimately arrive at a recommended alternative for upgrade of the MBCSD WWTP.

8.5.1 Alternative No. 1 - TFSC

The facilities associated with Alternative No. 1 are outlined below. The process schematic and conceptual layout for this alternative are shown in Figure 8.2 and 8.3 respectively. Design criteria are presented in Table 8.7.

This alternative incorporates the existing secondary treatment practice of TFSC basins. The main components of the TFSC system include the following:

- Primary clarifiers.
- Effluent and recirculation pumping.
- Trickling filters.
- Solids contact basins with submerged diffusers.
- Secondary clarifiers.

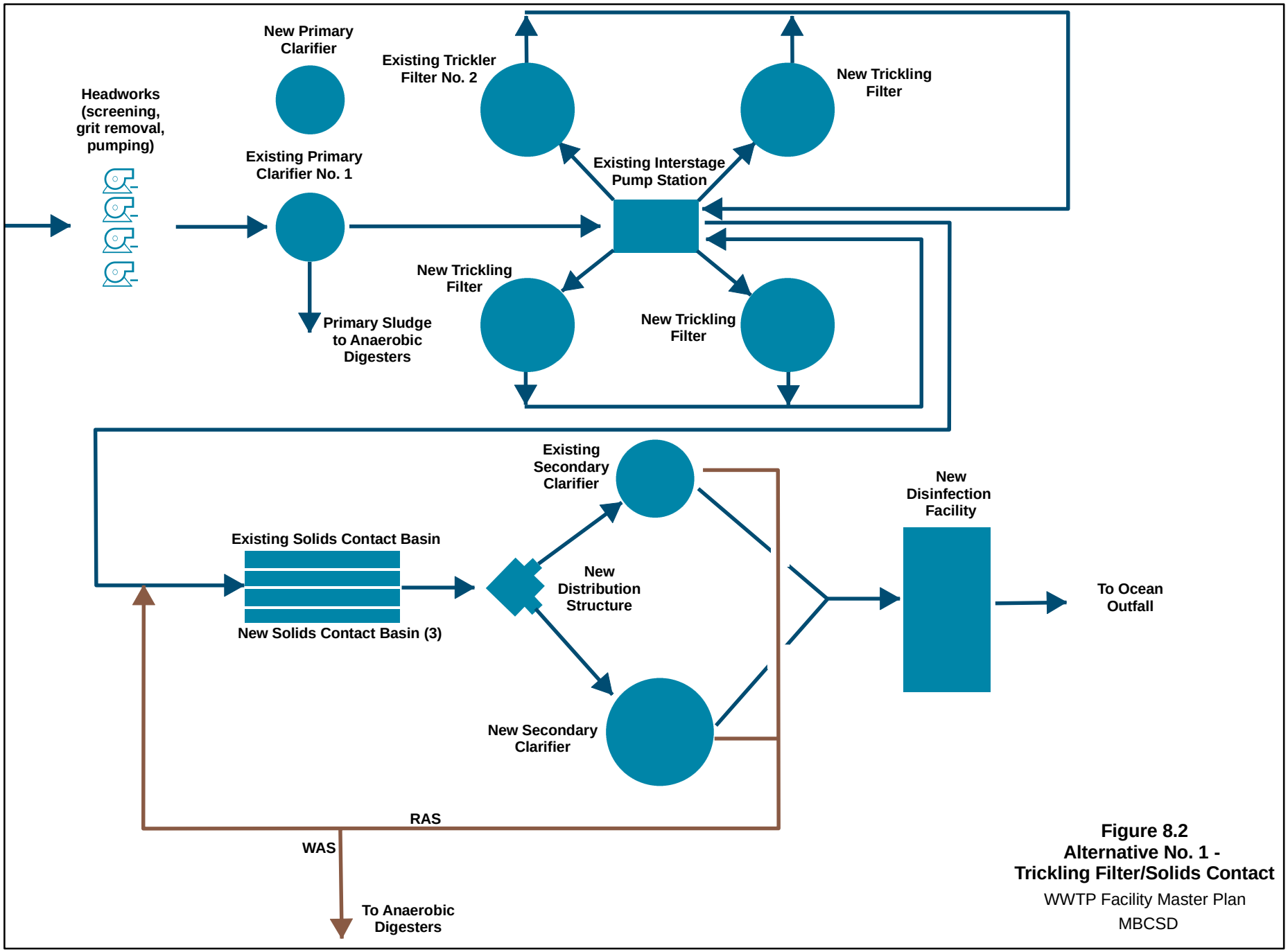

Figure 8.2
Alternative No. 1 -
Trickling Filter/Solids Contact

WWTP Facility Master Plan
MBCSD

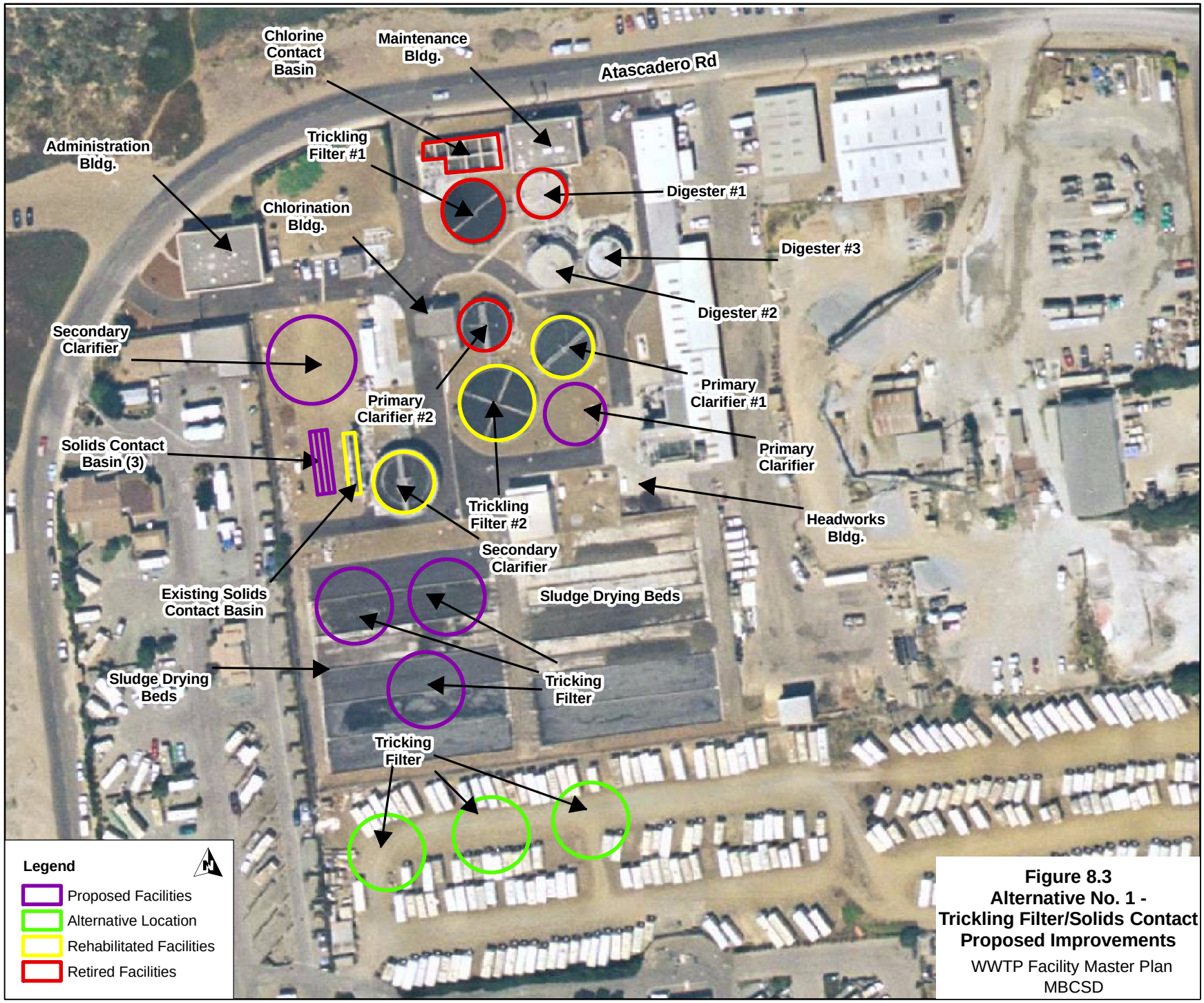

Figure 8.3
Alternative No. 1 - Trickling Filter/Solids Contact Proposed Improvements
WWTP Facility Master Plan
MBCSD

Table 8.7 Alternative No. 1 - Trickling Filter/Solids Contact - Process Unit Sizing
WWTP Facility Master Plan
MBCSD

Headworks	
Design Criteria	
Peak Hour Flow:	5.92 mgd
Redundant Mechanical Bar Screens:	1 + 1 standby
Existing Headworks	
Capacity:	8.2 mgd
Influent Flow Measurement	
Meter:	Palmer Bowlus Flume
Sewer Diameter:	30 in
Bar Screens	
Width:	3 ft.
Opening:	1 in.
Influent Pumps	
Number:	3
Capacity (each):	3.3 mgd
Aerated Grit Chamber	
Number	2
Grit Pumps	
Number:	2
Capacity:	250 gpm
Recommendation	
The existing headworks will be rehabilitated with installation of a new influent pump, VFD, and mechanical bar screens. Upgrades will also be made to the grit chambers including a new cyclone grit classifier and air piping and diffuser replacement.	
New Bar Screen	
Number:	2
Width:	3 ft
Opening:	3/8 in.
New Influent Pumps	
Number:	1
Capacity (each):	3.3 mgd
Primary Sedimentation	
Design Criteria	
Average Annual Daily Flow:	1.32 mgd
Peak Seasonal Dry Weather Flow:	1.5 mgd
Peak Hour Flow:	5.92 mgd
Existing Primary Clarifier No. 1	
Diameter:	50 ft
Surface Area:	1,963 ft^2
Existing Primary Clarifier No. 2	
Diameter:	40 ft
Surface Area:	1,257 ft^2
Primary Sludge Pumps	
Number:	2
Capacity:	90 - 300 gpm
Primary Scum Pumps	
Number:	2
Capacity:	90 - 300 gpm
Recommendation	
Due to its age and condition, Primary Clarifier No. 2 will be demolished, and Primary Clarifier No. 1 will be rehabilitated. Another primary clarifier will be constructed to replace the demolished clarifier.	
New Primary Clarifier	
Number:	1
Diameter:	50 ft
Surface Area:	1,963 ft^2

Interstage Pump Station	
Design Criteria	
Average Annual Daily Flow:	1.32 mgd
Peak Seasonal Dry Weather Flow:	1.5 mgd
Existing Biofilter Recirculation Pumps	
Number:	3
Capacity:	950-1,660 gpm
Existing Biofilter Effluent Pumps	
Number	2
Capacity:	2,300 gpm
Recommendation	
A third Biofilter Effluent pump will be added to handle increasing flows and increase the reliability of the Interstage Pump Station.	
New Biofilter Effluent Pump	
Number:	1
Capacity:	2,300 gpm
Trickling Filters	
Design Criteria	
Peak Seasonal Dry Weather Flow:	1.5 mgd
Existing Trickling Filter No. 1	
Diameter:	60 ft
Depth:	4.5 ft
Surface Area:	2,820 ft^2
Volume:	12,700 ft^3
Existing Trickling Filter No. 2	
Diameter:	70 ft
Depth:	5.0 ft
Surface Area:	3,770 ft^2
Volume:	18,800 ft^3
Recommendation	
Trickling Filter No. 1 will be retired, and Trickling Filter No. 2 will be rehabilitated. To improve effluent quality and increase secondary treatment capacity, additional trickling filters will be constructed.	
New Trickling Filters	
Number:	3
Diameter:	70 ft
Depth:	20 ft
Surface Area (Total):	11,545 ft^2
Volume (Total):	230,900 ft^3
Media:	Plastic
Solids Contact Basin	
Design Criteria	
Peak Seasonal Dry Weather Flow:	1.5 mgd
Existing Solids Contact Basin	
Length:	58 ft
Width:	4 ft
Depth:	4.25 ft
Volume:	7,375 gal
Recommendation	
The existing solids contact basin will be rehabilitated. Due to the size of the existing basin, additional solids contact basins will be constructed.	
New Solids Contact Basin	
Number:	3
Volume:	7,375 gallons
Solids Retention Time (SRT):	0.77 days

Table 8.7 Alternative No. 1 - Trickling Filter/Solids Contact - Process Unit Sizing
WWTP Facility Master Plan
MBCSD

Secondary Clarifiers	
Design Criteria	
Average Annual Daily Flow:	1.32 mgd
Peak Seasonal Dry Weather Flow:	1.5 mgd
Peak Hour Flow:	5.92 mgd
Existing Secondary Clarifiers	
Number:	1
Diameter:	55 ft
Surface Area:	2,376 ft^2
Recommendation	
The existing secondary clarifier will be rehabilitated, and a new clarifier will be constructed to accommodate full-secondary treatment capacity.	
New Secondary Clarifiers	
Number:	1
Diameter:	80 ft
Surface Area:	5,027 ft^2

RAS Pumps	
Existing RAS Pumps	
Number:	2
Capacity:	340 gpm
Recommendation	
The blowers used to supply the existing RAS pumps should be replaced. Additional centrifugal RAS/WAS pumps will also be installed to increase the reliability and capacity of the system.	
New RAS/WAS Pumps	
Number:	2
Type:	Centrifugal
Capacity	800 gpm
WAS Pumps	
Existing WAS Pumps	
Number:	2
Capacity:	80 gpm
Recommendation	
The new RAS pumps will provide additional wasting capacity to the system.	

8.5.1.1 Primary Clarification

The MBCSD WWTP currently utilizes two primary clarifiers upstream of the existing TFSC process. Due to the condition of Primary Clarifier No. 2, it will be retired and demolished. The larger of the two existing primary clarifiers, Primary Clarifier No. 1, will be rehabilitated and kept online. The rehabilitation effort will include improvements to the concrete basin as well as the clarifier mechanism and catwalk. In order to keep the overflow rate of the clarifier below 700 gallons per day per square foot (gpm/sf), an additional 50-foot clarifier will be constructed. The additional clarifier will also add redundancy and protect the trickling filters downstream if one clarifier is out of service.

8.5.1.2 Interstage Pump Station

The existing Interstage Pump Station pumps the primary effluent that will receive secondary treatment to the trickling filters, and the trickling filter effluent either to the solids contact basin or back to the trickling filters. Since this alternative will continue to employ trickling filters, the Interstage Pump Station will remain in service. In order to accommodate the future flows that will receive secondary treatment, a third effluent pump and VFD should be added. The existing circulation pumps are sufficient to accommodate future flow capacity anticipated at the facility.

8.5.1.3 Trickling Filters

Three new trickling filters will be constructed. The new trickling filters will incorporate cross flow plastic media. After the new trickling filters are online, Trickling Filter No. 1 should be retired and demolished, and Trickling Filter No. 2 should be rehabilitated. The improvements to Trickling Filter No. 2 will include repairs to the basin and replacement of the distribution mechanism. The rehabilitated trickling filter along with the new plastic media trickling filters will bring the secondary treatment capacity of the WWTP to 1.5 mgd.

8.5.1.4 Solids Contact Basins

While the existing solids contact basin will remain in service for this alternative, the diffusers and air manifold piping in the basin should be replaced. The existing basin is also operating below the recommended minimum HRT, and therefore additional basins have been included as part of this alternative to increase the biologically active volume. Three new solids contact basins will be constructed in parallel to the existing basin. The additional blowers needed to achieve the aeration requirements of these new basins have also been included as part of this alternative.

8.5.1.5 Secondary Clarification

An additional secondary clarifier will be needed as part of the TFSC process. Although the existing secondary clarifier was constructed during the last phase of expansion to the WWTP, rehabilitation of both the concrete basin and the clarifier mechanism should be done to extend its useful life during the upgrade to the WWTP. This new 80-foot secondary clarifier, along with the existing secondary clarifier, will allow for an overflow rate less than 400 gpd/sf.

8.5.2 Alternative No. 2 - EAAS

The facilities associated with Alternative No. 2 are outlined below. The process schematic and conceptual layout for this alternative are shown in Figure 8.4 and 8.5 respectively. Design criteria are presented in Table 8.8.

This alternative will incorporate EAAS (oxidation ditches) sized to treat 1.5 mgd with the existing trickling filters no longer in service. In addition to the existing secondary treatment facilities, the primary clarifiers and Interstage Pump Station will also be retired and demolished. The structures that have been evaluated for this alternative are a pair of parallel oxidation ditches with both aerobic and anoxic zones. These structures are very similar to those recently constructed for the City of Pismo Beach.

The main components of the extended aeration activated sludge process include the following:

- Oxidation ditches.
- Secondary clarifiers.
- RAS/WAS pumping.

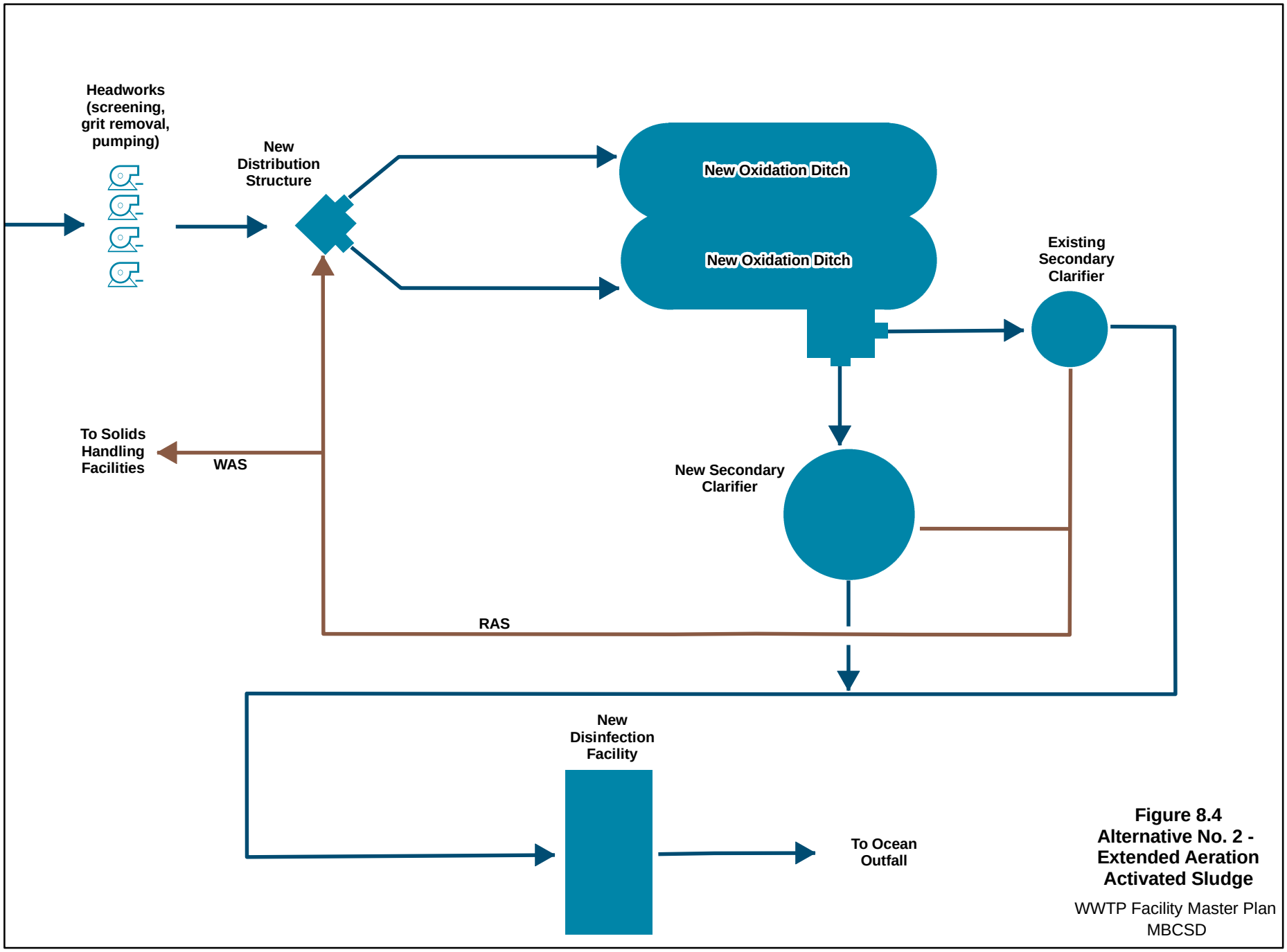

Figure 8.4
Alternative No. 2 - Extended Aeration Activated Sludge

WWTP Facility Master Plan
MBCSD

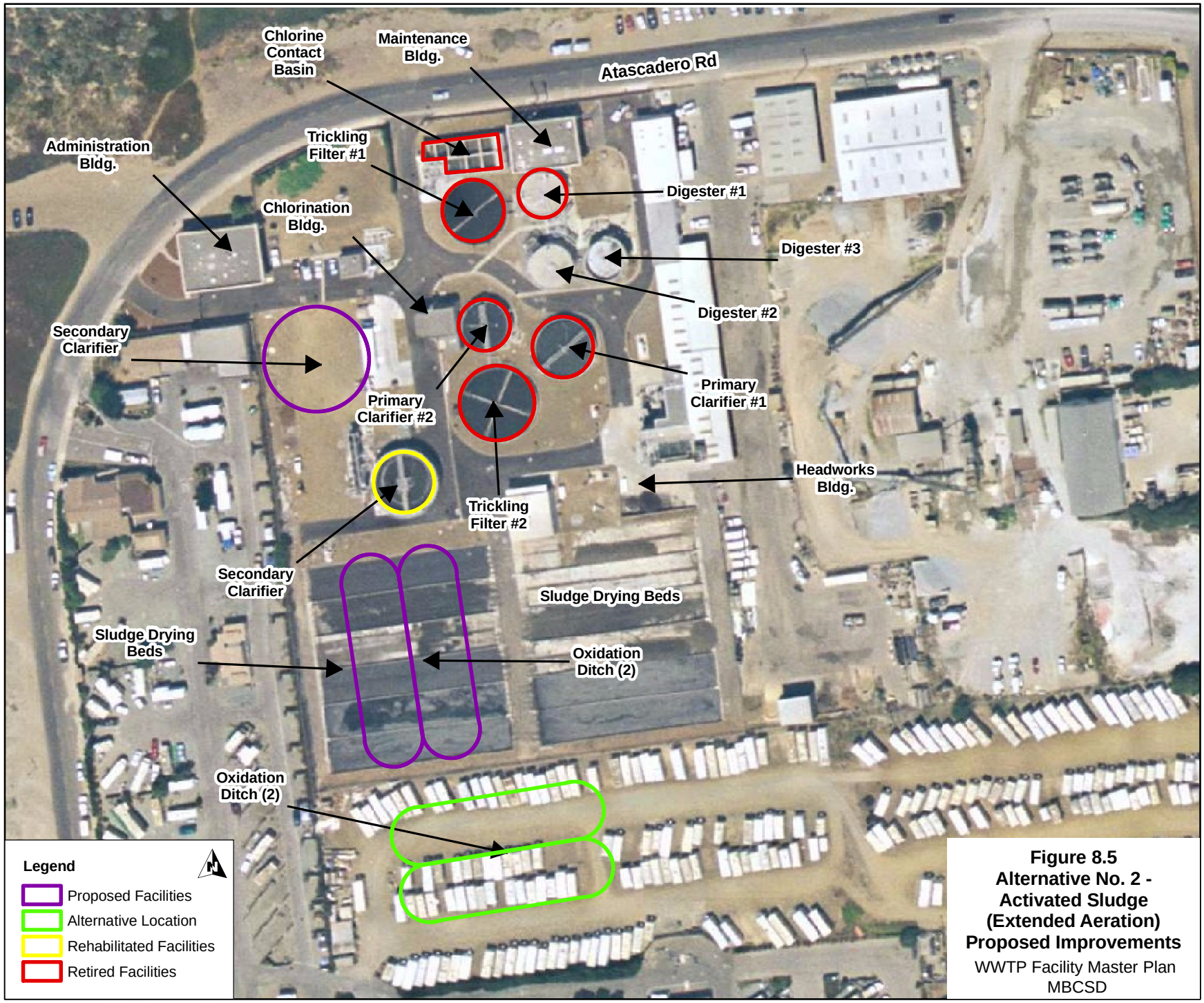

Figure 8.5
Alternative No. 2 - Activated Sludge (Extended Aeration) Proposed Improvements
WWTP Facility Master Plan
MBCSD

Table 8.8 Alternative No. 2 - EAAS - Process Unit Sizing
WWTP Facility Master Plan
MBCSD

Headworks

Design Criteria

Peak Hour Flow:	5.92 mgd
Redundant Mechanical Bar Screens:	1 + 1 standby

Existing Headworks

Capacity:	8.2 mgd

Influent Flow Measurement

Meter:	Palmer Bowlus Flume
Sewer Diameter:	30 inches

Bar Screens

Width:	3 ft
Opening:	1 in

Influent Pumps

Number:	3
Capacity (each):	3.3 mgd

Aerated Grit Chamber

Number:	2

Grit Pumps

Number:	2
Capacity:	250 gpm

Recommendation

The existing headworks will be rehabilitated with installation of a new influent pump, VFD, and mechanical bar screens. Upgrades will also be made to the grit chambers including a new cyclone grit classifier and air piping and diffuser replacement.

New Bar Screen

Number:	2
Width:	3 ft
Opening:	3/8 in

New Influent Pumps

Number:	1
Capacity (each):	3.3 mgd

Oxidation Ditches

Design Criteria

Peak Seasonal Dry Weather Flow:	1.5 mgd
Hydraulic Retention Time (HRT):	27.6 hours
Solids Retention Time (SRT):	12.04 days
Anoxic Zone Size	15% of Aeration Basin Size

Recommendation

Two parallel oxidation ditches will be constructed with aerobic and anoxic zones with the capacity to nitrify and denitrify 1.5 mgd.

New Oxidation Ditches

Number:	2
Sidewater Depth:	12 ft
Aeration Basin Volume (Total):	1.56 MG
Anoxic Basin Volume (Total):	0.27 MG
Length:	194.3 ft
Width:	52.4 ft

Secondary Clarifiers

Design Criteria

Average Annual Daily Flow:	1.32 mgd
Peak Seasonal Dry Weather Flow:	1.5 mgd
Peak Hour Flow:	5.92 mgd

Existing Secondary Clarifiers

Number:	1
Diameter:	55 ft
Surface Area:	2,376 ft^2

Recommendation

The existing secondary clarifier will be rehabilitated, and a new clarifier will be constructed to accommodate the necessary capacity for full secondary treatment.

New Secondary Clarifiers

Number:	1
Diameter:	95 ft
Surface Area:	7,088 ft^2

RAS Pump

Existing RAS Pumps

Number:	2
Capacity:	340 gpm

Recommendation

The existing RAS pumps will be retired and a new RAS/WAS Pump Station will be constructed.

New RAS/WAS Pumps

Number:	3
Type:	Centrifugal
Capacity:	785 gpm

WAS Pumps

Existing WAS Pumps

Number:	2
Capacity:	80 gpm

Recommendation

The existing WAS pumps will be retired and a new RAS/WAS Pump Station will be constructed.

8.5.2.1 Oxidation Ditches

Since the existing primary clarifiers will be retired in this alternative, the screened influent from the headworks will flow directly into the aeration basins (oxidation ditches). The ditches will incorporate an integral anoxic zone so it can be utilized for biological nitrification/denitrification. The extended aeration facilities will be divided into two ditches. This will allow one unit to be taken out of service for maintenance by temporarily increasing the flow to the other ditch, while still treating the total influent flow.

8.5.2.2 Secondary Clarification

An additional 95-foot secondary clarifier will be needed as part of the oxidation ditch treatment process. The existing secondary clarifier will also be rehabilitated as part of this alternative.

8.5.2.3 RAS/WAS Pump Station

The existing RAS and WAS pumps at the secondary sludge pump station will require extensive modifications and additions to convert it into a sludge pump station with the capacity to return at least the average day maximum demand needed for an extended aeration system. In addition to new centrifugal RAS/WAS pumps, a new exposed pump station, similar to the one constructed for the City of Pismo Beach, should also be included as part of this alternative.

8.5.3 Alternative No. 3 - MBR

The facilities associated with Alternative No. 3 are outlined below. The process schematic and conceptual layout for this alternative are shown in Figure 8.6 and 8.7 respectively. Design criteria are presented in Table 8.9.

This alternative would produce the best quality effluent of all the alternatives. Typically, the effluent quality would be less than 5 mg/L for BOD_5 and TSS, and turbidity would be expected to be less than 2 NTU. The MBR process has the ability to directly produce effluent eligible for unrestricted reuse with disinfection based on Title 22 regulations. Unlike other secondary treatment processes, solids produced in the aeration basins are removed using membranes and do not require secondary clarifiers. The main components of the MBR process include the following:

- Fine screenings following existing preliminary treatment.
- Flow equalization.
- Aeration basins containing submerged diffusers.
- Aeration air blowers facility.

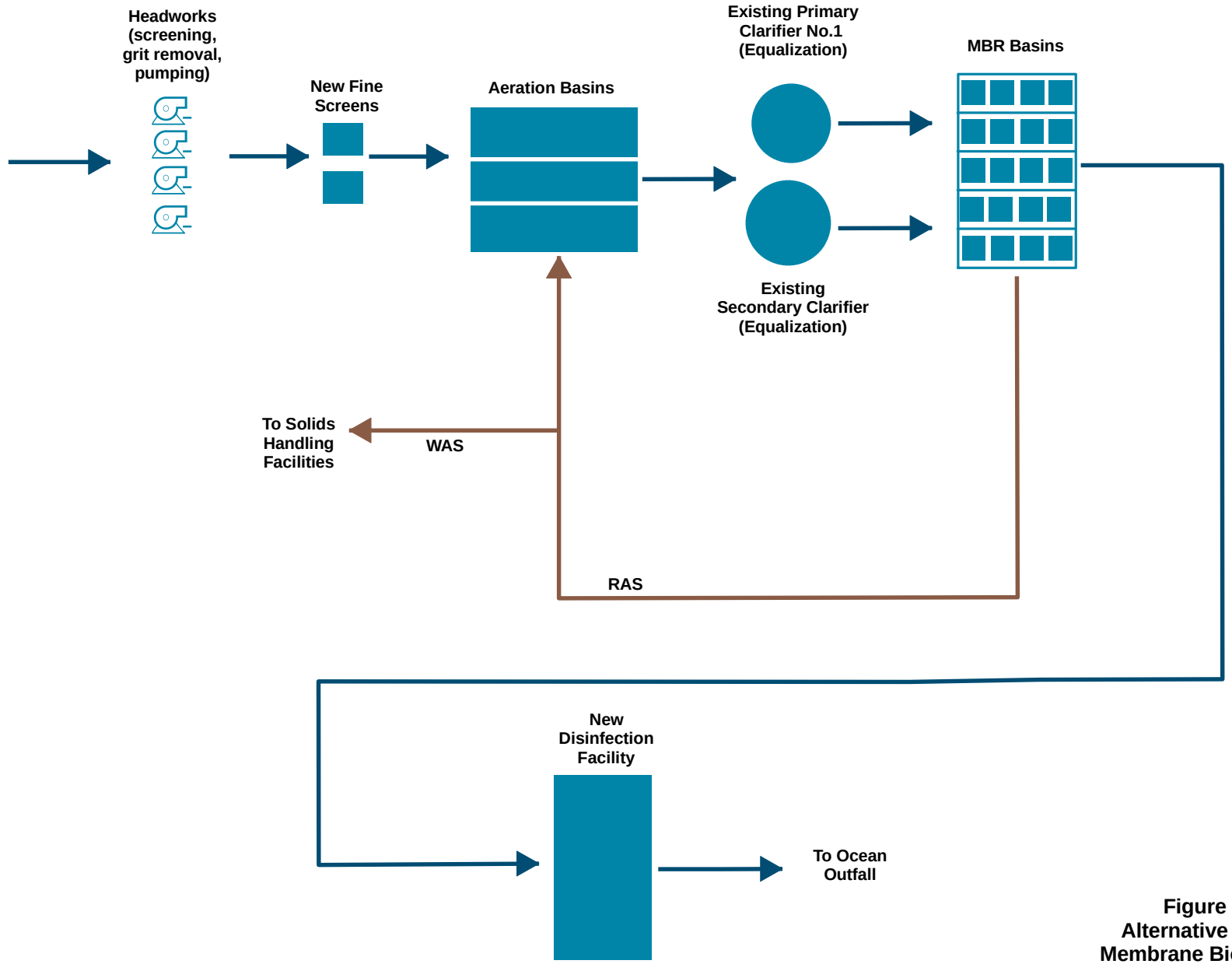

Figure 8.6
Alternative No. 3 -
Membrane Bioreactors
WWTP Facility Master Plan
MBCSD

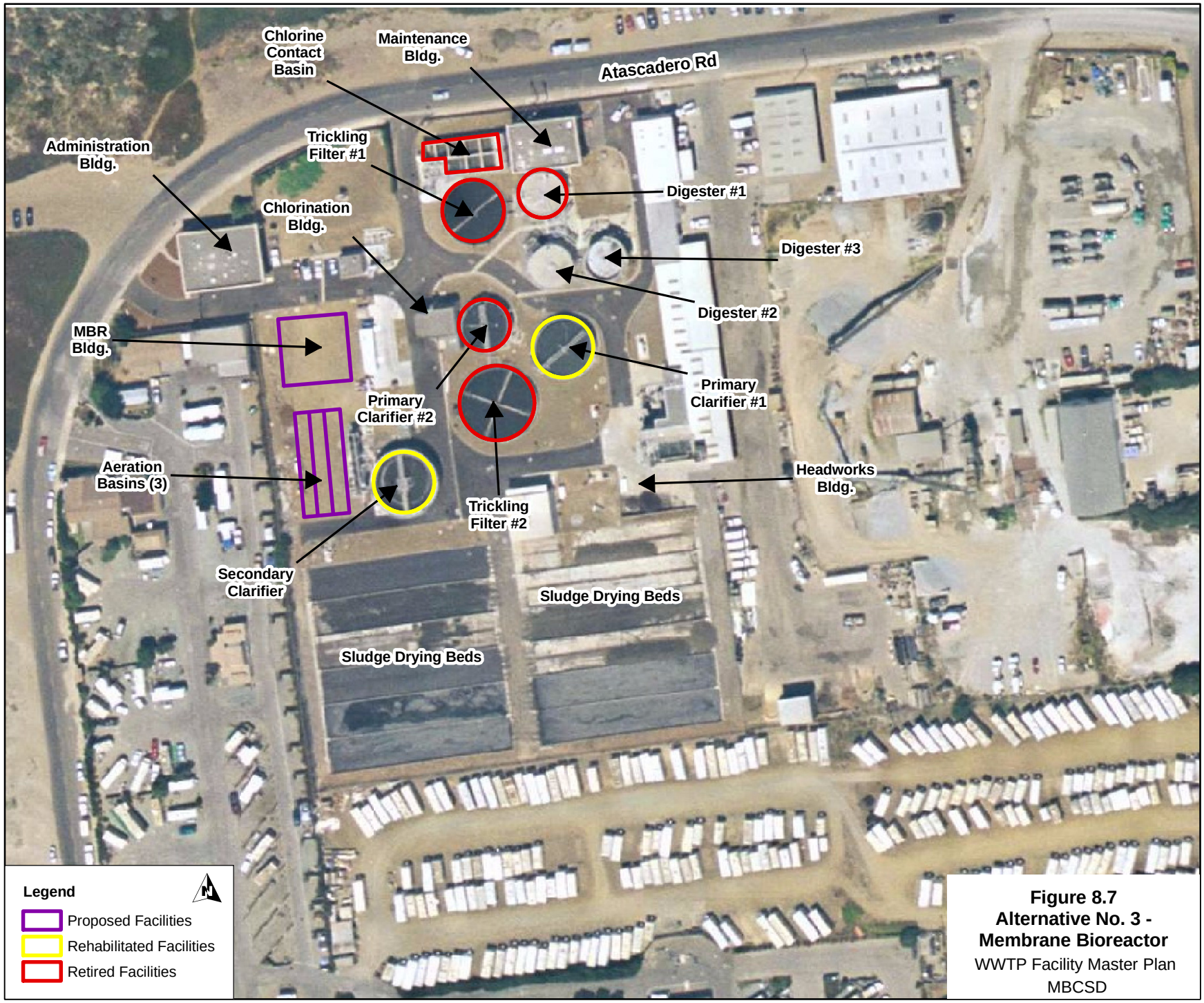

Figure 8.7
Alternative No. 3 - Membrane Bioreactor
WWTP Facility Master Plan
MBCSD

Table 8.9 Alternative No. 3 - MBR - Process Unit Sizing
WWTP Facility Master Plan
MBCSD

Headworks

Design Criteria

Peak Hour Flow:	5.92 mgd
Redundant Mechanical Bar Screens:	1 + 1 standby

Existing Headworks

Capacity:	8.2 mgd

Influent Flow Measurement

Meter:	Palmer Bowlus Flume
Sewer Diameter:	30 in

Bar Screens

Width:	3 ft
Opening:	1 in

Influent Pumps

Number:	3
Capacity (each):	3.3 mgd

Aerated Grit Chamber

Number:	2

Grit Pumps

Number:	2
Capacity:	250 gpm

Recommendation

The existing headworks will be rehabilitated with installation of a new influent pump, VFD, and mechanical bar screens. Upgrades will also be made to the grit chambers including a new cyclone grit classifier and air piping and diffuser replacement.

New Bar Screen

Number:	2
Width:	3 ft
Opening:	3/8 in

New Influent Pumps

Number:	1
Capacity (each):	3.3 mgd

Primary Sedimentation

Design Criteria

Average Annual Daily Flow:	1.32 mgd
Peak Seasonal Dry Weather Flow:	1.5 mgd
Peak Hour Flow:	5.92 mgd

Existing Primary Clarifier No. 1

Diameter:	50 ft
Surface Area:	1,963 ft^2

Existing Primary Clarifier No. 2

Diameter:	40 ft
Surface Area:	1,257 ft^2

Primary Sludge Pumps

Number:	2
Capacity:	90 - 300 gpm

Primary Scum Pumps

Number:	2
Capacity:	90 - 300 gpm

Recommendation

Primary Clarifier No. 1 will be partially rehabilitated to serve as an equalization basin following the aeration basins. The primary sludge pumps and scum pumps will be removed, and a new equalization pump will be installed.

Fine Screening

Design Criteria

Peak Seasonal Dry Weather Flow:	1.5 mgd

Recommendation

Fine screens will be installed ahead of the aeration basins to protect the downstream membranes from fouling by debris.

Number:	2
Type:	Perforated Plate
Size:	2 mm

Aeration Basins

Design Criteria

Peak Seasonal Dry Weather Flow:	1.5 mgd
Maximum Day Flow:	2.77 mgd
Peak Hour Flow:	5.92 mgd

Recommendation

New aeration basins will be constructed ahead of the MBR basins to remove organics and provide nitrification to the waste stream.

New Aeration Basin

Number:	3
Total Volume:	420,000 gallons
Length	70 ft
Width	12 ft
MLSS Concentration:	8,000 - 12,000 mg/L
Hydraulic Retention Time (HRT):	7.7 mgd
Solids Retention Time (SRT):	6.3 days
Aeration Requirements (@ PSDWF):	3,390 scfm

Membrane Bioreactor (Hollow Fiber)

Design Criteria

Average Annual Daily Flow:	1.32 mgd
Peak Seasonal Dry Weather Flow:	1.5 mgd
Maximum Day Flow:	2.77 mgd
Peak Hour Flow:	5.92 mgd
Peak Hour Flow (Instantaneous):	4.28 mgd

Recommendation

The MBR basins and support facilities will be housed in a building near the aeration basins and existing secondary clarifier.

New MBR Basins

Number of Trains:	5
Number of Cassettes per Train:	4

Table 8.9 Alternative No. 3 - MBR - Process Unit Sizing
WWTP Facility Master Plan
MBCSD

Membrane Area (Total):	299,200 ft^2
Membrane Design Flux (@ Max Day Flow):	13 gfd
Membrane Design Flux (@ PSDWF):	20 gfd
Pore Size:	0.04 microns
Secondary Clarifiers	
Design Criteria	
Average Annual Daily Flow:	1.32 mgd
Peak Seasonal Dry Weather Flow:	1.5 mgd
Peak Hour Flow:	5.92 mgd
Existing Secondary Clarifiers	
Number:	1
Diameter:	55 ft
Surface Area:	2,376 ft^2
Recommendation	
The existing secondary clarifier will be partially rehabilitated to serve as an equalization basin following the new aeration basins. The WAS pumps and scum pumps will be removed, and a new equalization pump will be installed.	

RAS Pumps	
Existing RAS Pumps	
Number:	2
Capacity:	340 gpm
Recommendation	
The existing RAS pumps will be retired and a new RAS/WAS Pump Station will be constructed.	
New RAS/WAS Pumps	
Number:	4
Type:	Centrifugal
Capacity:	1,400 gpm
WAS Pumps	
Existing WAS Pumps	
Number:	2
Capacity:	80 gpm
Recommendation	
The existing WAS pumps will be retired and a new RAS/WAS Pump Station will be constructed.	

- Membrane basins.
- Permeate pumping.
- Membrane air scour blowers, back pulse and chemical cleaning facilities.
- Membrane building.
- RAS/WAS pumping.

To protect the membranes against irreversible fouling from hair or fibers, and to maximize their effective life, the influent would be screened through fine screens with nominal 2 mm perforations. These fine screens would be installed ahead of the aeration basins in addition to coarser screening at the headworks. The liquid stream would also be sent through rehabilitated grit basins as part of the existing preliminary treatment and onward to the activated sludge basins. The screenings will be conveyed to washer-compactors for cleaning and dewatering prior to disposal. Washer-compactors remove fecal matter and reduce the volume of the wet screenings by up to 50 percent.

8.5.3.1 Biological Treatment Facilities

Following the preliminary treatment facilities and additional fine screening, the flow would be sent through activated sludge basins and to the online membrane basins. The membrane basins and ancillary equipment would be housed in a covered Membrane Building. The membrane system consists of cassette tanks, permeate pumps and back pulse system, blower system, chemical feed equipment, electrical panels, and controls.

Blowers for the activated sludge basins would be individually housed outdoors in sound enclosures.

The majority of the biological treatment occurs through three parallel activated sludge trains. A separate series of basins serve to house the membrane system. Separation of the membrane basins permits independent optimization of aeration equipment and activated sludge process as well as allows for isolated membrane cleaning. Routine maintenance requirements vary dependent on the membrane supplier but may be conducted as frequently as daily.

The activated sludge basins are designed to remove BOD as well as provide nitrification. Although ammonia concentrations are not regulated in typical irrigation uses with recycled water, membrane manufacturers currently require a nitrified feed to the membranes. Incorporation of nitrification to the biological process train significantly increases the aeration requirements as compared to BOD removal and consumes alkalinity. In addition, the nitrification process is more sensitive to low temperature conditions.

A common method of reducing the aeration and alkalinity requirements required for nitrification is denitrification. Denitrification is the biological reduction of nitrate to nitrogen gas by incorporating an anoxic zone. Although nitrate concentrations are not currently regulated for general unrestricted re-use standards, incorporating the denitrification process into the facility design may:

- Increase the aeration basin size by 10 to 20 percent.
- Lower aeration energy consumption by up to 30 percent.
- Recover up to 50 percent alkalinity.
- Increase pH.
- Anticipate possible nitrate and/or total nitrogen requirements.

Based on Carollo's experience, these advantages and disadvantages must be weighed based on the need for nitrogen removal. However, the cost to increase the size of the aeration basins is usually negated by the other benefits listed such as recovering alkalinity or increasing pH.

8.5.3.2 Flow Equalization

Mixed liquor discharged from the aeration basins will be sent to Primary Clarifier No. 1 and the existing secondary clarifier instead of directly to the membrane units during high flow events. Both of these clarifiers will be partially rehabilitated to serve as aerated equalization wet wells. This rehabilitation will consist of repairs to any corroding concrete and removal of the existing weirs, mechanisms, and catwalks. During normal operation, these wet wells allow the facility to use a common mixed liquor effluent basin to mix the aeration basin effluents prior to distribution to the membranes. The wet wells will equalize and store instantaneous flow to permit the reduction of peak flows to the membrane units. From the

wet well, submersible membrane feed pumps then pump the mixed liquor to feed the membrane tanks.

As the influent flow varies over the course of a day, the operating water depth of the wet wells will vary up to the maximum nine-foot water surface level. The membrane programmable logic controller (PLC) controls the rate at which mixed liquor is pumped from the membrane wet well to the online membrane tanks. The feed rate is calculated based on both an averaged influent flow meter signal and the instantaneous mixed liquor level in the wet wells. The strategy allows the membrane system to provide influent flow equalization and to minimize the instantaneous flux variations.

8.5.3.3 RAS/WAS Pump Station

RAS would be pumped to the MBR basins and returned to the aeration basins. For cost estimating purposes, a RAS recycle rate of 400 percent of the influent flow was assumed for the preliminary sizing of the RAS/WAS pump station. The recycle rate is much higher for this alternative (when compared to 100 percent for the conventional aeration alternative) because the MLSS concentration is higher.

8.5.4 Alternative No. 4 - EAAS/Filtration

The facilities associated with Alternative No. 4 are outlined below. The process schematic and conceptual layout for this alternative are shown in Figure 8.8 and 8.9 respectively. Design criteria are presented in Table 8.10.

While an MBR produces a better quality effluent than an EAAS/Filtration process, both have the ability to produce, with disinfection, unrestricted reuse quality effluent in compliance with Title 22 standards. The main components of the disk filtration process include the following:

- Oxidation ditches.
- Secondary clarifiers.
- RAS/WAS pumping.
- Chemical addition.
- Cloth-media disk filters.

8.5.4.1 Oxidation Ditches

The extended aeration activated sludge process for this alternative will be an oxidation ditch identical to the one described previously for Alternative No. 2.

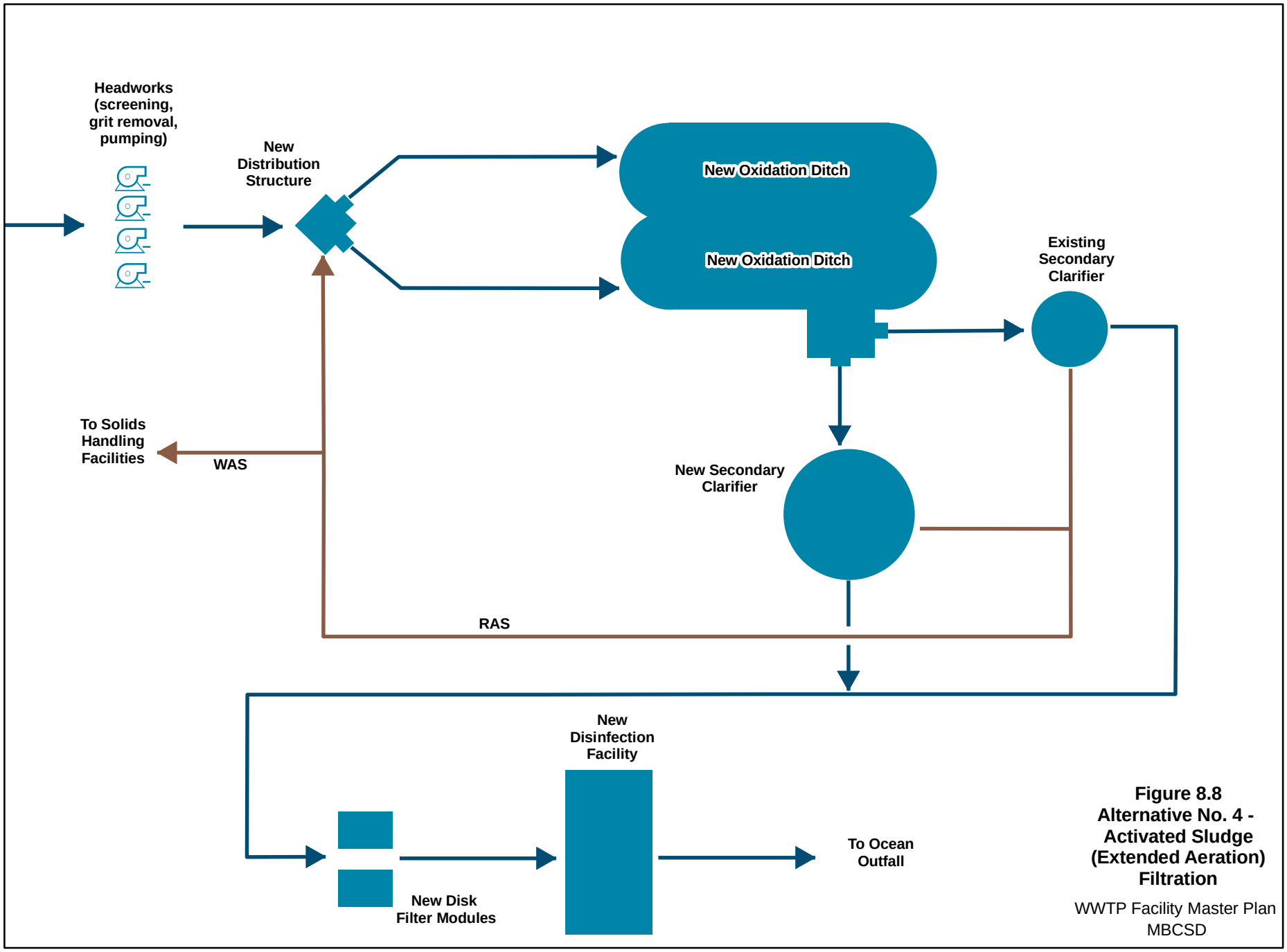

Figure 8.8
Alternative No. 4 - Activated Sludge (Extended Aeration) Filtration

WWTP Facility Master Plan
MBCSD

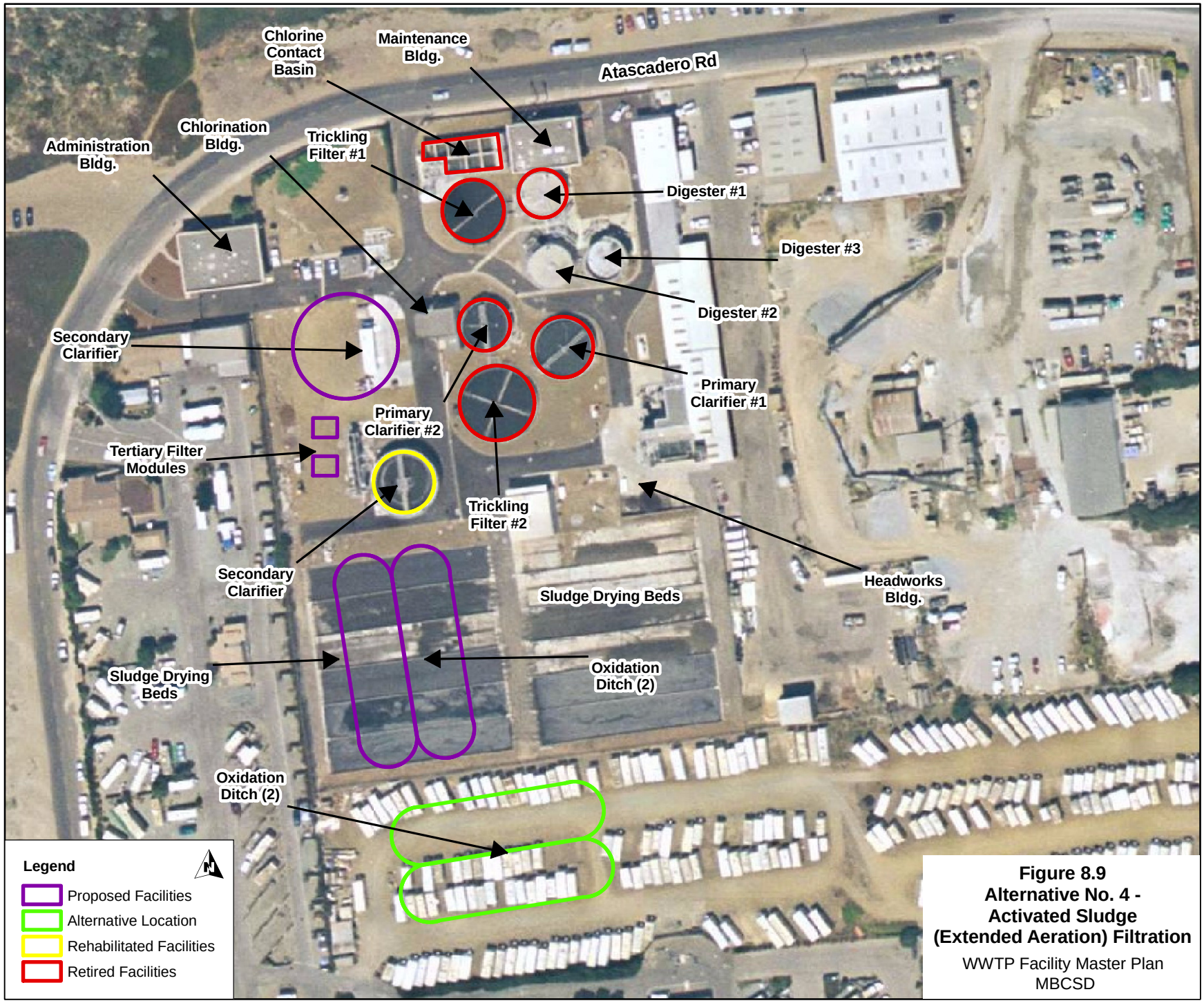

Figure 8.9
Alternative No. 4 - Activated Sludge (Extended Aeration) Filtration

WWTP Facility Master Plan
MBCSD

Table 8.10 Alternative No. 4 - EAAS/Filtration - Process Unit Sizing
WWTP Facility Master Plan
MBCSD

Headworks	
Design Criteria	
Peak Hour Flow:	5.92 mgd
Redundant Mechanical Bar Screens:	1 + 1 standby
Existing Headworks	
Capacity:	8.2 mgd
Influent Flow Measurement	
Meter:	Palmer Bowlus Flume
Sewer Diameter:	30 in
Bar Screens	
Width:	3 ft
Opening:	1 in
Influent Pumps	
Number:	3
Capacity (each):	3.3 mgd
Aerated Grit Chamber	
Number:	2
Grit Pumps	
Number:	2
Capacity:	250 gpm
Recommendation	
The existing headworks will be rehabilitated with installation of a new influent pump, VFD, and mechanical bar screens. Upgrades will also be made to the grit chambers including a new cyclone grit classifier and air piping and diffuser replacement.	
New Bar Screen	
Number:	2
Width:	3 ft
Opening:	3/8 in
New Influent Pumps	
Number:	1
Capacity (each):	3.3 mgd
Oxidation Ditch	
Design Criteria	
Peak Seasonal Dry Weather Flow:	1.5 mgd
Hydraulic Retention Time (HRT):	27.6 hours
Solids Retention Time (SRT):	12.04 days
Anoxic Zone Size:	15% of Aeration Basin Size
Recommendation	
Two parallel oxidation ditches will be constructed with aerobic and anoxic zones with the capacity to nitrify and denitrify 1.5 mgd.	
New Oxidation Ditch	
Number:	2
Sidewater Depth:	12 ft
Aeration Basin Volume (Total):	1.56 MG
Anoxic Basin Volume (Total):	0.27 MG
Length:	194.3 ft
Width:	52.4 ft
Secondary Clarifiers	
Design Criteria	
Average Annual Daily Flow:	1.32 mgd
Peak Seasonal Dry Weather Flow:	1.5 mgd
Peak Hour Flow:	5.92 mgd
Existing Secondary Clarifiers	
Number:	1
Diameter:	55 ft
Surface Area:	2,376 ft^2
Recommendation	
The existing secondary clarifier will be rehabilitated, and a new clarifier will be constructed to accommodate full secondary treatment.	
New Secondary Clarifiers	
Number:	1
Diameter:	95 ft
Surface Area:	7,088 ft^2
RAS Pumps	
Existing RAS Pumps	
Number:	2
Capacity:	340 gpm
Recommendation	
The existing RAS pumps will be retired and a new RAS/WAS Pump Station will be constructed.	
New RAS/WAS Pumps	
Number:	3
Type:	Centrifugal
Capacity:	785 gpm
WAS Pumps	
Existing WAS Pumps	
Number:	2
Capacity:	80 gpm
Recommendation	
The existing WAS pumps will be retired and a new RAS/WAS Pump Station will be constructed.	
Disk Filters	
Design Criteria	
Peak Seasonal Dry Weather Flow:	1.5 mgd
Peak Hour Flow:	5.92 mgd
Recommendation	
Disk Filter modules will be installed to treat a peak seasonal flow of 1.5 mgd to tertiary standards.	
New Disk Filters	
Number of Modules:	2
Number of Filters	16
Filtration Area per Filter Disk:	53.8 ft^2
Filtration Area (Total):	861 ft^2
Filtration Rate (All in Service):	1.2 gpm/sf
Filtration Rate (Module Out of Svc):	2.4 gpm/sf

8.5.4.2 Secondary Clarifiers

The secondary clarification capacity for this alternative is the same as for Alternative No. 2. With the rehabilitation of the existing secondary clarifier, the construction of a new 95-foot clarifier has also been included as part of this alternative.

8.5.4.3 RAS/WAS Pump Station

A new RAS/WAS pump station will be needed as part of this alternative. Like the requirements for the oxidation ditches and secondary clarifiers, the size of the RAS/WAS pump station will be the same as the one proposed for Alternative No. 2.

8.5.4.4 Cloth-Media Disk Filters

Following the secondary clarifiers, effluent will flow by gravity to the tertiary filters. A total of 16 filters housed in two stainless steel filter modules will have the capacity to produce 1.5 mgd of Title 22 quality effluent. Using two modules will give the filters flexibility and redundancy if one basin is taken offline for routine maintenance.

One important aspect of the EAAS/Filtration process is that the amount of tertiary effluent that is produced can be tailored to fit the needs of the City and CSD. With this option, filters can be initially installed to receive only a portion of the daily flow. Units can be easily added in the future to increase the tertiary capacity of the facility.

8.6 COMPARISON OF TERTIARY TREATMENT ALTERNATIVES

There are several factors to consider when upgrading and expanding the capacity of the MBCSD WWTP. These include capital and operations and maintenance costs, the ability to meet current and anticipated future regulatory requirements, and operational factors. These factors, for Alternative No. 3 and No. 4, will be addressed briefly below.

8.6.1 Costs

Included in Table 8.11 is a breakdown of Carollo's opinion of estimated capital and operations and maintenance costs for each alternative. Also included is a total PV cost, which takes into account the construction cost and the PV of the operations and maintenance cost for a 20-year period. The PV cost represents the amount of money that would need to be invested today to cover the construction costs for the project as well as the operations and maintenance costs over a specific period. For the purposes of this report, the PV calculations assume an interest rate of 6 percent and an annual inflation rate of 3 percent. A detailed cost breakdown for each alternative is shown in Appendix K. As can be seen in Table 8.11, the MBR alternative has an overall PV cost $11.5 million (48 percent) higher than the alternative that utilizes tertiary filtration. Both the capital, and operations and maintenance costs are higher for the MBR alternative.

The capital costs that were developed for this chapter include the rehabilitation of existing structures as well as the construction of new facilities. For this chapter, only the headworks and components of the secondary and/or tertiary facilities have been included in order to develop an accurate comparison between the alternatives. Parts of the complete WWTP upgrade that have been excluded from this analysis are the new disinfection and solids handling facilities. In the final chapter of this report, all components of the WWTP will be included to develop a total recommended project cost.

Table 8.11 Summary of Estimated Present Value Costs (20 Years)
WWTP Facility Master Plan
MBCSD

			Estimated Costs			
Alternative	**Description**	**Effluent Classification**	**Project**	**O&M**	**O&M Present Value (20 Years)**	**Total Present Value**
No. 3	MBR	Tertiary	$23,576,000	$822,000	$11,866,000	$35,442,000
No. 4	EAAS/Filtration	Tertiary	$15,561,000	$578,000	$8,344,000	$23,905,000

Note:
1. Project costs include a 35% Engineering, Legal, and Administrative Contingency.

The costs for the alternatives are based upon recent Carollo projects with similar components, including the upgrades recently completed for the City of Pismo Beach. These costs were updated to June 2006 dollars, making it consistent with previous chapters of this report. An overall contingency of 20 percent was added to cover the many items that cannot be identified at this level of development for the alternatives.

8.6.2 Regulatory Compliance

This section describes the ability of both tertiary alternatives to meet the anticipated future WDRs for the MBCSD. Both alternatives will produce an effluent that both meets the anticipated secondary treatment requirements for ocean discharge as well as for unrestricted reuse under Title 22 with the addition of additional chlorine contact time for disinfection. As discussed previously, the individual reuse options for the tertiary effluent will be governed by water quality.

Since both alternatives will produce tertiary quality effluent, both can also produce effluent quality that will meet the proposed design BOD_5 and TSS limits of 20 mg/L each. Both processes will also produce unrestricted reuse quality effluent, which can be used to irrigate crops for human consumption as well as parks, golf courses and cemeteries.

While both requirements meet all the necessary discharge criteria for both ocean discharge and reuse, Alternative No. 3 has the added benefit of increased pathogen removal. The

MBCSD must weigh this added benefit with the additional cost of tertiary treatment with a MBR.

8.6.3 Operational Factors

Alternative No. 3 includes a MBR plant, which consists of aeration basins followed by solids separation with membranes. Out of all the alternatives that have been evaluated, the MBR utilizes the fewest existing structures at the WWTP. Unlike TFSC or EAAS, MBRs do not utilize secondary clarifiers for solids removal.

The MBR process is new to the plant staff. However, it has fewer components when compared to the existing secondary treatment process, and has similar operations requirements to the use of EAAS followed by tertiary filtration. The MBR does however have more maintenance requirements than Alternative No. 4.

Alternatives No. 4 incorporates an EAAS process ahead of the cloth-media disk filters that is a very forgiving and easy to operate process. The extended aeration process handles wide fluctuation in influent flow and quality. The WAS from the process is relatively stable and can generally be thickened, or applied directly to sludge beds without the need for additional stabilization. Additionally the extended aeration process, if operated to nitrify and denitrify, produces a well settling mixed liquor, provides an oxygen credit, and replenishes alkalinity used in the oxidation process.

The oxidation ditch is new to the plant staff. However, there are fewer facilities necessary to operate an EAAS process in comparison to the existing practice of TFSC. Since there is no primary clarification included as part of Alternative No. 4, EAAS includes only the oxidation ditches, secondary clarifiers, and RAS/WAS pumping. In addition to the RAS/WAS pumping and secondary clarifiers, the TFSC process also includes primary clarifiers, primary sludge pumps, and TFSC basins. With fewer facilities, the EAAS process for Alternative No. 4 will require fewer operator hours to operate and maintain.

In addition to the oxidation ditch, Alternative No. 4 also includes cloth-media for disk filters. As with the oxidation ditch, these tertiary filters are new to plant staff. Although the filter and back wash pumps are on a schedule, the filters will require additional operator hours to monitor and maintain the filtration equipment.

Another difference between the use of an MBR and EAAS/Filtration to produce tertiary quality effluent is the need to pass the peak hour flow. Because the WDR for ocean discharge will only require secondary treatment, large storm flows can bypass the tertiary filters since the wastewater stream will already have received secondary treatment in the oxidation ditches. Since the secondary and tertiary treatment capabilities of an MBR occur in the same basins, the entire MBR process must be sized to accommodate peak flows, which could be as large as 6 mgd at build-out conditions. This reduces the hydraulic design requirements for the filters and the cost of the tertiary filtration process.

There are several oxidation ditch facilities current in operation or construction on the Central Coast. In its short operational history, the oxidation ditches at the City of Pismo Beach have a proven track record. The use of cloth-media filters is less widespread in the area. However, several communities including the City of Turlock use cloth-media filters for re-use.

8.6.4 Tertiary Alternatives Comparison Summary

In order to move easily compare the tertiary alternatives discussed in this chapter, Table 8.12 has been constructed that includes the selection criteria discussed above.

Table 8.12 Comparison of Treatment Alternatives WWTP Facility Master Plan MBCSD

Factors	Alternative No. 3 MBR	Alternative No. 4 EAAS/Filtration
Capital Costs	Higher	Moderate
Operating Costs	Higher	Moderate
Effluent Quality	Superior	Excellent
Ease of Operation	Moderate	Easy
Utilization of Existing Infrastructure	Minimal	Minimal
Similarity to Existing Process	None	None
Easily Accommodates Varying Flows and Loadings	Acceptable	Excellent
Constructability	Good	Moderate
TSS Removal	Superior	Excellent
Future Unrestricted Reuse	Excellent	Excellent
Odors	Low	Low
Footprint	Moderate	Moderate
Emerging Contaminant Removal	Better	Partial

8.7 COMPARISON OF SECONDARY TREATMENT ALTERNATIVES

There are several factors to consider when choosing a secondary treatment alternative for upgrade and expansion of the MBCSD WWTP. These include capital and operations and maintenance costs, the ability to meet current and anticipated future regulatory requirements, and operational factors. These factors, for Alternative No. 1 and No. 2, will be

addressed briefly below. A basic overview of the processes associated with these alternatives is discussed in Sections 8.4.1 and 8.4.2.

8.7.1 Costs

Included in Table 8.13 is a breakdown of Carollo's opinion of estimated capital and operations and maintenance costs for each alternative. Also included is a total PV cost, which takes into account the construction cost and the PV of the operations and maintenance cost for a 20-year period.

Table 8.13 Summary of Estimated Present Value Costs (20 Years)
WWTP Facility Master Plan
MBCSD

			Estimated Costs			
Alternative	**Description**	**Effluent Classification**	**Project**	**O&M**	**O&M Present Value (20 Years)**	**Total Present Value**
No. 1	Trickling Filters/Solids Contact	Secondary	$13,218,000	$589,000	$8,502,000	$21,720,000
No. 2	EAAS	Secondary	$13,152,000	$503,000	$7,261,100	$20,413,000

Note:
1. Project costs include a 35% Engineering, Legal, and Administrative Contingency.

8.7.1.1 Project Costs

The project costs that were developed for this chapter include the rehabilitation of existing structures as well as the construction of new facilities. For this chapter, only the headworks and components of the primary and secondary facilities have been included in order to develop an accurate comparison between the alternatives. These components include primary sludge pumping, RAS/WAS pumping, biofilter recirculation pumping, biofilter effluent pumping, and secondary clarification. Parts of the complete WWTP upgrade that have been excluded from this analysis are the new disinfection and solids handling facilities. In the final chapter of this report, all components of the WWTP will be included to develop a total recommended project cost.

As can be seen from Table 8.13, the project costs for the TFSC and EAAS are $13.2 million. It should be noted that the difference in cost between these two alternatives is less than 1 percent, which is within Carollo's cost estimating abilities for the facilities planning process. A detailed cost breakdown of the two secondary alternatives is shown in Appendix K.

8.7.1.2 Operations and Maintenance

The operations and maintenance costs for this chapter include the annual labor costs associated with the primary and secondary treatment facilities as well as the associated annual electrical costs. The actual annual labor and electrical costs can be seen in Appendix K.

The associated annual labor cost for the TFSC process is greater than that of the EAAS process. As mentioned previously, the TFSC process has more associated facilities and pieces of equipment when compared to the EAAS process. For example, primary clarifiers are not required ahead of the oxidation ditches in an EAAS facility. For the MBCSD WWTP, primary clarification translates into two large concrete basins and seven major pieces of equipment that require operator attention and routine maintenance. These additional requirements translate into more operations staff and a higher annual labor cost.

The associated annual electrical costs for the TFSC and EAAS processes are essentially the same. The additional cost associated with the large mechanical aerators of the oxidation ditches is offset by the additional cost to run the biofilter effluent and recirculation pumps and blowers used to aerate the solids contact basins.

8.7.1.3 Present Value Costs

The PV cost represents the amount of money that would need to be invested today to cover the construction costs for the project as well as the operations and maintenance costs over a specific period. For the purposes of this report, the PV calculations assume an interest rate of 6 percent and an annual inflation rate of 3 percent.

As can be seen in Table 8.13, the TFSC alternative has an overall PV cost $1,307,000 (6 percent) higher than the EAAS alternative. The difference in the present value cost for each alternative can be attributed to the slightly higher operations and maintenance costs of TFSC as well as a higher project costs. As mentioned previously, this higher operations and maintenance cost is associated with additional operations staff needed to run the TFSC basins, and other associated facilities at the WWTP.

8.7.2 Regulatory Compliance

This section describes the ability of both secondary alternatives to meet the anticipated future ocean discharge permit for the MBCSD. Unlike the tertiary alternatives that were previous evaluated, neither EAAS nor TFSC will produce an effluent that meets unrestricted reuse under Title 22.

8.7.2.1 TFSC

While it is difficult for the TFSC process to achieve the proposed design BOD_5 and TSS effluent limits of 20 mg/L each, the limits can be reached by adding large amounts of

additional TFSC capacity. The need for additional TFSC capacity is illustrated by the new design criteria and lower than anticipated capacity of the existing facility. At this time, the MBCSD WWTP has the capacity to treat approximately 0.5 mgd to the design standards of 20 mg/L for both BOD_5 and TSS. A detailed discussion of the secondary treatment capacity of the existing WWTP is included in Section 8.2.

8.7.2.2 EAAS

Due to a longer retention time and its capability to biologically nitrify and denitrify the wastewater, the EAAS process will provide the best quality effluent between the two secondary alternatives. The oxidation ditches will have no problem meeting the proposed design BOD_5 and TSS limits of 20 mg/L each. The effluent discharged by the City of Pismo Beach has BOD_5 and TSS concentrations between 1 and 5 mg/L. This will allow the MBCSD to consistently meet the anticipated effluent limits of the new NPDES permit.

8.7.3 Operational Factors

Unlike the tertiary treatment alternatives where both processes would be new to plant staff, the TFSC has the advantage of being the process that is currently used at the facility. In addition to plant staff's experience with the process, several other operational factors must be considered when choosing a treatment alternative including ease of operation, impacts on future biosolids management practices, and impacts on the surrounding area such as odors.

8.7.3.1 Ease of Operation

Alternative No. 1 includes a TFSC plant, which consists of primary clarifiers, TFSC basins, interstage pump station, RAS/WAS pumping, and secondary clarifiers. Although the TFSC process is familiar to plant staff, it also has the most components of any of the secondary or tertiary alternatives, with almost 50 associated facilities and major pieces of equipment. As discussed earlier, not only do these additional components make operating the plant more difficult, but it also translates into higher operations and maintenance costs.

Alternative No. 2 includes an EAAS plant, which consists of oxidation ditches, secondary clarifiers, and a RAS/WAS pump station. The EAAS process that is evaluated for expansion of the MBCSD WWTP has fewer than 20 associated facilities and major pieces of equipment. This large discrepancy in facility and equipment numbers can be attributed to the primary clarifiers and interstage pumping associated with the TFSC process, which represents approximately 15 associated facilities and pieces of equipment.

8.7.3.2 Biosolids Management

Because of the unstabilized sludge quality produced by the TFSC process, additional solids stabilization by anaerobic digestion will continue to be used in the future at the MBCSD WWTP.

While biosolids management was discussed in Chapter 7 (Biosolids Treatment and Disposal), of this report it is important to mention the impact the type of secondary treatment has on the expansion of the facility, and the biosolids handling options that will be available to plant staff in the future.

Primary sludge and WAS from the solids contact basins require additional solids stabilization, which translates into the continued use of anaerobic digesters at the facility. The rehabilitation of the existing digesters has been estimated at approximately $2 million. Table 7.7 in Chapter 7 shows the detailed costs of full rehabilitation of Digester No. 2 and 3. In contrast, EAAS produces no primary sludge, and the WAS produced by the oxidation ditches is relatively stable and could be thickened or applied directly to sludge beds without the need for additional stabilization. Choosing the EAAS process for the expansion of the MBCSD WWTP makes demolition, or conversion of the existing digesters to sludge holding tanks, viable biosolids management options. The complete cost of possible biosolids management alternatives for both the TFSC and EAAS alternatives are detailed in Section 7.9.

While the TFSC process and associated anaerobic digesters have significant economic impacts on the expansion of the MBCSD WWTP, the process does have other benefits in the area of local sustainability. These non-economic factors must also be considered during the selection of a recommended treatment alternative.

The benefits of the TFSC process and rehabilitation of the digesters are twofold. First, the combination of primary sludge and WAS produced by the TFSC process lends itself to better digestion and volume reduction. This type of sludge can also be more easily composted than the sludge from an EAAS process. While the sludge produced from the TFSC process is more easily digested and composted, the EAAS sludge can also be further stabilized using these methods. However, digestion of EAAS sludge may take more attention from plant staff because of possible foaming issues.

Second, the possibility exists to utilize the gas produced by the digesters as an alternative energy source with the use of microturbines. While it is Carollo's opinion that cogeneration is not feasible for the MBCSD WWTP at this time due to the low quantity of gas available, this option may become viable in the future if the cost of energy continues to rise significantly.

8.7.3.3 Odors

The EAAS process operates with minimal odor, noise, and vector effects on the surrounding community.

While the existing facility has not had significant problems with vector, noise or odor complaints, trickling filters have a history of potential odor, fly, and snail issues. The snail and fly problems, while not generally considered an issue for the surrounding community,

can be an operational problem. For example, the snail shells tend to settle in the aeration basins and digesters and can cause ongoing maintenance for plant personnel. To date, the MBCSD WWTP has not had a problem with snails.

If in the future trickling filter odors become a problem for the MBSD WWTP, mitigation measures could need to be taken. These measures include covering the primary clarifiers and trickling filters, installing ventilation blowers, and implementing odor control in the form of a scrubber or biofilter. This infrastructure represents a significant cost that has not been included as part of this cost analysis. The possibility of adding these facilities in the future must be considered when choosing a secondary treatment alternative.

In contrast, the EAAS process (oxidation ditch) operates with minimal noise, odor, or vector issues. This can be verified with a visit to the City of Pismo Beach WWTP. Although there is some noise from the mechanical aerators at the oxidation ditches, this should not be a problem in the industrial setting of the MBCSD WWTP. The oxidation ditch is generally a good neighbor because the wastewater immediately enters the aeration basins that freshen the wastewater and minimize odor impacts on the surrounding neighbors. The odors generated, when detected, are often described as a “musty” odor that is not objectionable to most people.

8.7.4 Secondary Alternatives Comparison Summary

In order to more easily compare the secondary alternatives discussed in this chapter, Table 8.14 has been constructed that includes the selection criteria discussed above.

Alternative No. 2, EAAS with an oxidation ditch, appears to provide measurable advantages over the TFSC process at a similar overall cost to the City and CSD. The treatment option recommended by Carollo will be discussed in detail in the final chapter of this report.

Table 8.14 Comparison of Secondary Alternatives WWTP Facility Master Plan MBCSD		
Factors	**Alternative No. 1 TFSC**	**Alternative No. 2 EAAS**
Capital Costs	Similar	Similar
Operating Costs	Moderate	Moderate
BOD_5/TSS Removal Efficiency	95%	98%
Ease of Operation	Moderate	Easy
Utilization of Existing Infrastructure	High	Minimal
Similarity to Existing Process	Similar	Not Similar
Easily Accommodates Varying Flows and Loadings	Acceptable	Excellent
Constructability	Moderate	Moderate
Vectors (flys, etc.)	Potential	Low
Noise	Acceptable	Acceptable
Odors	Moderate	Low

RECOMMENDATIONS

9.1 SUMMARY

The purpose of this chapter is to present the four recommendations that have been developed for upgrade of the Morro Bay Cayucos Sanitary District (MBCSD) Wastewater Treatment Plant (WWTP). These recommendations include both secondary and tertiary treatment options. In addition to treatment options, each recommendation has also been presented with different biosolids management options, which include hauling and composting. The aspects of each recommendation and range of biosolids options are described in detail, and the chapter concludes with a critical analysis of each recommendation.

9.1.1 RECOMMENDATION NO. 1 - OXIDATION DITCH

Recommendation No. 1 includes the construction of new oxidation ditches at the WWTP with biosolids handling facilities that will produce a sub-Class B quality biosolids product. This recommendation has a total project cost of $24,168,000, the lowest of any of the alternatives. Following the upgrade, the WTTP will have the ability to discharge up to 1.5 mgd of advanced secondary quality effluent to the ocean. Sludge will be sent directly to centrifuges for dewatering, and discharged to bins or trailers for immediate disposal offsite.

9.1.2 RECOMMENDATION NO. 1A - OXIDATION DITCH WITH FILTRATION

Recommendation No. 1A has been developed as a tertiary treatment alternative to Recommendation No. 1. This recommendation includes all the components of the oxidation ditch and direct hauling processes previously described with the addition of tertiary filters. Following the upgrade, the WWTP will have the ability to discharge 1.5 mgd of tertiary quality effluent to the ocean. The project cost of Recommendation No. 1A is estimated at $26,233,000, an incremental cost of approximately $2 million over the advanced secondary option.

9.1.3 RECOMMENDATION NO. 2 - TRICKLING FILTERS/SOLIDS CONTACT

Recommendation No. 2 includes the rehabilitation of the existing trickling filter solids contact (TFSC) process with solar drying of biosolids. This recommendation also includes the construction of three new trickling filters and solids contact basins. The type of biosolids management included in this recommendation mirrors what is currently practiced at the WWTP with the addition of mechanical dewatering. The majority of the Class B biosolids produced are hauled offsite by San Joaquin Composting and 30 percent is composted onsite. Following the upgrade, the WWTP will have the ability to discharge 1.5 mgd of secondary quality effluent to the ocean. The project cost of Recommendation No. 2 is

estimated at $25,109,000. While this recommendation will produce an effluent that will meet the future anticipated ocean discharge requirements, the trickling filters produce the lowest quality effluent, with the highest levels of BOD and TSS, of any of the recommendations being considered.

9.1.4 RECOMMENDATION NO. 3 - MEMBRANE BIOREACTOR (MBR)

Recommendation No. 3 includes the construction of a new membrane bioreactor (MBR) facility at the WWTP and facilities for direct hauling of biosolids. The recommendation has both the highest project and annual operations and maintenance costs at $33,160,000 and $2,038,000 respectively. Following the upgrade, the WWTP will have the ability to discharge 1.5 mgd of tertiary quality effluent to the ocean, and produce sub-Class B biosolids. The effluent quality associated with this recommendation is the highest of any of the recommendations being considered.

9.1.5 BIOSOLIDS EVALUATION - DIRECT HAUL vs. COMPOSTING

While a majority of the focus when choosing a recommended project is on effluent quality or the type of wastewater treatment process, the JPA Board must also determine the level of biosolids treatment for the recommended project. While all of the recommendations were initially presented with biosolids hauling, the cost to implement full-scale and partial onsite composting has also been presented for each recommendation. The project cost impact of adding composting to each recommended project ranges from approximately $800,000 for the trickling filter recommendation to $2,400,000 for the other recommendations.

9.1.6 EVALUATION OF RECOMMENDATIONS

In order to evaluate the treatment alternatives used to develop the four recommendations for upgrade of the WWTP, two selection criteria matrices were constructed (Tables 8.12 and 8.14). Based on the results of this analysis, the most favorable recommendations were the oxidation ditch and oxidation ditch with tertiary filtration. An evaluation of the complete project recommendations reaffirm the findings made in Chapter 8, and show that oxidation ditches or oxidation ditches followed by filtration are the best options for upgrade of the MBCSD WWTP.

9.1.7 FINAL RECOMMENDED PROJECT - OXIDATION DITCH WITH FILTRATION

After consideration of the economic and non-economic factors associated with the different project recommendations made in this chapter, the JPA Board chose Recommendation No. 1A, oxidation ditch with filtration, with partial composting as the final recommended project for the facility master plan. This project will be used for evaluation of the upgrade of the WWTP during the environmental review process.

The final recommendation includes new oxidation ditches, cloth-media disk filters, secondary clarifier, centrifuges, gravity belt thickener (GBT), chlorine contact basin, full

rehabilitation of Digester No. 1 and 2, improvements to the existing electrical facilities, rehabilitation of the headworks, and miscellaneous improvements to other support facilities. Several structures will be retired and demolished.

After upgrade of the WWTP, the MBCSD will have the ability to discharge 1.5 mgd of tertiary treated effluent to the ocean. If water reuse is implemented in the future, additional chlorine contact capacity must be added to the treatment process or the MBCSD could consider adding an alternative disinfection method such as ultraviolet (UV) disinfection. Approximately 30 percent of the biosolids produced at the WWTP will continue to be composted onsite using windrows constructed in the sludge drying beds. The amount of composting done onsite in the future will be at the discretion of plant staff and will be dictated by the availability of green waste, space in the sludge drying beds, odors, and operator availability. Excess biosolids will continue to be hauled offsite by San Joaquin Composting.

9.2 RECOMMENDATION NO. 1 - EAAS WITH DIRECT HAULING

Recommendation No. 1 includes the construction of two new parallel oxidation ditches at the WWTP with direct hauling of dewatered biosolids offsite by a third party composting facility. In addition to the secondary treatment and biosolids management facilities, the recommendation also includes support facilities such as a new chlorine contact basin, and contingencies for subsoil stabilization and flood impact mitigation measures. The major aspects of the project are described in detail in Sections 8.4.2 and 8.5.2 in Chapter 8 (Alternatives Analysis).

The total project cost for Recommendation No. 1, including the support facilities, has been estimated at $24,168,000, with an associated construction cost of $14,918,000. These figures are given in June 2006 dollars.

The effluent quality produced by the EAAS process will be advanced secondary and the biosolids will be sub-Class B. The biosolids hauled from the WWTP site will be composted at San Joaquin Composting to produce a Class A product for land application. Optional biosolids handling is discussed later in this chapter. The process schematic and conceptual layout for this recommendation are shown in Figure 9.1 and 9.2 respectively.

9.2.1 Recommendation No. 1A - Tertiary Treatment (Optional)

With the EAAS process, the MBCSD has the option to add cloth-media filters, or another type of tertiary filtration, to produce tertiary quality effluent. The specifics regarding tertiary filtration are discussed in detail in Sections 8.4.4 and 8.5.4. The impact on the cost of Recommendation No. 1 would be an incremental $2,065,000 or an overall increase of 8 percent to the cost of the project, and a $47,000 increase in annual operations and maintenance costs.

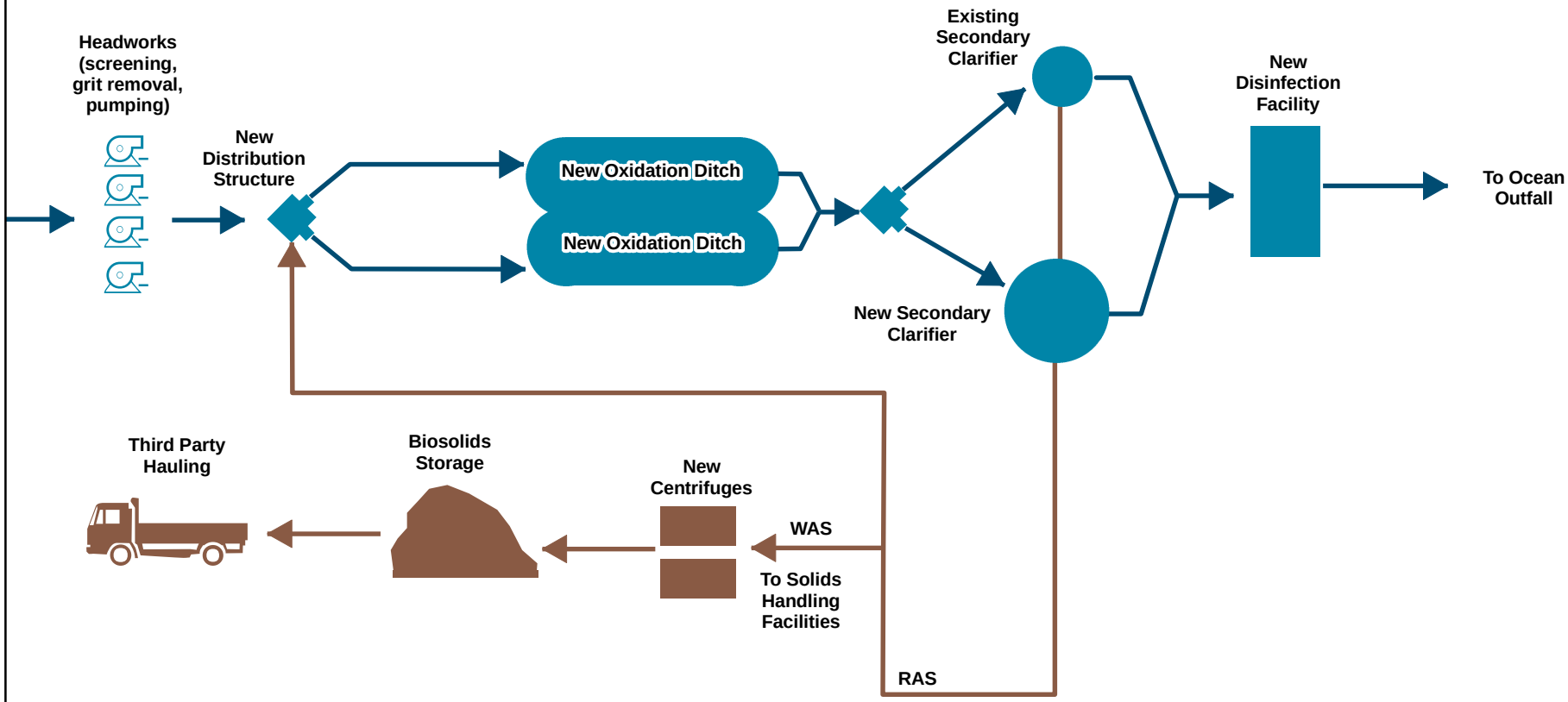

Figure 9.1
Recommendation No. 1 - EAAS With Direct Hauling

WWTP Facility Master Plan
MBCSD

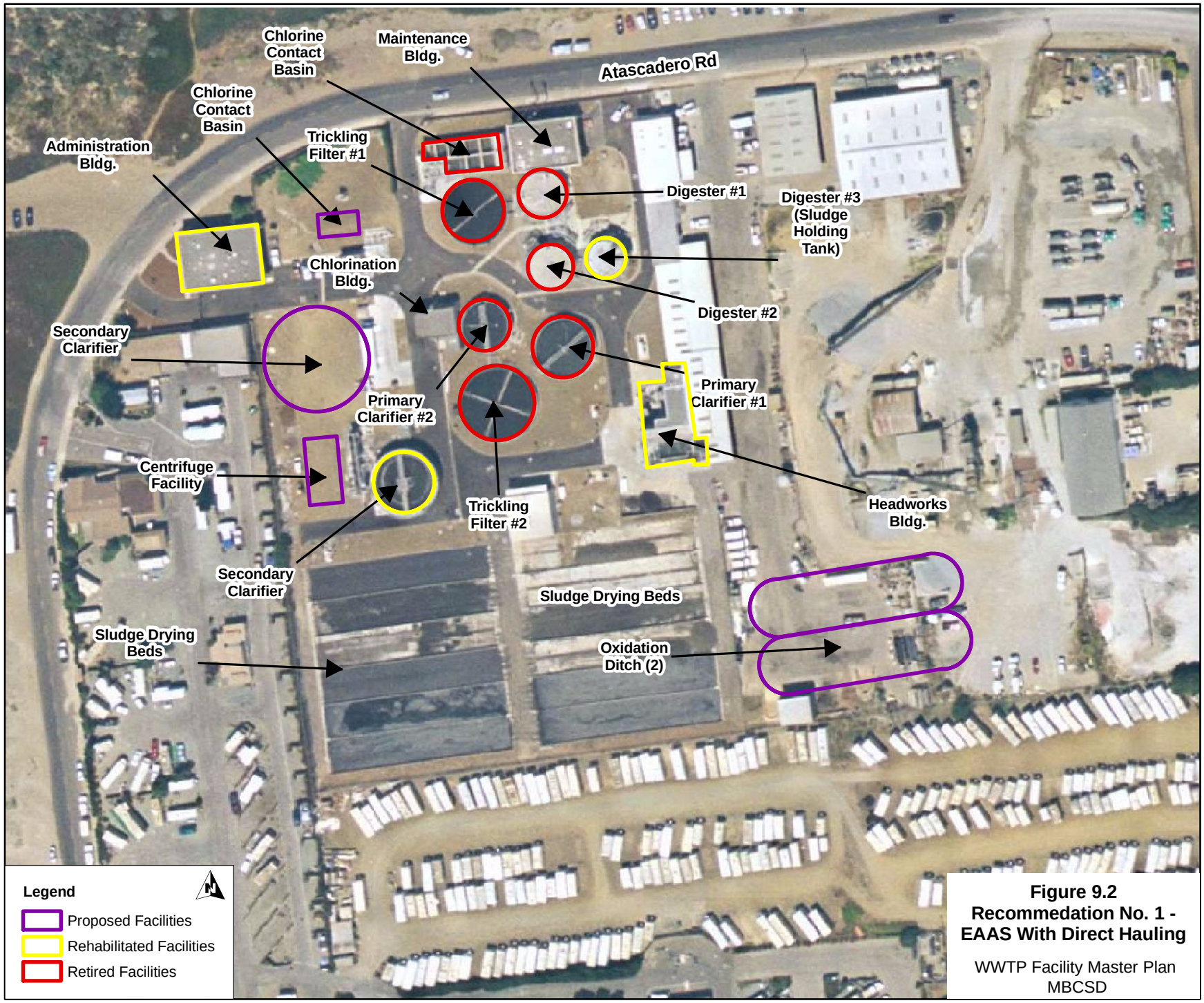

Figure 9.2
Recommedation No. 1 - EAAS With Direct Hauling

WWTP Facility Master Plan
MBCSD

The costs quoted for this tertiary option are for sending tertiary treated effluent to the ocean. In order to produce an effluent that is eligible for unrestricted reuse based on Title 22 standards, additional chlorine contact capacity would be needed.

The process schematic and conceptual layout for this recommendation are shown in Figure 9.3 and 9.4 respectively.

9.2.2 Biosolids Management

Primary and secondary sludge at the MBCSD WWTP is currently pumped from the primary clarifiers to the anaerobic digesters for further treatment. Because of the longer solids retention time (SRT) of the oxidation ditches, the WAS that is produced is stable enough to be hauled from the site without use of the anaerobic digesters. These biosolids will be designated as sub-Class B.

For Recommendation No. 1 and 1A, solids will be sent directly from the secondary clarifiers to a dewatering facility where centrifuges will convert the WAS to a product that can be loaded into trucks and directly hauled away by San Joaquin Composting or another third party composting facility. Digester No. 1 will be demolished, and Digester No. 3 will be partially rehabilitated to serve as a sludge holding tank ahead of the centrifuges. Digester No. 2 will be retired with the option to rehabilitate it in the future in order to accommodate increased onsite composting. The existing sludge drying beds will remain in service and used for emergency sludge storage if the new oxidation ditches are located in an area outside of the existing WWTP footprint.

9.3 RECOMMENDATION NO. 2 - TFSC WITH HAULING

Recommendation No. 2 includes the rehabilitation of both Trickling Filter No. 2 and the existing solids contact basin. In order to bring the secondary treatment capacity of the WWTP to 1.5 mgd, new TFSC basins, and an additional secondary clarifier will be constructed.

The total project cost for Recommendation No. 2 has been estimated at $25,109,000, with an associated construction cost of $15,499,000. Both costs are in June 2006 dollars. The process schematic and conceptual layout for this recommendation are shown in Figure 9.5 and 9.6 respectively. The major components of the TFSC treatment process can be seen in Sections 8.4.1 and 8.5.1.

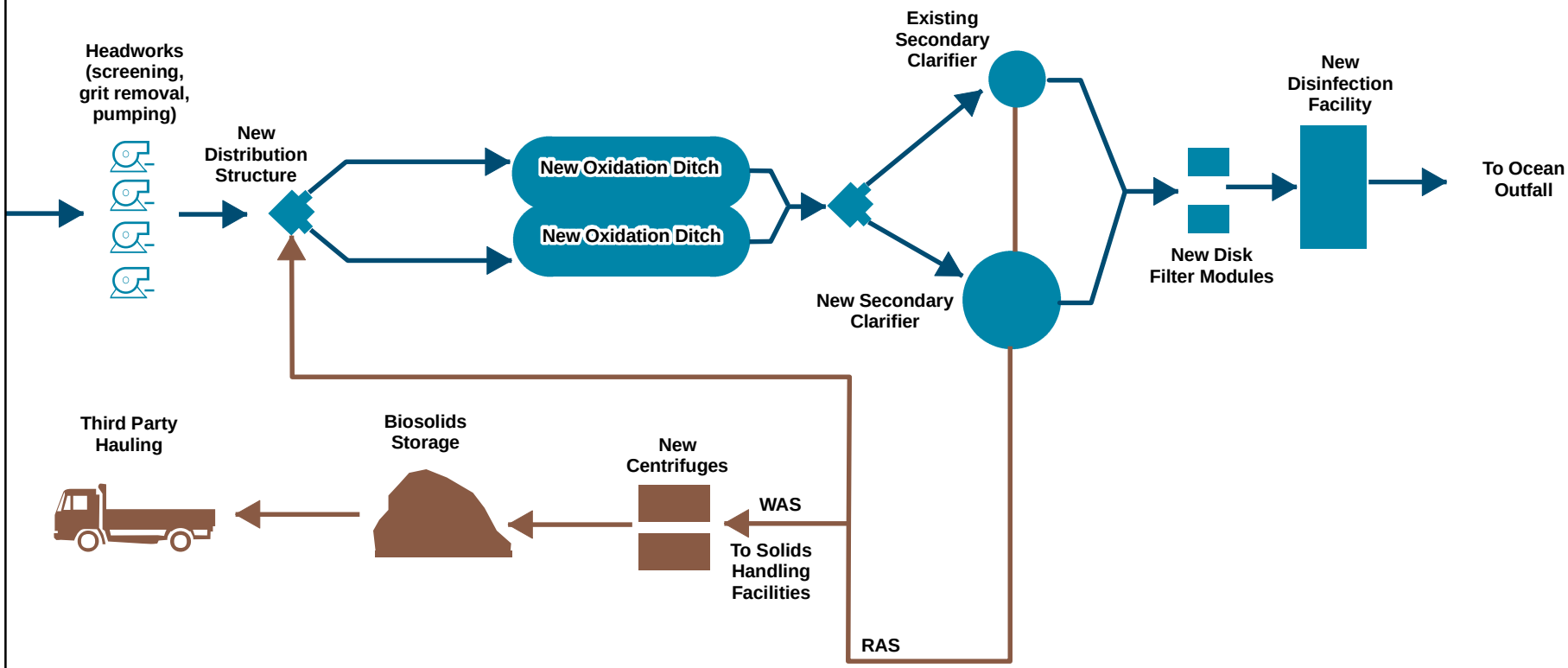

Figure 9.3
Recommendation No. 1A - EAAS/Filtration With Direct Hauling

WWTP Facility Master Plan
MBCSD

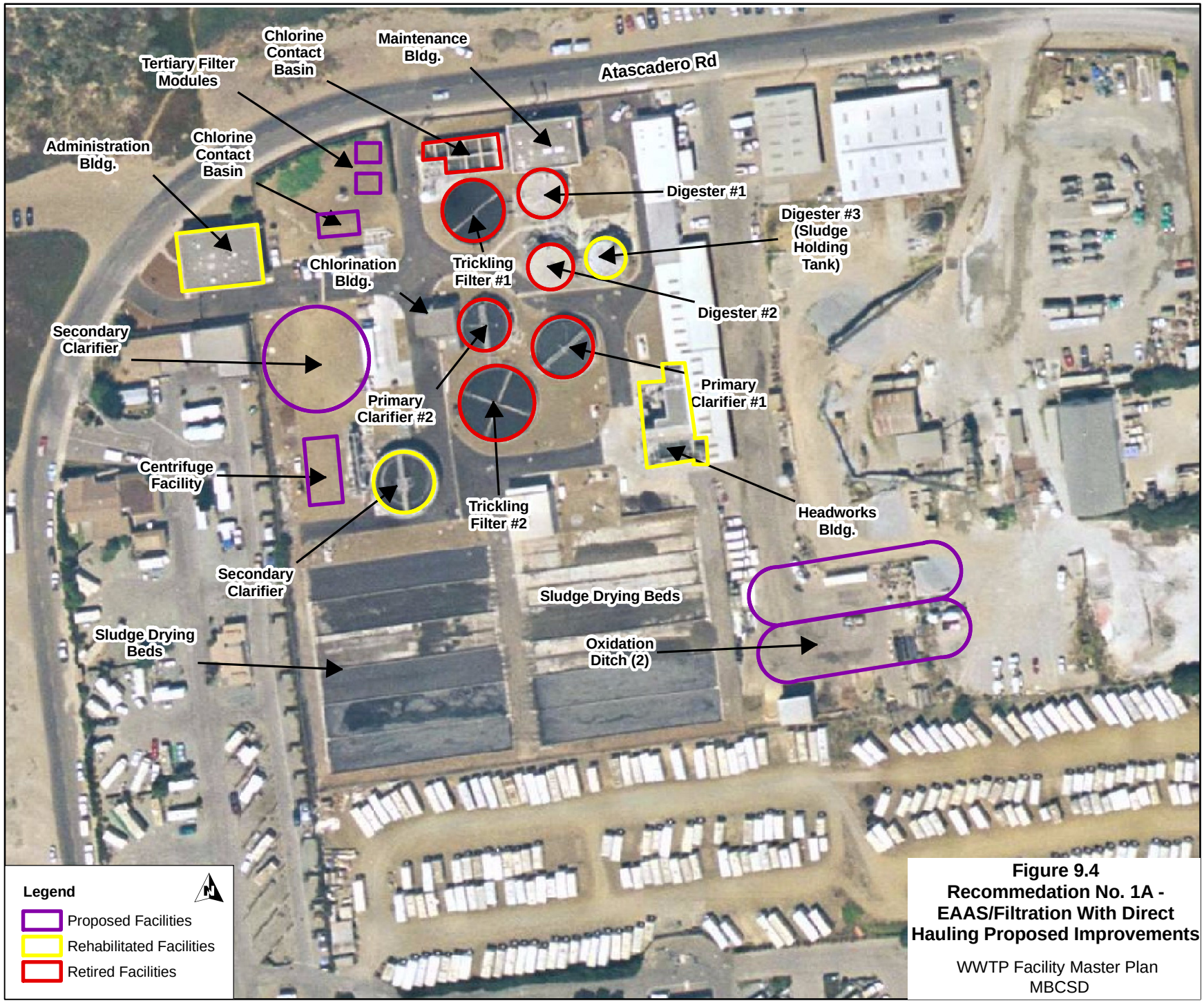

Figure 9.4
Recommedation No. 1A - EAAS/Filtration With Direct Hauling Proposed Improvements

WWTP Facility Master Plan
MBCSD

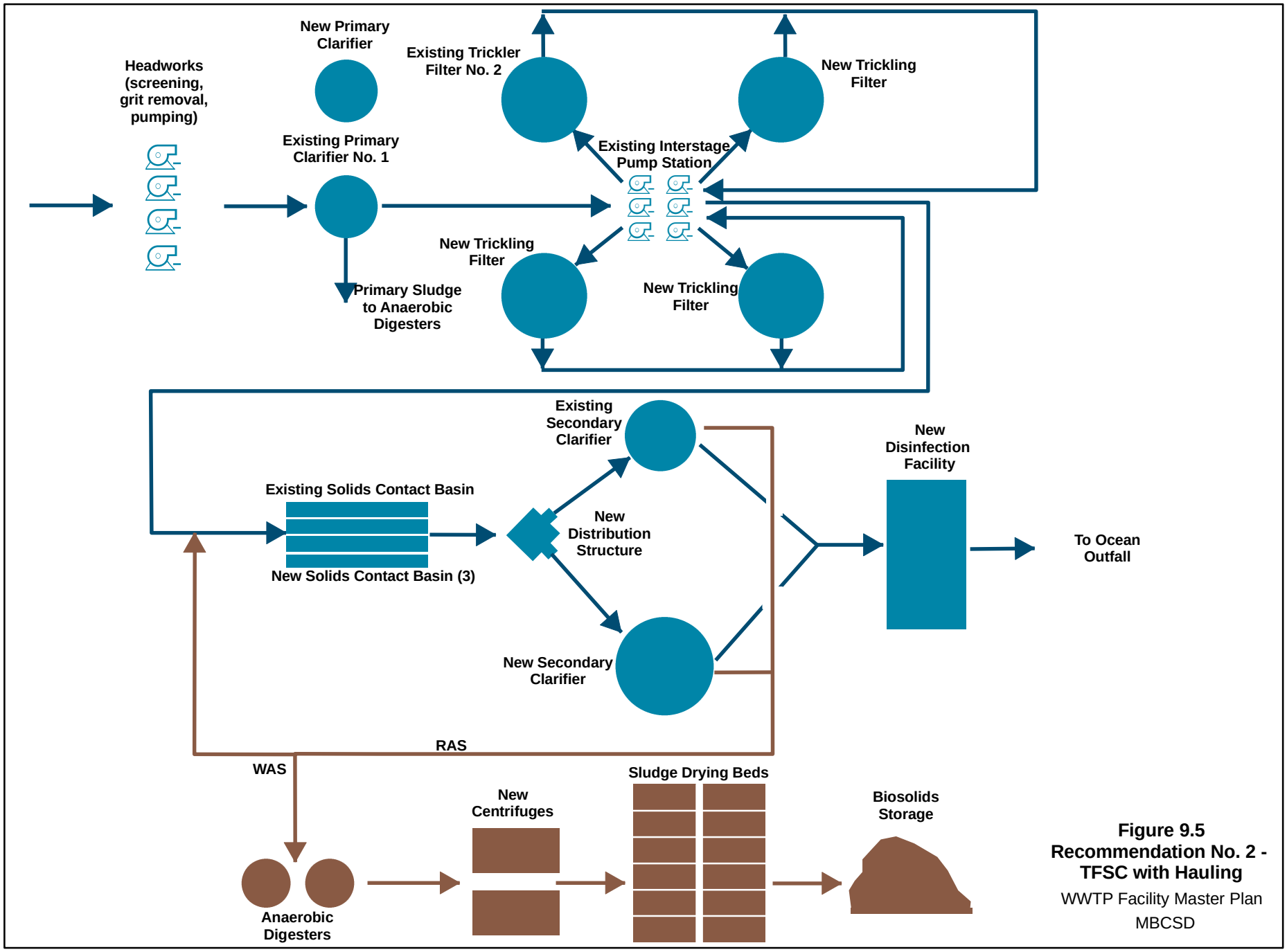

Figure 9.5
Recommendation No. 2 - TFSC with Hauling
WWTP Facility Master Plan
MBCSD

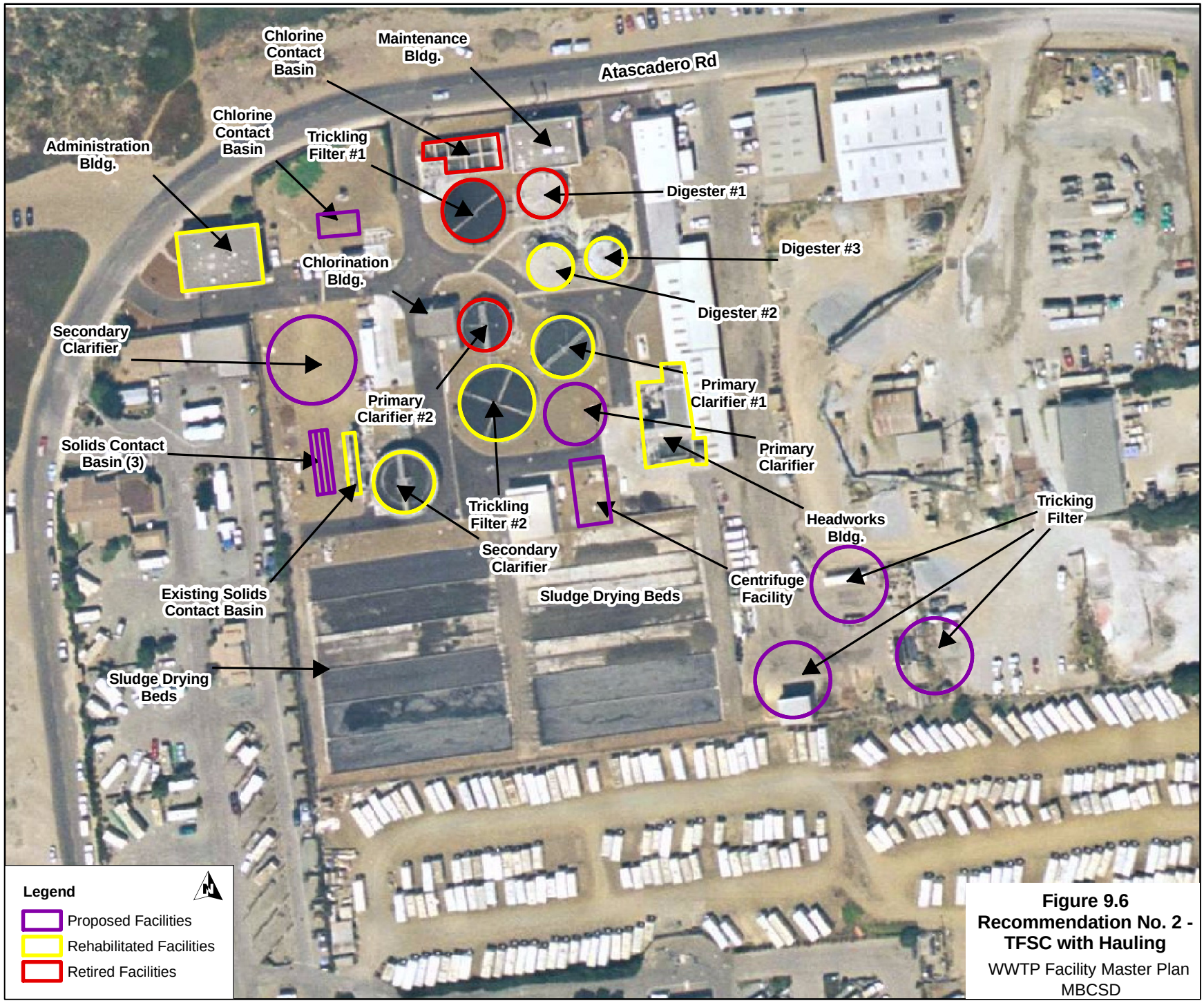

Figure 9.6
Recommendation No. 2 - TFSC with Hauling
WWTP Facility Master Plan
MBCSD

9.3.1 Biosolids Management Facilities

The MBCSD WWTP currently sends primary and secondary sludge to the anaerobic digesters, and on to the sludge drying beds. After the solids are dried, approximately 30 percent is composted onsite in windrows that are maintained by plant staff. The remaining biosolids are stored onsite until they can be hauled away by San Joaquin Composting for further treatment.

The biosolids management practices included in Recommendation No. 2 are a continuation of what is currently being done at the facility. However, in order to expedite the drying process and send a smaller volume of sludge to the sludge drying beds, an outdoor dewatering facility with centrifuges will be constructed. With the use of mechanical dewatering, the biosolids being sent to the sludge drying beds will have a higher solids content, and will take less time to reach the point where they can be hauled or composted. In addition to a new dewatering facility, Digester No. 2 and 3 must be fully rehabilitated and converted to pump mix. Rehabilitation of these digesters represents approximately $1,899,000 of the total direct cost of the project.

With this recommendation, the majority of the biosolids will continue to be disposed of outside of San Luis Obispo County by a third-party, and WWTP staff, at their discretion, can continue to compost a portion of the biosolids to a Class A product onsite.

9.4 RECOMMENDATION NO. 3 - MEMBRANE BIOREACTOR WITH DIRECT HAULING

Recommendation No. 3 includes the construction of a MBR facility at the MBCSD WWTP. The biosolids generated by the MBR will be sent directly to a dewatering facility before being discharged to a container for direct hauling out of San Luis Obispo County. Optional solids handling is discussed later in this chapter.

The total project cost for Recommendation No. 3, in June 2006 dollars, has been estimated at $33,160,000 with an associated construction cost of $20,469,000. This recommendation represents the highest level of treatment available for upgrade of the MBCSD WWTP. Similar to Recommendation No. 1A, the effluent produced by the MBR has the potential to meet the Title 22 requirements for unrestricted reuse. However, like Recommendation No. 1 and 1A, the biosolids produced will be sub-Class B and must be further treated at a facility such as San Joaquin Composting before being land applied outside of San Luis Obispo County. The process schematic and conceptual layout for this recommendation are shown in Figure 9.7 and 9.8 respectively. The main components of the proposed MBR facility are detailed in Sections 8.4.3 and 8.5.3.

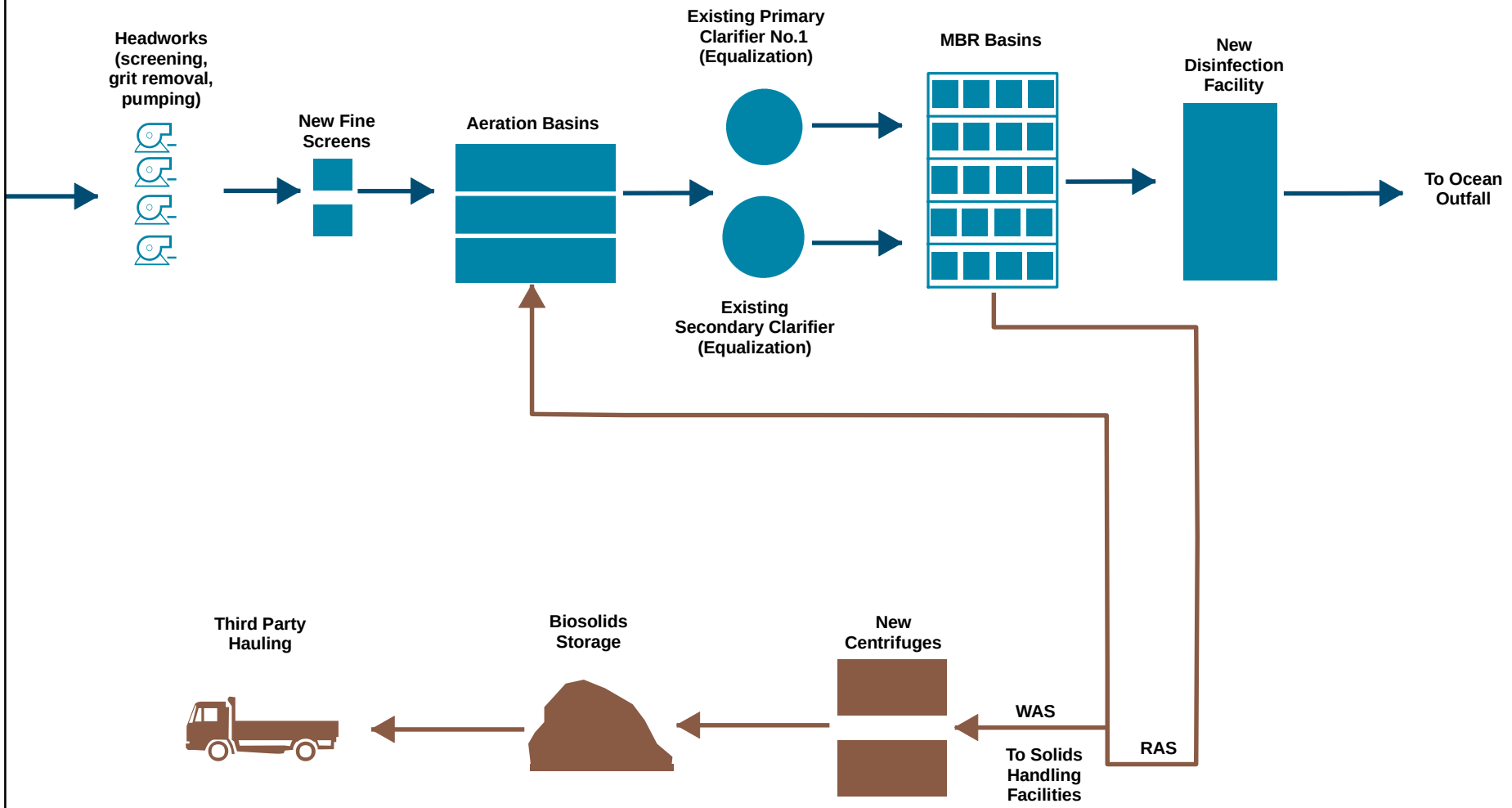

Figure 9.7
Recommendation No. 3 - MBR with onsite Composting
WWTP Facility Master Plan
MBCSD

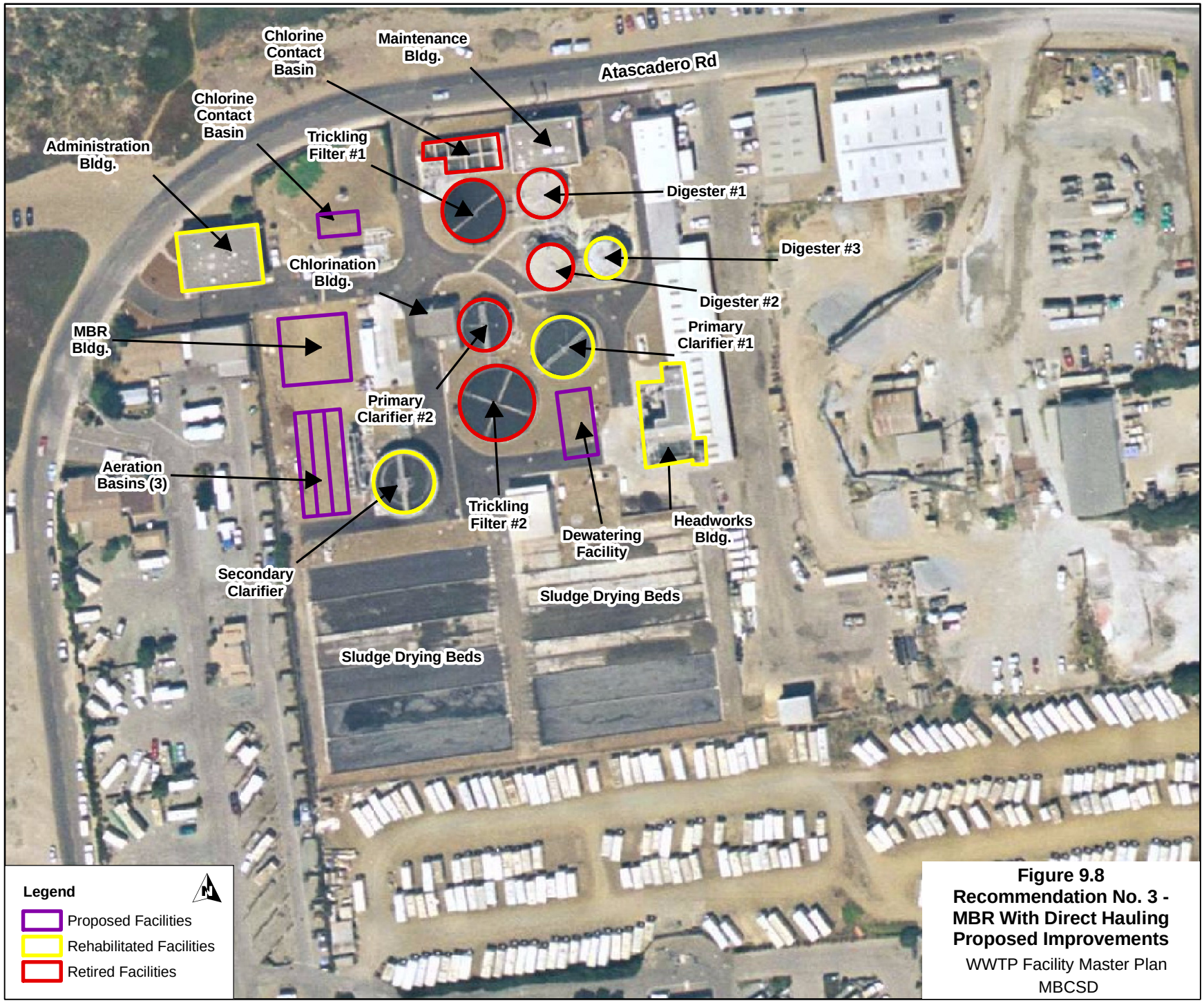

Figure 9.8
Recommendation No. 3 - MBR With Direct Hauling Proposed Improvements
WWTP Facility Master Plan
MBCSD

9.4.1 Biosolids Management Facilities

The biosolids management facilities for Recommendation No. 3 are identical to those already discussed in Section 9.2.2 for Recommendations No. 1 and 1A.

9.5 SUPPORT FACILITIES

Improvements that are needed in other areas of the MBCSD WWTP that are not specifically discussed in the preceding chapters of the facility plan have been identified. These areas include the rehabilitation of the existing headworks, construction of a new chlorine contact basin, replacement of the 3-W pumps, extensive rehabilitation of the existing electrical equipment, improvements to the control building and laboratory, improvement of the plant drain system, subsoil stabilization, and flood impact mitigation. The conditions of these facilities and the recommended improvements are discussed in detail in Chapter 6 (Rehabilitation) of this report. The total estimated project cost for these improvements is $10,853,000. This cost is included in the recommendation options presented previously and detailed in Table 9.1.

Table 9.1 Miscellaneous Improvement and Allowances
WWTP Facility Master Plan
MBCSD

Parameter	Value[1]
Rehabilitation of Headworks	$1,320,000
New Chlorination Facilities	$355,000
Rehabilitation of Control Building	$360,000
Rehabilitation of Electrical Equipment	$945,000
Rehabilitation of Plant Drain System	$19,000
Rehabilitation of 3-W System	$200,000
Subsoil Stabilization	$1,000,000
Flood Impact Mitigation	$2,500,000
Subtotal	**$6,699,000**
Unidentified Item Contingency (20 percent)	$1,340,000
Subtotal Construction Cost 2006[2]	$8,039,000
Engineering, Administrative, and Legal Costs (35 Percent)	$2,814,000
Total Project Cost 2006	**$10,853,000**

Notes:
1. ENR (20 cities) June 2006 = 7,700
2. Includes Contractor overhead and profit.

9.5.1 Headworks

Extensive rehabilitation of the headworks and aerated grit removal basins is needed to increase the reliability of the facility as part of the WWTP upgrade. Major improvements to the headworks include two new modern bar screens with a washer/compactor that will replace the existing channel grinder and bar screens. These new screens will reduce the amount of trash flowing to the downstream processes and help protect the clarifiers and digesters from operational and maintenance problems. In order to increase the pumping capacity of the headworks, a new influent pump and VFD should be also be installed. This pump is needed to accommodate future flow increases as well as provide greater operational flexibility to the facility.

Several major components of the grit removal system have been in service for 20 or more years and have reached their useful life. These items include the exposed air piping, swing arms, diffusers, grit cyclones, and classifier. Rehabilitation of the headworks includes the replacement of this equipment as well as repair of the concrete of the grit basins. The breakdown of rehabilitation costs for the headworks is detailed in Table 9.2.

Table 9.2 Headworks Improvements
WWTP Facility Master Plan
MBCSD

Parameter	Value[1]
New Mechanical Bar Screens	$300,000
New Screening Washer/Compactor	$100,000
New Influent Pump with VFD	$150,000
New Influent Pump Piping	$50,000
New Air Piping for Grit Basins	$250,000
New Grit Cyclone/Classifier	$100,000
New Grit Piping	$50,000
Allowance for Miscellaneous Improvements	$320,000
Subtotal	**$1,320,000**
Unidentified Item Contingency (20%)	$264,000
Subtotal Construction Cost 2006[2]	$1,584,000
Engineering, Administrative, and Legal Costs (35%)	$554,000
Total Project Cost 2006	**$2,138,000**

Notes:
1. ENR (20 cities) June 2006 = 7,700
2. Includes Contractor overhead and profit.

9.5.2 Chlorination/Dechlorination Systems

The MBCSD currently uses sodium hypochlorite (NaOCl) to disinfect blended primary and secondary effluent before it is discharged to the ocean. As an intermediate step between disinfection and ocean discharge, the MBCSD adds sodium bisulfite ($NaHSO_3$) to dechlorinate the effluent to protect aquatic life. For the purpose of this report, Carollo has assumed the MBCSD will continue to chemically disinfect and dechlorinate the wastewater in the future.

As discussed in Chapter 6 of this report, the chlorine contact basin currently in use at the WWTP was built during the original construction of the plant in 1953. Based on direction from the JPA Board, Carollo has been given the discretion to retire the structure during this phase of upgrade of the facility for planning purposes. Therefore, a new chlorine contact basin will be constructed to accommodate a projected peak seasonal dry weather flow (PSDWF) of 1.5 mgd. Based on an actual hydraulic retention time (HRT) of 60 minutes, the volume of the basin will be approximately 63,000 gallons (gal). The design criteria for the chlorine contact basin are shown in Table 9.3.

Table 9.3 Chlorine Contact Basin Design Criteria
WWTP Facility Master Plan
MBCSD

Criteria	Value
Peak Seasonal Dry Weather Flow (mgd)	1.5
Peak Hour Flow (mgd)	5.92
Hydraulic Retention Time at PSDWF (min)	60
Hydraulic Retention Time at PHF (min)	15
Basin Volume (gal)	62,500

In addition to a new chlorine contact basin, the NaOCl and $NaHSO_3$ feed systems were previously highlighted for replacement or rehabilitation. The cost of this rehabilitation as well as the cost of a new chlorine contact basin is listed below in Table 9.4.

It should be noted that the design criteria, and associated costs, provided in this report for a new chlorine contact basin are adequate to meet the anticipated future ocean discharge requirements for the MBCSD. If in the future the decision is made to produce an effluent that meets Title 22 standards for unrestricted reuse, the MBCSD would need to install additional chlorine contact capacity. This additional capacity is needed to increase the total contact time of the basin to 120 minutes, as required by the California Department of Health Services (DHS).

Table 9.4 Chlorination/Dechlorination System Improvements WWTP Facility Master Plan MBCSD	
Parameter	**Value[1]**
Construction of New Chlorine Contact Basin	$180,000
Repair and Replace Chlorine Residual Analyzer	$50,000
Allowance for Piping and Value Replacement	$50,000
Replace Propeller Meter with Mag Meter	$50,000
Allowance for Lighting and Electrical Upgrades	$25,000
Subtotal	**$355,000**
Unidentified Item Contingency (20%)	$71,000
Subtotal Construction Cost 2006[2]	$426,000
Engineering, Administrative, and Legal Costs (35%)	$149,000
Total Project Cost 2006	**$575,000**

Notes:
1. ENR (20 cities) June 2006 = 7,700
2. Includes Contractor overhead and profit

During the design phase, the new chlorine contact basin will be designed so lamps can be easily installed for UV disinfection in the future. Based on the anticipated new NPDES permit, Carollo does not recommend replacing the disinfection process already in place at the MBCSD WWTP at this time. However, recent concerns over the production of disinfection byproducts such as tri-halo methanes (THM) has forced other agencies discharging to inland surface waters to examine disinfection alternatives such as UV, ozonation, or other advanced oxidation processes. This trend has been driven by drinking water regulations, and has been the most prevalent for treatment facilities that discharge into inland surface waters. The implications for ocean dischargers are not as well known at this time. Therefore, alternative disinfection can be examined in the future when more information becomes available.

9.5.3 Electrical Equipment

Based on Carollo's initial assessment of the existing motor control centers (MCC), generator, and main switchgear, the total construction cost of rehabilitation was estimated at $2,850,000. The details of this evaluation are discussed in detail in Chapter 6 of this report. The majority of this cost can be attributed to the replacement of all five existing MCCs.

Based on the extent of these improvements, a more in depth electrical evaluation was performed to refine the rehabilitation costs by one of Carollo's electrical engineers. The results of this evaluation revealed the costs for rehabilitation of the electrical equipment to be much less than originally expected. The electrical costs for the upgrade of the WWTP

are detailed in Table 9.5. The electrical study is also included in Appendix H.

Table 9.5 Electrical Improvements WWTP Facility Master Plan MBCSD	
Parameter	**Value**
Replace Switchgear	$200,000
New Electrical Building	$200,000
Replace MCC-A	$90,000
Rehabilitate MCC-B	$20,000
Replace MCC-C	$245,000
Rehabilitate MCC-C1	$20,000
Replace MCC-D	$150,000
Rehabilitate MCC-E	$20,000
Allowance for Lighting Upgrades	$40,000
Subtotal	**$985,000**
Unidentified Item Contingency (20%)	$197,000
Subtotal Construction Cost 2006[2]	$1,182,000
Engineering, Administrative, and Legal Costs (35%)	$414,000
Total Project Cost 2006	**$1,596,000**
Notes: 1. ENR (20 cities) June 2006 = 7,700 2. Includes Contractor overhead and profit	

9.5.4 Control Building

Several major upgrades to the control building were identified in Chapter 6 of this report. The vast majority of these upgrades are improvements to the laboratory. These improvements include new chemical storage areas and laboratory equipment. In addition to the laboratory improvements listed above, an allowance has been included for other miscellaneous improvements including expansion of the office space, locker rooms, and training room.

9.5.5 3-W Pump Station

While the 3-W Pump Station has been well maintained, minor improvements are needed if the decision is made to use the system after upgrade of the WWTP. Originally, the system was intended to provide wash down water for WWTP staff throughout the facility. However, the use of 3-W has been discontinued because of safety issues associated with the use of a blended primary/secondary effluent. Improvements to the 3-W pump station include the installation of isolation valves to facilitate repair to the system.

9.5.6 Plant Drain System

Drains are located throughout the WWTP site designed to carry runoff offsite. In order to mitigate the potential of wastewater or wash down water reaching the ocean, the improvements are needed to route the plant drains back to the headworks where it can be treated. This can be accomplished by either gravity or sumps with pumps. Changes to the plant drain system will be finalized during the design phase of the project.

9.5.7 Subsoil Stabilization

Based on the last expansion of the WWTP in 1982, subsoil stabilization using vibrocompaction was performed in areas where structures were constructed. The assumption has been made that a similar type of soil preparation will be necessary during this phase of expansion of the WWTP. Therefore, based on direction from Hayward-Baker, a local geotechnial contractor with experience in subsoil compaction, a $1,000,000 contingency has been added to the construction costs for each alternative to cover the cost of subsoil stabilization over a one-acre area. The details regarding vibrocompaction are discussed in detail in Chapter 4 (Subsoil Stabilization) of this report.

9.5.8 Flood Impact Mitigation

A construction contingency of $2,500,000 ($4,050,000 in project cost) has been added to the construction cost of each recommendation that has been developed by Carollo to cover the cost of flood impact mitigation measures that will need to be addressed during construction of this phase of upgrade to the WWTP. The extent of these measures is unknown at this time, and will require a more in-depth study to determine the actual costs prior to or during the design process. Carollo is currently working with Wallace Group to determine the cost of this type of study.

9.6 COMPARISON OF RECOMMENDATIONS

While a detailed comparison of secondary and tertiary treatment alternatives was performed in Chapter 8 of this report, a comparison of Carollo's final recommendations will also be made. This critical comparison aided the JPA Board in choosing a project for upgrade of the MBCSD WWTP. The criteria included in this comparison are cost, regulatory compliance, and operational factors.

9.6.1 Costs

Included in Table 9.6 is a breakdown of Carollo's opinion of estimated project and operations and maintenance costs for each alternative. In addition to these costs, the total present value (PV) has also been included. For a detailed discussion of PV cost, see Section 8.6.1 in Chapter 8 of this report.

Table 9.6 Summary of Present Value Costs (20 Years)
WWTP Facility Master Plan
MBCSD

Recommendation	Description	Effluent Classification	Estimated Costs			
			Project	Annual O&M Cost	O&M Present Value (20 Years)	Total Present Value
No. 1	EAAS with Direct Hauling	Secondary	$24,168,000	$1,727,000	$24,933,000	$49,101,000
No. 1A	EAAS/Filtration with Direct Hauling	Tertiary	$26,233,000	$1,774,000	$25,613,000	$51,846,000
No. 2	TFSC with Hauling	Secondary	$25,109,000	$1,661,000	$23,977,000	$49,086,000
No. 3	MBR with Direct Hauling	Tertiary	$33,160,000	$2,038,000	$29,422,000	$62,582,000

A detailed cost breakdown for each recommendation is shown in Appendix L. The construction costs developed for this chapter includes all the components of a complete project for upgrade of the WWTP to a secondary or tertiary capacity of 1.5 mgd. Whereas previous costs, presented in Chapter 7 and 8 of this report, only included rehabilitation of the preliminary treatment facilities (headworks) and rehabilitation or construction of secondary or tertiary facilities, these costs include additional components such as a new chlorine contact basin, biosolids management facilities, subsoil stabilization, and a contingency for flood impact mitigation. The breakdown of project costs between different facilities for each recommendation is shown in Table 9.7.

Table 9.7 Breakdown of Total Project Costs
WWTP Facility Master Plan
MBCSD

	Recommendations			
Process Area	**Rec. No. 1 EAAS w/Direct Hauling**	**Rec. No. 1A EAAS/Filtration w/Direct Hauling**	**Rec. No. 2 TFSC w/Hauling**	**Rec. No. 3 MBR w/Direct Hauling**
Rehabilitation	$4,834,000	$4,834,000	$6,077,000	$4,956,000
Secondary Treatment	$9,835,000	$10,180,000	$8,223,000	-
Tertiary Treatment	-	$1,722,000	-	$18,757,000
Biosolids Dewatering	$2,749,000	$2,749,000	$4,275,000	$2,749,000
Disinfection	$575,000	$575,000	$575,000	$575,000
Demolition, Subsoil Stabilization, Flood Impacts	$6,172,000	$6,172,000	$5,957,000	$6,122,000
Total Project Cost	**$24,165,000**	**$26,232,00**	**$25,107,000**	**$33,159,000**

9.6.2 Regulatory Compliance

This section describes the effluent and biosolids qualities produced by each of the recommendations being presented in this chapter. The recommended projects produce a range of effluent qualities from a quality capable of meeting the future discharge permit to the best available tertiary quality.

9.6.3 BOD_5 and Solids Removal

Traditionally, wastewater quality is described in terms of the level of organics BOD_5 and TSS that are present in the effluent stream. While a lot of discussion has recently focused

on the benefits of tertiary treatment over secondary treatment, the difference in effluent quantity for the MBCSD has not been quantified. It is important to note the amount of solids and organics that are currently being discharged into Estero Bay and in the future with the implementation of each of the recommendations that is being presented.

Table 9.8 and 9.9 summarize the difference in effluent quality for several different scenarios including the current permit limits, current effluent quality, future permit limits, and the recommendations.

Table 9.8 Organic Loading to Estero Bay
WWTP Facility Master Plan
MBCSD

Condition	BOD_5 Concentration (mg/L)	Annual Loading[3] (lbs BOD/year)	Percent Removal
Current Permit Limits[1]	120	475,000	60.4%
Current Discharge[2]	45	198,000	83.8%
New Secondary Permit Limits	30	119,000	91.2%
Recommendation No. 1	5	20,000	98.5%
Recommendation No. 1A	3	12,000	99.1%
Recommendation No. 2	20	79,000	94.1%
Recommendation No. 3	2	8,000	99.4%

Notes:
1. Average monthly BOD_5 concentration of 120 mg/L and maximum of 180 mg/L.
2. Current discharge based on the 2006 annual average BOD_5 concentration and flow of 1.3 mgd.
3. Loading based on annual average flow of 1.3 mgd at build-out.

9.6.4 Biosolids Treatment

An important consideration when choosing a recommended project for upgrade of the MBCSD WWTP is the disposal of biosolids that result from the biological treatment process. While different levels of biosolids treatment and management options were discussed in Chapter 7 (Biosolids Treatment and Disposal) of this report, more focus tends to be put on the wastewater treatment process when choosing a final project. At this time, two basic options exist for disposal of biosolids for the MBCSD. These options include disposing of biosolids within San Luis Obispo County or continuing to haul biosolids out of the county to a third-party facility for further treatment and land application. The possible biosolids management options available for upgrade of the WWTP and the impact of these options on the total project cost are discussed in detail below.

The MBCSD currently treats primary and WAS in anaerobic digesters. Treated sludge is then sent to the sludge drying beds until it has reached solids concentrations of between 80 and 90 percent. Historically, the majority of these dried solids were stored onsite until

they were hauled away by San Joaquin Composting. In recent years, MBCSD staff has begun composting a portion of its biosolids onsite. Approximately 30 percent of the biosolids produced annually are combined with green waste and formed into windrows for composting. This process is currently done in the sludge drying beds, and the resulting compost meets the requirements for EQ Class A biosolids, allowing for beneficical resuse within the local community. Plant staff has been able to keep annual biosolids hauling costs low by minimizing the moisture content of the biosolids transported by San Joaquin Composting.

Table 9.9 Solids Loading to Estero Bay WWTP Facility Master Plan MBCSD

Condition	TSS Concentration (mg/L)	Annual Loading[3] (lbs TSS/year)	Percent Removal
Current Permit Limits[1]	70	277,000	81.2
Current Discharge[2]	21	95,000	93.2
New Secondary Permit Limits	30	119,000	91.7
Recommendation No. 1	5	20,000	98.6
Recommendation No. 1A	2	8,000	99.4
Recommendation No. 2	20	79,000	94.4
Recommendation No. 3	1	4,000	99.7

Notes:
1. Average monthly TSS concentration of 70 mg/L and maximum of 105 mg/L.
2. Current discharge based on the 2006 annual average TSS concentration and flow of 1.3 mgd.
3. Loading based on annual average flow of 1.3 mgd at build-out.

9.6.4.1 Biosolids Hauling

The four recommendations previously discussed for upgrade of the MBCSD WWTP included some form of biosolids hauling. For these recommendations, biosolids would be treated to either a sub-Class B or Class B product before being hauled to nearby Kings County by San Joaquin Composting. Providing this level of biosolids treatment would prevent the MBCSD from land applying these biosolids within the county.

Applying similar biosolids management options for each recommendation, allows for an accurate comparison of the wastewater treatment alternatives. However, in addition to the type of wastewater treatment process included in the recommended project, the JPA Board must also choose between hauling and composting to manage biosolids in the future. All of the recommendations previously presented can be paired with onsite composting to allow the MBCSD to dispose of biosolids within San Luis Obispo County and promote sustainability within the community. The cost of adding composting to these

recommendations and a comparison of these biosolids management options is presented below.

Recommendation No. 1, 1A, and 3 include retirement of the existing digesters and sludge drying beds. The WAS produced by the oxidation ditches or membrane bioreactors will be mechanically dewatered and discharged directly to a bin or trailer for offsite hauling. The resultant biosolids will not meet the requirements for a Class B product, which have been termed sub-Class B.

While the biosolids the MBCSD currently produces and has hauled offsite are designated Class B, San Joaquin Composting will continue to be able to accept sub-Class B biosolids from the WWTP in the future. However, the MBCSD will have to pay a slightly higher tipping fee, and the number of trips made to haul biosolids from the WWTP to Kings County will increase. The biosolids hauling costs paid by the MBCSD will also increase due to the higher moisture content of the product being hauled. A detailed estimate of biosolids hauling costs for different treatment scenarios are give in Table 7.13 in Chapter 7 of this report.

Implementation of direct hauling for future biosolids handling represents the least cost alternative for upgrade of the WWTP in the near term. Direct hauling does not require rehabilitation of the anaerobic digesters, expansion of the WWTP site outside of its current footprint, or continued use of the sludge beds. However, without the rehabilitation of the digesters, the WWTP will no longer be able to continue composting onsite.

Recommendation No. 2, while also employing offsite disposal for biosolids management, requires the rehabilitation of the anaerobic digesters and the continued use of the sludge drying beds. This option represents the type of biosolids management that is currently being practiced at the MBCSD WWTP. Because the biosolids produced will continue to be treated in the anaerobic digesters, the resulting biosolids will meet the requirements for a Class B product. As discussed in Chapter 8 of this report, continuing to use the TFSC process at the WWTP in the future requires the rehabilitation and use of the anaerobic digesters. Therefore, the option to mechanically dewater the biosolids and directly haul them offsite is not available for Recommendation No. 2. Sludge from the primary clarifiers and TFSC process must first be treated in the anaerobic digesters and solar dried before they can be hauled away by San Joaquin Composting. Since 2002, the WWTP staff has also been composting a portion of the biosolids onsite. The amount of composting at this time is dictated by operator availability, green waste availability, and space constraints at the facility. Based on discussion with WWTP staff, the pilot scale composting operation has been doing well, and community feedback has been positive.

Implementation of this recommendation would require the WWTP to expand outside of its current footprint. This additional land will accommodate the three new trickling filters needed to increase the secondary capacity of the facility without retiring any of the existing sludge drying beds. Based on discussion with WWTP staff, the location of the new trickling filters has been shown in an area east of the current WWTP site, which is currently owned

by the City and used for trailer storage. The proposed location for construction of the new trickling filters is shown in Figure 9.6.

9.6.4.2 Composting

Due to regulations in place in San Luis Obispo County, biosolids must first be treated to a Class A product before they can be land applied. While several methods for producing Class A biosolids were discussed in Chapter 5 of this report, the preferred Class A treatment alternative was determined to be composting, since it is already in practice at the facility. While the MBCSD WWTP currently composts a portion of its biosolids in the sludge drying beds, additional area is needed to construct additional windrows. The MBCSD would be able to dispose of the total quantity of biosolids within San Luis Obispo County produced if the decision is made to expand the composting area and implement full-scale onsite composting.

Because of the size constraints of the existing site, which were discussed previously, the WWTP must expand outside of its current footprint if full-scale composting is chosen as the biosolids management option in the future. The new composting area will be approximately 250 feet by 150 feet and has been tentatively located to the east of the WWTP site in an area jointly owned by the City and CSD. This area is currently leased to a third party. At this time, there is uncertainty regarding the land application of biosolids within San Luis Obispo County. A temporary ordinance was filed in March 2004, and was renewed in February 2006, limiting the amount of EQ biosolids that can be annually land-applied within the county. However, this temporary ordinance exempted biosolids composted with green waste, which is what is currently practiced at the MBCSD. A draft of a new permanent ordinance limits the application of EQ biosolids in the county, but does not exclude biosolids composted with green waste.

The possibility of a permanent ordinance or other future regulations that limit the application of EQ Class A biosolids within San Luis Obispo County call into question the viability of composting as a long-term sustainable solution to biosolids disposal. This possibility must be weighed with the significant cost to implement full-scale composting at the MBCSD WWTP, which includes rehabilitation of the anaerobic digesters and significantly expansion of the existing WWTP site.

Based on the current uncertainty surrounding biosolids regulations in both San Luis Obispo County and the Central Valley, the decision to continue hauling biosolids offsite can be chosen as a near-term solution, and leave the option open for composting in the future. This option would entail continued use of the sludge drying beds, leaving Digester No. 2 in its current state, and ensuring land outside of the existing footprint is available to accommodate the composting area. Digester No. 3, which would be partially rehabilitated to serve as a sludge holding tank in the direct hauling scenario, would be full rehabilitated in the future to anaerobically digest sludge prior to composting. Digester No. 2 would also need to undergo full rehabilitation in the future in order to accommodate composting.

9.6.4.3 Partial Composting

Due to some of the challenges highlighted above for implementing full-scale composting at the MBCSD WWTP, Carollo has developed the costs for partial composting as a third biosolids management option. In this scenario, plant staff would continue to compost a portion of their biosolids onsite, and have the remaining biosolids hauled offsite by San Joaquin Composting. The amount of composting done onsite would be at the discretion of plant staff and would depend on operator availability, weather, drying bed space, and available green waste.

The cost impacts of partial composting for Recommendations No. 1, 1A, and 3 are very similar to the cost of full-scale composting. The major component of the total project cost for these options is the rehabilitation of the existing anaerobic digesters. This cost has been estimated at approximately $2 million. Partial composting, like full-scale composting, would require full rehabilitation of the digesters.

The ancillary composting equipment such as a front-end loader, turner, and screen are also include as part of the partial composting option. As mentioned previously, Carollo recommends the MBCSD purchase this equipment prior to upgrade of the WWTP to improve the efficiency of the existing process and the quality of the composted product. The composting equipment represents approximately $150,000 to the total project cost for each recommendation. However, the partial composting option does not include the addition of a new composting area or additional plant staff. Windrows will continue to be managed in the existing sludge drying beds.

9.6.4.4 Evaluation of Biosolids Management Options

In order to evaluate the impact of biosolids disposal within San Luis Obispo County on the project cost for each recommendation, the additional cost of full-scale and partial composting has been determined. Tables 9.10 and 9.11 show the cost for each recommendation as well as the incremental project and operations and maintenance costs associated with differenct levels of composting. It should be noted that the relative impact of composting on the total project cost for Recommendation No. 2 is less than for the other recommendations. This difference is due to the cost of full digester rehabilitation, which is required for Recommendation No. 2 with hauling.

In order to evaluate the non-economic impacts of different biosolids management options, a matrix has been constructed comparing offsite hauling and composting. The matrix includes important selection criteria that have been developed by Carollo with the assistance of both City and CSD staff. The matrix is presented in Table 9.12.

Table 9.10 Cost Impact of Full-Scale Composting
WWTP Facility Master Plan
MBCSD

Recommendation	Description	Project	O&M	O&M Present Value (20 Years)	Total Present Value
No. 1	EAAS with Direct Hauling	$24,168,000	$1,727,000	$24,933,000	$49,101,000
	Additional Cost for Composting	$2,353,000	-$70,000	-$1,010,000	$1,343,000
	Total	**$26,251,000**	**$1,657,000**	**$23,293,000**	**$50,444,000**
No. 1A	EAAS/Filtration with Direct Hauing	$26,233,000	$1,774,000	$25,613,000	$51,846,000
	Additional Cost for Composting	$2,355,000	-$70,000	-$1,009,000	$1,346,000
	Total	**$28,588,000**	**$1,704,000**	**$24,604,000**	**$53,192,000**
No. 2	TFSC with Hauling	$25,109,000	$1,661,000	$23,977,000	$49,086,000
	Additional Cost for Composting	$779,000	$20,000	$292,000	$1,071,000
	Total	**$25,888,000**	**1,681,000**	**$24,269,000**	**$50,157,000**
No. 3	MBR with Direct Hauling	$33,160,000	$2,038,000	$29,422,000	$62,582,000
	Additional Cost for Composting	$2,356,000	-$70,000	-$1,009,000	$1,347,000
	Total	**$35,516,000**	**$1,968,000**	**$28,413,000**	**$63,929,000**

Notes:
1. ENR (20 cities) June 2006 = 7,7000
2. Includes Contractor overhead and profit.

Table 9.11 Cost Impact of Partial Composting
WWTP Facility Master Plan
MBCSD

		Estimated Costs			
Recommendation	**Description**	**Project**	**O&M**	**O&M Present Value (20 Years)**	**Total Present Value**
No. 1	EAAS with Direct Hauling	$24,168,000	$1,727,000	$24,933,000	$49,101,000
	Partial Composting Cost	$1,815,000	-$94,000	-$1,359,000	$456,000
	Total	**$25,983,000**	**$1,633,000**	**$23,574,000**	**$49,557,000**
No. 1A	EAAS/Filtration with Direct Hauing	$26,233,000	$1,774,000	$25,613,000	$51,846,000
	Partial Composting Cost	$1,819,000	-$94,000	-$1,358,000	$461,000
	Total	**$28,052,000**	**$1,680,000**	**$24,255,000**	**$52,307,000**
No. 2	TFSC with Hauling	$25,109,000	$1,661,000	$23,977,000	$49,086,00
	Partial Composting Cost	$779,000	-$6,000	-$87,000	$156,000
	Total	**$25,888,000**	**1,655,000**	**$23,890,000**	**$49,242,000**
No. 3	MBR with Direct Hauling	$33,160,000	$2,038,000	$29,422,000	$62,582,000
	Partial Composting Cost	$2,356,000	-$94,000	-$1,357,000	$462,000
	Total	**$35,516,000**	**$1,944,000**	**$28,065,000**	**$63,044,000**

Notes:
1. ENR (20 cities) June 2006 = 7,7000
2. Includes Contractor overhead and profit.

Table 9.12 Biosolids Management Selection Criteria WWTP Facility Master Plan MBCSD		
Factor	**Hauling**	**Composting**
Biosolids Produced	Class B/ sub-Class B	Class A
Local Sustainability	Low	Higher
Project Cost	Minimal	Higher
Hauling costs	Higher	Minimal
Operation Cost	Low	Higher
Solids Disposal in County	None	Good
Truck Traffic from Outside County	Higher	Minimal
Odors	Low	Potential
Electricity Usage	Low	Higher
Ease of Operation	Easy	Moderate
Footprint	Minimal	Moderate

9.6.5 Operational Factors

The existing staffing at the MBCSD will be discussed below as well as Carollo's estimates for staffing needs for each recommendation that has been presented in this report.

9.6.5.1 Current Staffing Levels

The MBCSD WWTP currently employs eight staff members that manage and operate the facility. This staff includes seven operators and the plant superintendent. This staff is not responsible for maintaining the collection systems of either the City or CSD. In addition to running the WWTP, the operators also perform routine maintenance and small capital improvement projects that can be handled in house. The MBCSD does not employ a separate maintenance crew at this time. Based on discussion with WWTP staff, the creation of a separate maintenance crew is not anticipated following the upgrade. The MBCSD WWTP also utilizes one of the operators on staff to perform laboratory tasks. Using an operator in the laboratory rather than a dedicated laboratory analyst, gives the WWTP more staffing flexibility.

During the week, the WWTP is staffed for one full-time day shift. On Saturday and Sunday, two operators are onsite for a full shift. While the primary responsibility of the weekend operators is overseeing the facility and performing required lab responsibilities, they are also able to perform routine maintenance tasks as needed. The additional staffing during the weekends is appropriate for the treatment process currently in use at the WWTP. With almost 50 associated facilities and pieces of equipment, the TFSC process is complex and more difficult to manage than other treatment processes with fewer components. The TFSC is also sensitive and requires operator attention to maintain a consistent effluent quality capable of meeting the future anticipated permit limits.

9.6.5.2 Recommendation No. 1 - EAAS with Direct Hauling

Recommendation No. 1 has a lower staffing requirement than what is currently practiced at the MBCSD WWTP. The major facilities associated with Recommendation No. 1 that require operator attention include the headworks, oxidation ditches, secondary clarifiers, and centrifuges. After the biosolids are dewatered, they will be stored onsite until they are hauled away by a third party.

Based on the number of facilities that will be operated at the WWTP in the future with Recommendation No. 1, as well as the ease of operation of the oxidation ditch process, the MBCSD could reduce its staff from eight to seven persons. These seven employees would include the plant superintendent, one operator assigned to manage the laboratory, and five operators responsible for operations and maintenance of the different treatment processes onsite.

9.6.5.3 Recommendation No. 1A - EAAS/Filtration with Direct Hauling

The staffing requirements for Recommendation No. 1A would be the same as Recommendation No. 1. The installation of cloth-media filters following the EAAS process will not require the work of additional WWTP staff. Carollo recommends reducing the staff at the MBCSD to a total of seven, and continuing the current practice of weekend staffing.

9.6.5.4 Recommendation No. 2 - TFSC with Hauling

Recommendation No. 2 has the highest staffing requirements of any of the recommendations being presented. This recommendation represents full rehabilitation of the existing treatment facilities at the WWTP including the TFSC basin, and anaerobic digesters. After being dried in the sludge drying beds, biosolids will be stored onsite until they are hauled away by a third party. The size and extent of the onsite composting operation will be determined by site constraints and staff availability.

Carollo recommends that with the continued use of the trickling filters and anaerobic digesters, the WWTP should continue to be staffed as it is today with eight total employees. Due to the number of facilities associated with the trickling filters including the interstage pump station, primary clarifiers, and solids contact basins, the practice of weekend staffing should also be continued. Unlike the EAAS process, the TFSC process requires greater operator attention to consistently produce an effluent that will meet the anticipated future discharge requirements.

9.6.5.5 Recommendation No. 3 - MBR with Direct Hauling

Recommendation No. 3 includes the construction of a new MBR facility with the incorporation direct hauling of biosolids. This recommendation includes new aeration basins, MBR facilities, and mechanical dewatering in the form of centrifuges.

The staffing requirements for the MBR and centrifuge facilities will be less than Recommendation No. 2 and the existing practice at the WWTP. With the implementation of Recommendation No. 3, the MBCSD will be able to decrease the number of staff from eight

to seven. Six operators will be needed to operate the MBR and new biosolids management facilities. An operator will also continue to manage the laboratory.

Due to the number of facilities and pieces of equipment that must be managed between the MBR and the new biosolids management practice, Carollo recommends the MBCSD continue to staff two operators during the weekend. In addition to operating and monitoring the MBR facility, these weekend man-hours can also be used to clean and maintain the membranes.

Table 9.13 summarizes the staffing requirements for each recommendation described above.

Table 9.13 Summary of Staffing Recommendations
WWTP Facility Master Plan
MBCSD

Condition	Number of Staff	Approx. Annual Staffing Costs
Current Operation	8	$643,000
Recommendation No. 1	7	$563,000
Recommendation No. 1A	7	$563,000
Recommendation No. 2	8	$643,000
Recommendation No. 3	7	$563,000

9.7 SUMMARY OF RECOMMENDED PROJECTS

With the exception of Recommendation No. 3, the cost of all the projects are within approximately $2.5 million. In addition to cost, selection of a recommended project should be based on several factors and not solely on cost. To critically evaluate the recommendations, two decision matrices that rank the recommendations have been prepared. These matrices include many factors that have been voiced as areas of concern by the JPA Board during development of the treatment alternatives and biosolids management options. These factors have been divided into two tiers by Carollo based on their importance to the decision making process. The ranking factors are as follows:

- The most desirable alternative for each factor is given a rating of 1.
- The least desirable alternative for each factor is given a rating of 4.

The ranking system, is presented in Tables 9.14 and 9.15.

Table 9.14 First Tier Selection Criteria WWTP Facility Master Plan MBCSD

Factor	Rec. No. 1-EAAS w/Direct Hauling	Rec. No. 1A-EAAS/Filtration w/Direct Hauling	Rec. No. 2-TFSC w/Hauling	Rec. No. 3-MBR w/Direct Hauling
Effluent Quality	3	2	4	1
Project Costs	1	3	2	4
Operating Costs	2	2	1	3
Ease of Operation	1	2	4	3
Footprint	2	2	2	1
Score	**9**	**11**	**13**	**12**

Table 9.15 Second Tier Selection Criteria WWTP Facility Master Plan MBCSD

Factor	Rec. No. 1-EAAS w/Direct Hauling	Rec. No. 1A-EAAS/Filtration w/Direct Hauling	Rec. No. 2-TFSC w/Hauling	Rec. No. 3- MBR w/Direct Hauling
Accommodation of Varying Flows and Loads	1	1	3	2
Potential for future Reuse	2	1	3	1
Utilization of Existing Infrastructure	2	2	1	2
Odors	1	1	2	1
Emerging Contaminant Removal	2	2	3	1
Score	**17**	**18**	**25**	**19**

Based on the results of the decision matrices, Recommendation No. 1 - EAAS with Direct Hauling has a total score of 17, the lowest score of all the recommendations. With 18, Recommendation No. 1A has the second lowest score. The recommendation with the highest score of 25 is Recommendation No. 2 - TFSC with Hauling.

9.8 FINAL RECOMMENDED PROJECT

9.8.1 Description of Final Recommended Project

Based upon the evaluation of the economic and non-economic factors, the final recommended alternative for upgrading the MBCSD WWTP is the EAAS/Filtration with partial composting option. Included in the project would be upgrades and/or expansion to the existing support facilities.

The project would include rehabilitation of the existing headworks to increase its capacity and reliability. After rehabilitation, the headworks would be able to handle the anticipated PHF of 5.92 mgd. It would include new mechanical bar screens, screenings washer/compactor, influent pump with VFD, and other miscellaneous improvements to the headworks and grit chamber. Improved pretreatment will result in the production of more screenings, and provide better protection for downstream treatment units including the anaerobic digesters.

The existing TFSC basin, interstage pump station, and primary clarifiers will be retired and demolished as part of this project. Two new oxidation ditches, with a total volume of 1.83 million gallons (MG) will be constructed to treat a PSDWF of 1.5 mgd. The new oxidation ditch will be configured with both aerobic and anoxic zones to facilitate nitrification and denitrification, and remove nitrogen from the wastewater stream. A flow split structure would be provided to direct pretreated wastewater from the headworks to each oxidation ditch.

The MBCSD WWTP currently uses a single 55-foot diameter secondary clarifier to remove suspended solids from the secondary treated effluent. In order to increase clarifier capacity, improve effluent quality, and add redundancy to the treatment process, an additional 95-foot diameter clarifier will be included as part of this project. A new RAS/WAS pump station would return settled mixed liquor from the clarifiers to the oxidation ditches and waste to the anaerobic digesters for further treatment.

While the new oxidation ditches will produce a significantly better quality effluent than the existing trickling filter process, the MBCSD has decided to further treat the secondary effluent before discharge into Estero Bay. With the use of cloth-media disk filters, the MBCSD will remove additional suspended solids from the wastewater stream resulting in the discharge of tertiary filtered effluent to the ocean.

Due to the structural condition of the existing chlorine contact basin, it will be retired and demolished as part of this project. A new chlorine contact basin will be included as part of this project to disinfect tertiary effluent before it is discharged to the ocean. If the MBCSD decides to reuse this effluent in the future, additional chlorine contact capacity will be needed.

The existing Digester No. 2 and 3 will be fully rehabilitated as part of the project. This rehabilitation includes draining, cleaning, and fully repairing the digesters and replacing the existing gas mix system with a new pump mix system. A new GBT will be required

upstream of the anaerobic digesters to thicken the WAS and reduce the hydraulic loading to the digesters.

Following digestion, solids will be sent to two new centrifuges for dewatering before solar drying. The centrifuges will be housed with the GBT in a semi-enclosed structure. The centrifuges will function to decrease the volume of sludge sent to the sludge drying beds. Dewatering the sludge prior to application to the drying beds will free-up space for the construction of additional windrows for composting. The biosolids not composted onsite will continue to be hauled away by San Joaquin Composting.

Recommended support facility improvements to be included in the project are improvements to the existing electrical equipment, control building, 3-W pump station, and plant drain system. In addition to these improvements, significant flood impact mitigation measures will be included as part of this project. At this time, the extent and type of work that must be done to add flood protection to the WWTP site has been estimated at approximately $4 million. In order to refine these costs additional studies must be done before or during the design process.

When treatment alternatives were initially developed for upgrade of the MBCSD WWTP in Chapter 8 of this report, Carollo recommended placing the new oxidations to the south of the existing plant site in an area of land owned by the City that is currently used for trailer storage. Moving the oxidation ditches offsite was recommended to keep the existing sludge drying beds in service after completion of the upgrade. However, based on direction from City and CSD staff, the oxidation ditches will be located to the east of the sludge drying beds on land jointly owned by the City and CSD. The land is currently leased to a third party. A preliminary site plan for the final recommended project is shown in Figure 9.9.

9.8.2 Construction Costs

The various components of the final recommended project described above with their associated construction costs are shown in Table 9.16. The total construction cost for the final recommended project is $20.8 million.

9.8.3 Project Costs

In addition to the construction costs, the project includes planning, environmental, engineering design and construction monitoring, and legal and administrative costs. Since the State Revolving Fund (SRF) loan payment starts one-year after plant startup and funds are first dispersed at the start of construction, interest on the borrowed money is then added to the project cost. Currently, the SRF interest is 2.5 percent. The total estimated project costs are $28.1 million. Based on these costs, the annual payment (principle and interest) for a 20-year loan from the SRF program, at 2.5 percent, is $1.9 million per year.

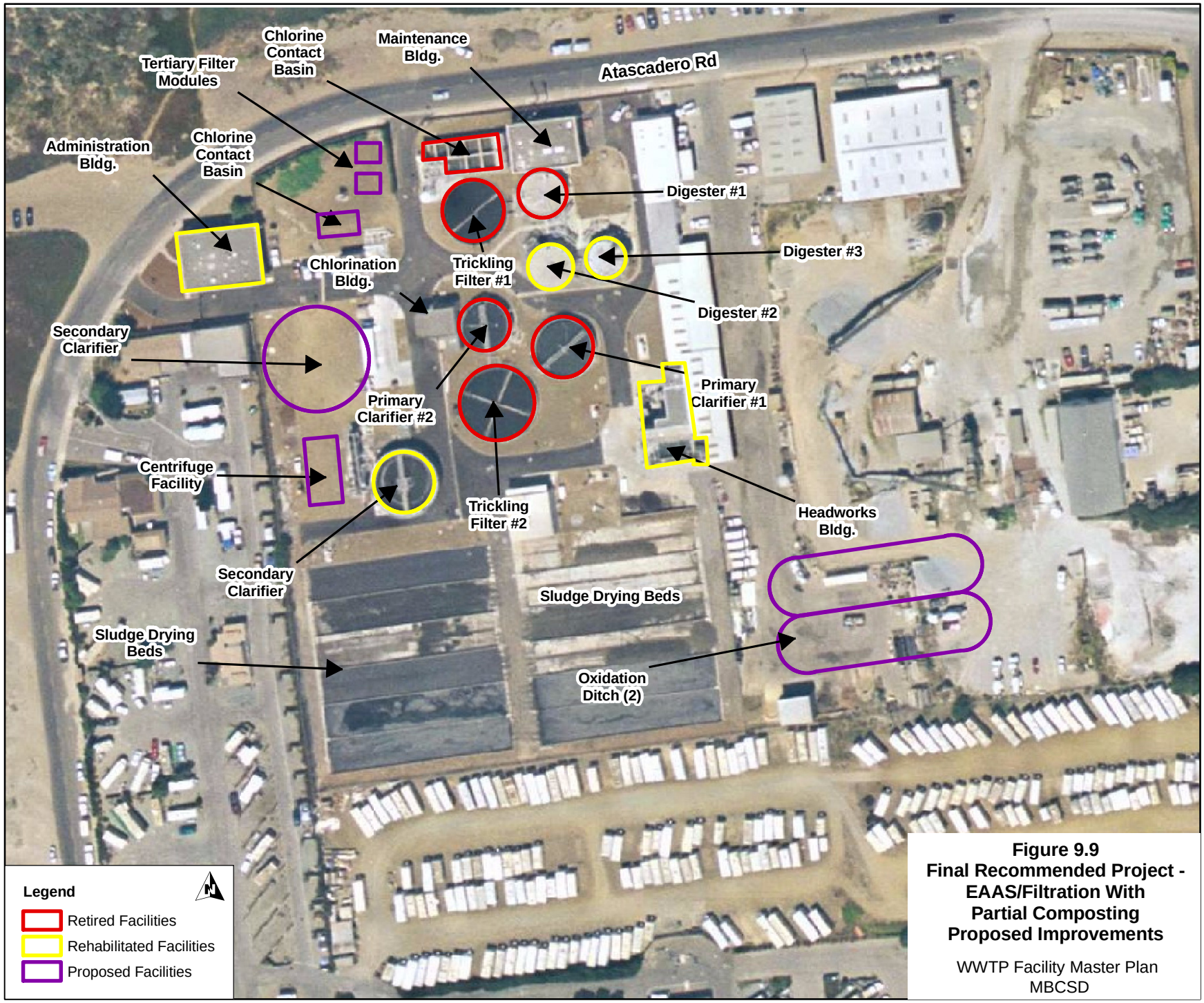

Figure 9.9
Final Recommended Project - EAAS/Filtration With Partial Composting Proposed Improvements

WWTP Facility Master Plan
MBCSD

Table 9.16 Construction Costs for Final Recommended Project WWTP Facility Master Plan MBCSD	
Component	**Cost[1]**
Oxidation Ditch Facility	$7,900,000
Tertiary Filters	$1,276,000
Existing Facilities Rehabilitation	$4,714,000
Existing Electrical Improvements	$1,134,000
Biosolids Management Facilities	$1,246,000
Demolition and Subsoil Stabilization	$1,511,000
Flood Impact Mitigation	$3,000,000
Total Construction Costs	**$20,781,000**
Note: 1. ENR (20 cities) June 2006 = 7,700	

9.8.4 Schedule

Table 9.17 outlines a preliminary schedule of events for the City and CSD to upgrade the WWTP for compliance with full secondary treatment standards. The schedule shows a plant startup in February 2014 for full compliance in April 2014. These dates are based on the MBCSD 8-year full Secondary Compliance Schedule prepared by Carollo dated March 30, 2006.

Table 9.17	**Project Schedule WWTP Facility Master Plan MBCSD**
Event	**Date**
Planning	
Draft Revenue Programs Completed	January 2008
Draft Facility Plan Completed	October 2007
Prepare RFP for Environmental Documentation Services	May 2008
Award Contract for Environmental Documentation Services	September 2008
Design	
Prepare RFP for Design	February 2010
Award Contract for Design	October 2010
Begin Bidding Process	January 2012
Construction	
Award Contract for Construction	February 2012
New Plant Startup	February 2014
Full compliance Achieved	April 2014
1st Year of Operation	February 2015

APPENDIX A – MORRO BAY CAYUCOS SANITARY DISTRICT FLOOD HAZARD REVIEW

February 27, 2007

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CIVIL ENGINEERING
CONSTRUCTION MANAGEMENT
LANDSCAPE ARCHITECTURE
MECHANICAL ENGINEERING
PLANNING
PUBLIC WORKS ADMINISTRATION
SURVEYING / GIS SOLUTIONS
WATER RESOURCES
WALLACE SWANSON INTERNATIONAL

Mr. David Stringfield, PE, Partner
Carollo Engineers
7580 North Ingram Avenue, Suite 112
Fresno, California 93711

Subject: Morro Bay Cayucos Sanitary District (MBCSD) Wastewater Treatment Plant Flood Hazard Review

Dear Mr. Stringfield:

We have collected documents, performed a site review, and developed initial recommendations regarding flood hazard protection for the expansion of the MBCSD Wastewater Treatment Plant (WWTP).

SUMMARY AND RECOMMENDATIONS

The MBCSD Wastewater Treatment Plant (plant) experiences both localized drainage problems and larger flooding problems. Flooding has occurred in the past at the plant, and the site is in a designated Flood Insurance zone. Our initial findings are that the site may be flooded as little as 2 feet to over 6 feet depending on the survey datum and further hydraulic evaluation.

With expansion of the plant, there are approaches to address the flooding, including flood protection and flood reduction. Flood proofing is probably more feasible for this site than flood reduction.

During the initial phases of project design, the potential flood elevation needs to be verified. At a minimum, a survey needs to be performed to relate elevations of the treatment site to the FEMA flood insurance elevation, on the same datum. Also, the FEMA flood map may not accurately represent the flooding mechanisms and therefore the actual flood elevation in the area. A detailed flood study should therefore be performed to provide a more accurate representation. Additional information is available for purchase that may clarify the FEMA analysis. We recommend that the City budget for additional professional services using a phased approach as follows:

- Phase I evaluation ($8,500): Perform a limited evaluation including a field survey to relate the plant design plans to the FEMA datum, acquire additional cross sectional data available from FEMA, compare the received data to existing conditions, and prepare a supplemental letter report. After the completion of the Phase I evaluation, the potential financial benefit of preparing a more costly Phase II study can be evaluated.

- Phase II evaluation ($46,000): Perform a detailed flood study to establish an updated flood elevation at the WWTP site. The work will include a field survey of relevant cross sections from the beach to Highway 101, development of a computerized flood model, assessment of alternative improvement methods, and preparation of a comprehensive report.

Based on this initial evaluation, our recommendations are as follows:

1. Engage a consultant to complete the Phase I flood evaluation as described above.

WALLACE GROUP
A California Corporation

4115 BROAD ST
SUITE B-5
SAN LUIS OBISPO
CALIFORNIA 93401

T 805 544-4011
F 805 544-4294

www.wallacegroup.us

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2. After completion of the Phase I analysis, consider engaging a consultant to complete the Phase II study if the potential financial benefit justifies the expense.
3. The following options should be considered during the final design:
    a. Consider improving the capacity of the storm drain from the plant to the beach outfall.
    b. Consider flood proofing the plant improvements:
        i. Flood walls around critical components or the entire plant.
        ii. Raising other critical components (electrical) above the flood elevation.
    c. Consider a raised berm along Kaiser Park to direct any creek overflow to Embarcadero Road.
    d. Consider a creek enhancement project to increase the capacity of Morro Creek.

FEMA FLOOD DETERMINATION

The site is within flood zones identified by the Federal Emergency Management Agency (FEMA) as follows:

- Flood Insurance Rate Map (FIRM) Panel 060307 0005 C, Revised 1985.
- The WWTP is partially in an A-14 zone and partially in a B zone.
- 100-year flood elevation at the site is approximately 20.4, NVGD 1929 datum

A copy of the FIRM is enclosed with the location of the WWTP indicated. The flood insurance mapping in the WWTP area as shown on the 1985 revision (the most recent) is consistent with the 1985 Flood Insurance Study for the FIRM. The FEMA web site lists several map amendments and revisions, but they do not affect the WWTP site.

The FIRM indicates that the 100-year flood elevation at the plant is just over 20 feet using the NVGD 1929 datum. There is limited topographic data to use for comparison. The USGS map is also on the NVGD 29 datum, but it shows limited elevation data in this area. The 1981 improvement plans for the WWTP indicate that the plant site is generally at an elevation of 14 to 15 feet, but it is not clear if these plans are on the same datum.

It is of course, important to understand the depth of potential flooding at the site. Clearly there has been flooding in localized areas of the plant of a foot or so of depth, and larger storms can occur. If the 1981 improvement plans are on the same datum as the FIRM, then the site is 5 to 6 feet below the FEMA flood elevation. We recommend that the site elevations be verified by survey and related to the FEMA datum, to determine the flood insurance depths at the site.

MECHANISMS OF FLOODING

There is apparently more than one source of flooding at the WWTP site. Plant operators have experienced flooding at the pant in 1995 and 2004. These storms were not the 100-year storm that is the basis of the FEMA map. A study of that map shows another mechanism that may be controlling in larger storms.

Flooding Mechanisms Reported by Plant Operators:

- Overflow from excessive runoff flowing down Embarcadero Road.
- Overflow from Morro Creek, entering the plant from the southeast.
- Backing up of the storm drain leading to the beach outflow at the Embarcadero

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Extension. This storm drain can back up from either ocean storm surge, or a build up of sand blocking the outlet.

Flooding Mechanisms Implied by the FEMA FIRM:

- Backed up ponded area caused by restricted flow in the Morro Creek outlet to the ocean.
- Uncontrolled upstream runoff.

Coastal Flooding:

- The Flood Insurance Study considered the ocean influence based on an evaluation of tidal considerations (still water elevation) and wave effects (wave setup, height, runup, and overtopping). The evaluation considers the combined effects of these factors and established the following total water elevations (TWL's):
  - 10-year 7.6 feet
  - 100-year 9.9 feet
  - 500-year 20.0 feet
  - NVGD-29 datum.
- The 100-year elevation of 9.9' is consistent with the FIRM and does not appear to directly cause flooding at the WWTP.
- Current tide readings are typically published based on the NAVD-88 datum which is approximately 2.8 feet higher than NVGD-29 in this location. According to the NOAA benchmark station for Port San Luis, with 19 years of records, some pertinent tidal elevations are:
  - Highest observed water level (NVGD-29) 7.65 ft (NAVD-88) 4.85 ft
  - Mean Higher High Water (MHHL) (NVGD -29) 5.32 ft (NAVD-88) 2.53 ft
  - Mean Sea Level (MSL) (NVGD -29) 2.80 ft (NAVD-88) 0 ft
  - Mean Lower Low Water (MLLW) (NVGD -29) 0 ft (NAVD-88) -2.80 ft

Various flooding mechanisms are shown schematically on the enclosed sketch.

The FEMA map shows a 5-feet drop in water surface elevation in Morro Creek, from the beach to just past Embarcadero Road. Then it shows a large mostly level ponded area to Highway 1. This area includes the WWTP site. This configuration suggests that FEMA determined the geometry of Morro Creek to be a restriction to flow downstream of Embarcadero Road, causing a large ponded area to develop upstream of the restricted section.

While it is clear that the plant has drainage and flooding problems, we are not convinced that the mechanism of flooding is as implied by the FIRM, because this section of Morro Creek seems to be relatively wide and free flowing. We have walked the creek from the ocean upstream of the mobile home park, and the most restricted section appears to be further upstream, along the mobile home park and along the City's Kaiser Park. This is consistent with the operator's experience that flood waters approach from the southeast.

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Prior to design, the original cross sections from FEMA should be purchased, which normally cost about $200. We would visually compare these to the existing cross section to look for any obvious discrepancies with the information. If it appears the FEMA study is not consistent with the existing cross sections, then the FEMA flood elevations may not be representative of actual flood risk.

OTHER REPORTED FLOODING AND DRAINAGE PROBLEMS

Based on discussion with the plant operators and a site review, the following issues are noted:

- The existing headworks structure is below grade and is particularly at risk from flooding. Staff has constructed a low wall and installed facilities for placing flood gates. A stockpile of sand is also used for additional protection.
- The storm drain system is dependent on an open beach outfall. Due to shifting sand dunes, the outfall periodically becomes covered with sand. City maintenance crews are tasked with uncovering the outfall when needed. If this is not done, the plant storm drain system backs up. According to the WWTP Improvement Plans, the existing storm drain is a dedicated drain for the WWTP site. One alternative to a gravity storm drain is the installation of a storm water pumping station, which would allow for a higher outlet. However, a pump station sized to handle plant drainage would be overwhelmed during periods of inundation from upstream overflow.
- Some electrical control rooms are at grade and do not have flood protection other than operators placing sand when needed.
- High ground water is present. Subsurface vaults are filled with groundwater to within a few feet of the surface year-round.
- Staff coordinates with the neighboring Hanson Aggregate owners regarding the orientation of their yard and supplies. Flood waters from the southeast first cross the Hanson property. When Hanson has stock on hand of large concrete block, they store the blocks on-site in a manner that directs flood waters to Embarcadero Road rather than through the WWTP.

FLOOD PROTECTION

There are essentially two approaches that may be applicable for addressing drainage and flooding when designing the WWTP expansion. One approach is to acknowledge that flooding occurs and floodproof the improvements. This entails constructing flood walls around critical areas (such as the headworks and sludge beds), and/or elevating other components such as electronic controls above the flood elevation. Construction of a flood wall around the entire plant could also be evaluated. As discussed, the flood elevation may need to be reevaluated.

FLOOD REDUCTION

Another approach is to improve area drainage so that flooding is reduced or eliminated. Considering the four mechanisms of flooding, the opportunities for reducing flooding are:

Embarcadero Road Overflow: Significant drainage improvements would be required to reduce this drainage problem. A storm drain system would have to be constructed from the freeway to the beach outfall with greater capacity than existing conditions. This would improve the area drainage, but would still be dependant on city maintenance to keep the storm drain beach outfall uncovered from sand. A lesser improvement that would be of

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benefit in smaller storms would be to increase the size of the storm drain from the plant to the outfall.

Southeast flooding: This flooding is believed to come from restricted sections of Morro Creek, along and upstream of the RV park. Potentially, the creek capacity could be increased. There are many concerns with this – environmental, property ownership, and hydraulic feasibility. However, this is believed to be the largest source of flood risk, and addressing it could be very helpful for reducing the WWTP flooding. Based on a field review, it appears that there is more opportunity for increasing creek capacity on the south side of the creek. If pursued, the creek modifications could be combined with a creek habitat enhancement strategy to address environmental concerns.

Morro Creek backwater flooding: This is the flooding depicted on the FEMA flood map. This flooding may not be representative of the actual conditions, and we are not recommending physical improvements to address it.

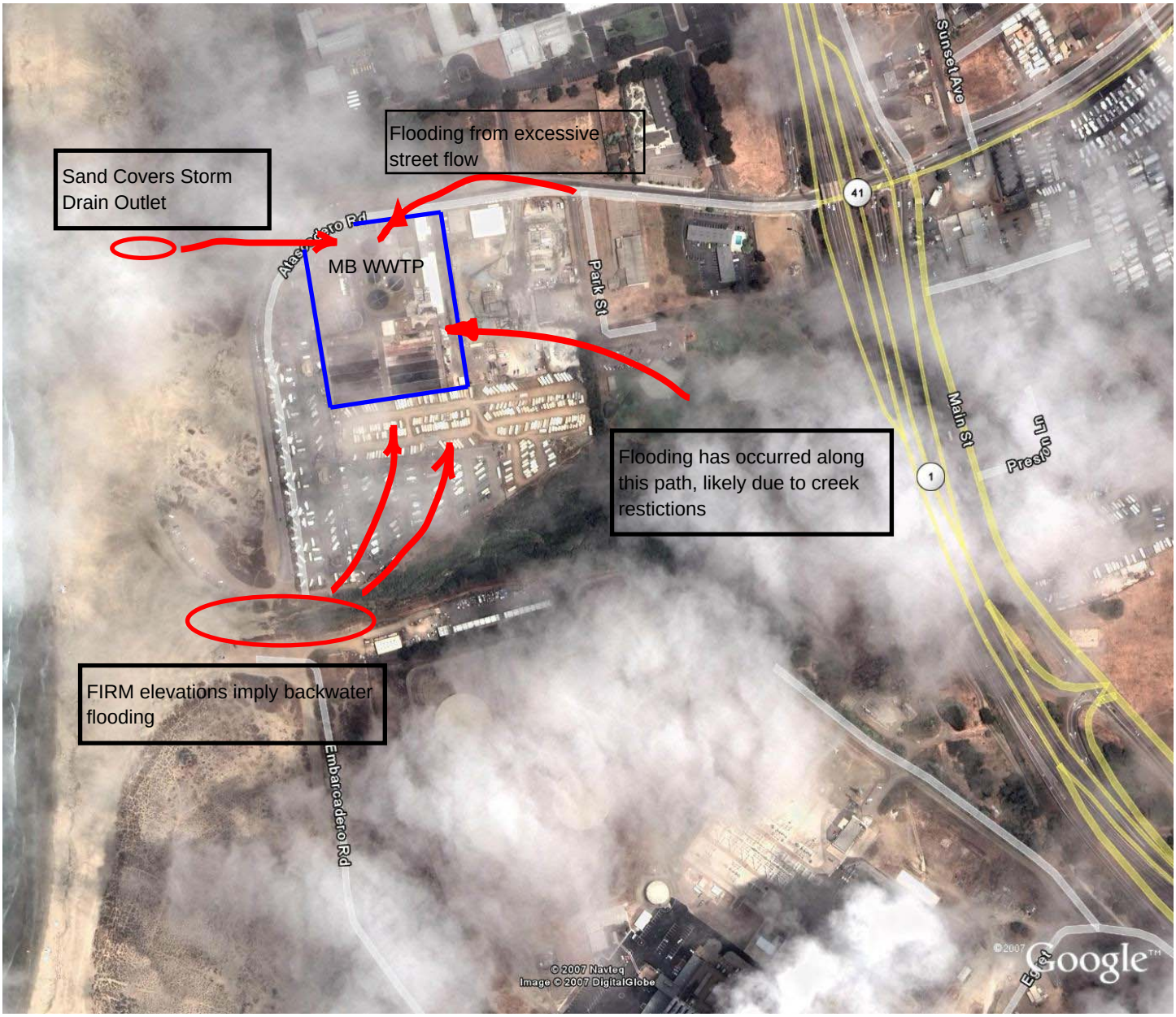
We trust that our preliminary evaluation will be of benefit to your master planning efforts. If you have any questions, please contact me. Attached are copies of some of the documents referenced in this letter.

Sincerely,

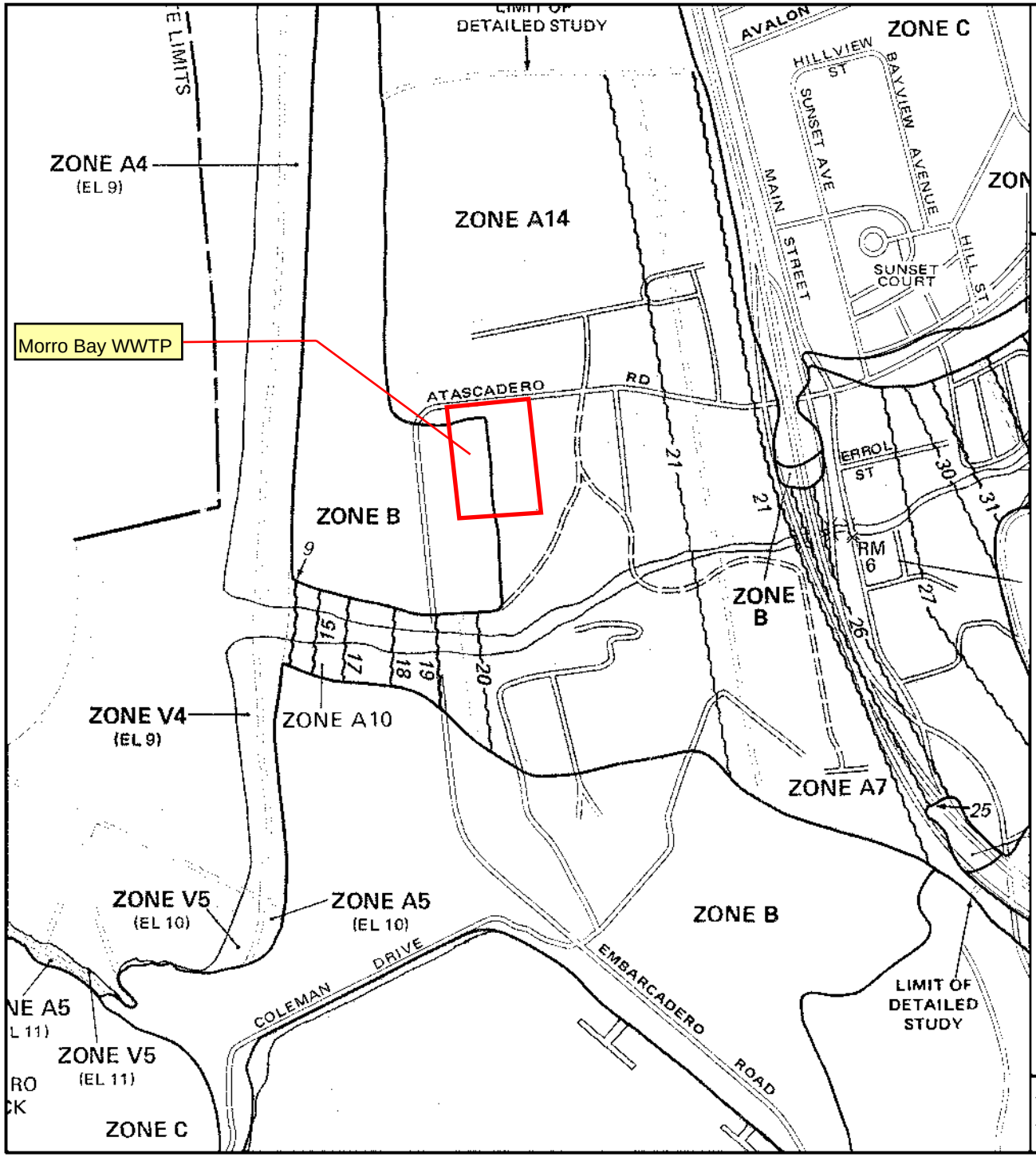
WALLACE GROUP

Craig Campbell, PE, PLS
Principal Engineer

REGISTERED PROFESSIONAL ENGINEER
CRAIG CAMPBELL
No. 34405
Expires 9-30-07
CIVIL
STATE OF CALIFORNIA



MORRO BAY WWTP - MECHANISMS OF FLOODING



APPROXIMATE SCALE IN FEET

800 0 800

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

CITY OF
MORRO BAY,
CALIFORNIA
SAN LUIS OBISPO COUNTY

ONLY PANEL PRINTED

COMMUNITY-PANEL NUMBER
060307 0005 C

MAP REVISED:
NOVEMBER 1, 1985

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

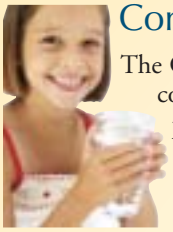
APPENDIX B – 2004 ANNUAL WATER QUALITY REPORT

Annual

Water Quality Report

Water testing performed in 2004

PWS ID#: CA4010011



Continuing Our Commitment

The City of Morro Bay presents our annual water quality report. This edition covers all testing completed from January through December 2004. We are pleased to tell you that our compliance with all state and federal drinking water laws remains exemplary. As in the past, we are committed to delivering the best quality drinking water.

For more information about this report, or for any questions relating to your drinking water, you may call the City of Morro Bay Public Services Department at (805) 772-6261.

Where Does My Water Come From?

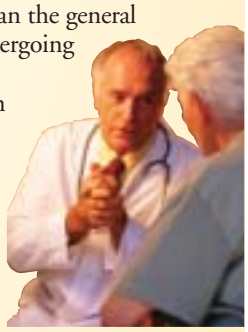
The City of Morro Bay's primary source of water is surface water from the state water system. The state system is administered locally by the Central Coast Water Authority (www.ccwa.com). The water is treated at the Polonio Pass Water Treatment Plant, which is near the junction of Highways 41 and 46. The water is then pumped to Morro Bay and other subscribers. The state water supply is augmented by water pumped from wells located near Keiser Park (Morro Basin) and Chorro Creek Road (Chorro Basin) and by the city's desalinization plant located on Atascadero Road. The groundwater (well water) does not require treatment, but a disinfectant is added. During 2004, state water provided 83% of the city's drinking water.

A Drinking Water Source Assessment for the city wells was completed during the 2001 fiscal year and the results are available to the public by contacting the Public Services Department.

Overall, the wells had a risk assessment of low to medium. The Morro Basin wells are considered most vulnerable to the following activities not associated with any detected contaminants: gas stations, known contaminant plumes. The Chorro Basin wells are considered most vulnerable to the following activities not associated with any detected contaminants: agricultural drainage, septic systems, wells (agricultural, irrigation), and other animal operations.

Important Health Information

Some people may be more vulnerable to contaminants in drinking water than the general population. Immunocompromised persons such as persons with cancer undergoing chemotherapy, persons who have undergone organ transplants, people with HIV/AIDS or other immune system disorders, some elderly, and infants can be particularly at risk from infections. These people should seek advice about drinking water from their health care providers. The U.S. EPA/CDC (Centers for Disease Control) guidelines on appropriate means to lessen the risk of infection by *Cryptosporidium* and other microbial contaminants are available from the Safe Drinking Water Hotline at (800) 426-4791.



Information on the Internet

The California Department of Health Services (www.dhs.ca.gov/ps/ddwem/technical/dwp/dwpindex.htm), the U.S. EPA Office of Water (www.epa.gov/watrhome), and the Centers for Disease Control and Prevention (www.cdc.gov) web sites provide a substantial amount of information on many issues relating to water resources, water conservation, contaminants, and public health.

Community Participation

The Morro Bay City Council meets the second and fourth Monday of each month at the Veterans Hall on Surf Street. Time is set aside at each meeting for public input if you have concerns you wish to express about the drinking water.

Water Conservation Tips

Water conservation measures are an important first step in protecting our water supply. Such measures not only save the supply of our source water, but also can save you money by reducing your water bill. Here are a few suggestions:

Conservation measures you can use inside your home:

- Fix leaking faucets, pipes, toilets, etc.
- Replace old fixtures; install water-saving devices in faucets, toilets and appliances.
- Wash only full loads of laundry.
- Do not use the toilet for trash disposal.
- Take shorter showers.
- Do not let the water run while shaving or brushing teeth.
- Soak dishes before washing.
- Run the dishwasher only when full.

You can conserve outdoors as well:

- Water the lawn and garden in the early morning or evening.
- Use mulch around plants and shrubs.
- Repair leaks in faucets and hoses.
- Use water-saving nozzles.
- Use water from a bucket to wash your car, and save the hose for rinsing.

Information on other ways that you can help conserve water can be found at www.epa.gov/safewater/publicoutreach/index.html.

Substances That Might Be in Drinking Water

The sources of drinking water (both tap water and bottled water) include rivers, lakes, streams, ponds, reservoirs, springs, and wells. As water travels over the surface of the land or through the ground, it dissolves naturally occurring minerals and, in some cases, radioactive material, and can pick up substances resulting from the presence of animals or from human activity.

In order to ensure that tap water is safe to drink, the U.S. EPA and the California Department of Health Services (CDHS) prescribe regulations that limit the amount of certain substances in water provided by public water systems. CDHS regulations also establish limits for contaminants in bottled water, which must provide the same protection for public health. Drinking water, including bottled water, may reasonably be expected to contain at least small amounts of some substances. The presence of contaminants does not necessarily indicate that water poses a health risk.

Substances that may be present in source water include:

Microbial Contaminants, such as viruses and bacteria, which may come from sewage treatment plants, septic systems, agricultural livestock operations, and wildlife;

Inorganic Contaminants, such as salts and metals, which can be naturally occurring or result from urban stormwater runoff, industrial or domestic wastewater discharges, oil and gas production, mining, or farming;

Pesticides and Herbicides, which may come from a variety of sources such as agriculture, urban stormwater runoff, and residential uses;

Organic Chemical Contaminants, including synthetic and volatile organic chemicals, which are by-products of industrial processes and petroleum production, and can also come from gas stations, urban stormwater runoff, and septic systems;

Radioactive Contaminants, which can be naturally occurring or can be the result of oil and gas production and mining activities.

More information about contaminants and potential health effects can be obtained by calling the U.S. EPA's Safe Drinking Water Hotline at (800) 426-4791.

Sampling Results

During the past year, the city and state water personnel have taken hundreds of water samples in order to determine the presence of any radioactive, biological, inorganic, volatile organic or synthetic organic contaminants. The table below shows only those contaminants that were detected in the water. Although all of the substances listed here are under the Maximum Contaminant Level (MCL), we feel it is important that you know exactly what was detected and how much of the substance was present in the water. The state requires us to monitor for certain substances less than once per year because the concentration of these substances does not change frequently. In these cases, the most recent sample data are included, along with the year in which the sample was taken.

PRIMARY DRINKING WATER STANDARD (Regulated in order to protect against possible adverse health effects)

				State Water		Well Water			
SUBSTANCE (UNITS)	YEAR SAMPLED	MCL	PHG (MCLG)	AMOUNT DETECTED	RANGE LOW HIGH	AMOUNT DETECTED	RANGE LOW HIGH	VIOLATION	TYPICAL SOURCE
Aluminum (ppm)	2004	1	0.6	0.07	0.03-0.16	0.25	ND-1	No	Erosion of natural deposits; residue from some surface water treatment processes
Barium (ppm)	2004	1	2	NA	NA	0.02	ND-0.1	No	Discharge of oil drilling wastes and from metal refineries; erosion of natural deposits
Gross Alpha particle Activity (pCi/L)	2004	15	NA	ND	NA	1.15	0.35-1.9	No	Erosion of natural deposits
Nitrate (as nitrate, NO_3) (ppm)	2004	45	45	2.8	1.2-4.8	19	2-34	No	Runoff and leaching from fertilizer use; leaching from septic tanks, sewage; erosion of natural deposits
Nitrite (as nitrogen, N) (ppm)	2004	1	1	0.43	NA	ND	NA	No	Runoff and leaching from fertilizer use; leaching from septic tanks, sewage; erosion of natural deposits
Turbidity (NTU)[1]	2004	TT	NA	0.14	0.04-0.14	3.7	ND-3.7	No	Soil runoff

City of Morro Bay Distribution System

SUBSTANCE (UNITS)	YEAR SAMPLED	MCL [MRDL]	PHG (MCLG) [MRDLG]	AMOUNT DETECTED	RANGE LOW HIGH	VIOLATION	TYPICAL SOURCE
Chlorine (ppm)	2004	[4.0 as Cl_2]	[4 as Cl_2]	1.12	0.21-2.22	No	Drinking water disinfectant added for treatment
Halocetic Acids (ppb)	2004	60	NA	12.9	2-22	No	By-product of drinking water disinfection
TTHMs [Total Trihalomethanes] (ppb)	2004	80	NA	45	26-66	No	By-product of drinking water chlorination

Tap water samples were collected for lead and copper analyses from 20 homes throughout the service area

SUBSTANCE (UNITS)	YEAR SAMPLED	ACTION LEVEL	PHG (MCLG)	AMOUNT DETECTED (90TH%TILE)	HOMES ABOVE ACTION LEVEL	VIOLATION	TYPICAL SOURCE
Copper (ppm)[2]	2003	1.3	0.17	0.10	0	No	Internal corrosion of household plumbing systems; erosion of natural deposits; leaching from wood preservatives
Lead (ppb)[2,3]	2003	15	2	5	1	No	Internal corrosion of household water plumbing systems; discharges from industrial manufacturers; erosion of natural deposits

SECONDARY DRINKING WATER STANDARD (Regulated in order to protect the odor, taste and appearance of drinking water)

SUBSTANCE (UNITS)	YEAR SAMPLED	SMCL	PHG (MCLG)	State Water AMOUNT DETECTED	State Water RANGE LOW HIGH	Well Water AMOUNT DETECTED	Well Water RANGE LOW HIGH	Desal Plant AMOUNT DETECTED	Desal Plant RANGE LOW HIGH	VIOLATION	TYPICAL SOURCE
Chloride (ppm)	2004	500	NS	74	44-126	71	65-82	130	NA	No	Runoff/leaching from natural deposits; seawater influence
Color (Units)	2004	15	NS	2	ND-5	3.4	ND-10	ND	NA	No	Naturally-occurring organic materials
Iron (ppb)[4]	2004	300	NS	ND	NA	200	ND-400	ND	NA	No	Leaching from natural deposits; industrial wastes
Specific Conductance (µmhos/cm)	2004	1,600	NS	449	257-684	980	950-1,000	540	NA	No	Substances that form ions when in water; seawater influence
Sulfate (ppm)	2004	500	NS	36	NA	82	76-92	2.0	NA	No	Runoff/leaching from natural deposits; industrial wastes
Total Dissolved Solids [TDS] (ppm)	2004	1,000	NS	247	141-376	588	540-620	290	NA	No	Runoff/leaching from natural deposits

UNREGULATED SUBSTANCES

SUBSTANCE (UNITS)	YEAR SAMPLED	State Water AMOUNT DETECTED	State Water RANGE LOW–HIGH	Well Water AMOUNT DETECTED	Well Water RANGE LOW–HIGH	Desal Plant AMOUNT DETECTED	Desal Plant RANGE LOW–HIGH	TYPICAL SOURCE
Boron (ppb)	2004	0.098[5]	NA	140	NA	ND	NA	Erosion of natural deposits
Calcium (ppm)	2004	55	44-61	66	62-69	18	NA	Erosion of natural deposits
Hardness (ppm)[6]	2004	108	86-126	420	410-430	50	NA	Erosion of natural deposits
pH (Units)	2004	8.3	7.8-8.6	7.1	7.0-7.2	9.0	NA	Runoff/leaching from natural deposits
Potassium (ppm)	2004	2.7	NA	0.7	0.6-0.8	3.2	NA	Erosion of natural deposits
Sodium (ppm)	2004	46	NA	46	45-49	87	NA	Erosion of natural deposits

[1] Turbidity is a measure of the cloudiness of the water. We monitor it because it is a good indicator of water quality and the effectiveness of disinfectants.

[2] Next sampling will be done in 2006.

[3] Infants and young children are typically more vulnerable to lead in drinking water than the general population. It is possible that lead levels at your home may be higher than at other homes in the community as a result of materials used in your home's plumbing. If you are concerned about elevated lead levels in your home's water, you may wish to have your water tested and flush your tap for 30 seconds to 2 minutes before using tap water. Additional information is available from the Safe Drinking Water Hotline at (800) 426-4791.

[4] Individual wells may contain a higher concentration of a certain contaminant, but the individual well water is blended with other sources (well, desal, or state) to reduce the concentration.

[5] Results are from 2002.

[6] To convert hardness to grains per gallon, divide by 17.1.

Table Definitions

AL (Action Level): The concentration of a contaminant which, if exceeded, triggers treatment or other requirements which a water system must follow.

Amount: The amount detected; or when a range of values is shown, the average detected.

MCL (Maximum Contaminant Level): The highest level of a contaminant that is allowed in drinking water. Primary MCLs are set as close to the PHGs (or MCLGs) as is economically and technologically feasible. Secondary MCLs (SMCL) are set to protect the odor, taste and appearance of drinking water.

MCLG (Maximum Contaminant Level Goal): The level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs are set by the U.S. EPA.

MRDL (Maximum Residual Disinfectant Level): The level of a disinfectant added for water treatment that may not be exceeded at the consumer's tap.

MRDLG (Maximum Residual Disinfectant Level Goal): The level of a disinfectant added for water treatment below which there is no known or expected risk to health. MRDLGs are set the U.S. Environmental Protection Agency.

NA: Not applicable

ND: Not detected

NS: No standard

NTU (Nephelometric Turbidity Units): Measurement of the clarity, or turbidity, of water.

pCi/L (picocuries per liter): A measure of radioactivity.

PDWS (Primary Drinking Water Standard): MCLs for contaminants that affect health along with their monitoring and reporting requirements, and water treatment requirements.

PHG (Public Health Goal): The level of a contaminant in drinking water below which there is no known or expected risk to health. PHGs are set by the California EPA.

ppm (parts per million): One part substance per million parts water (or milligrams per liter).

ppb (parts per billion): One part substance per billion parts water (or micrograms per liter).

TT (Treatment Technique): A required process intended to reduce the level of a contaminant in drinking water.

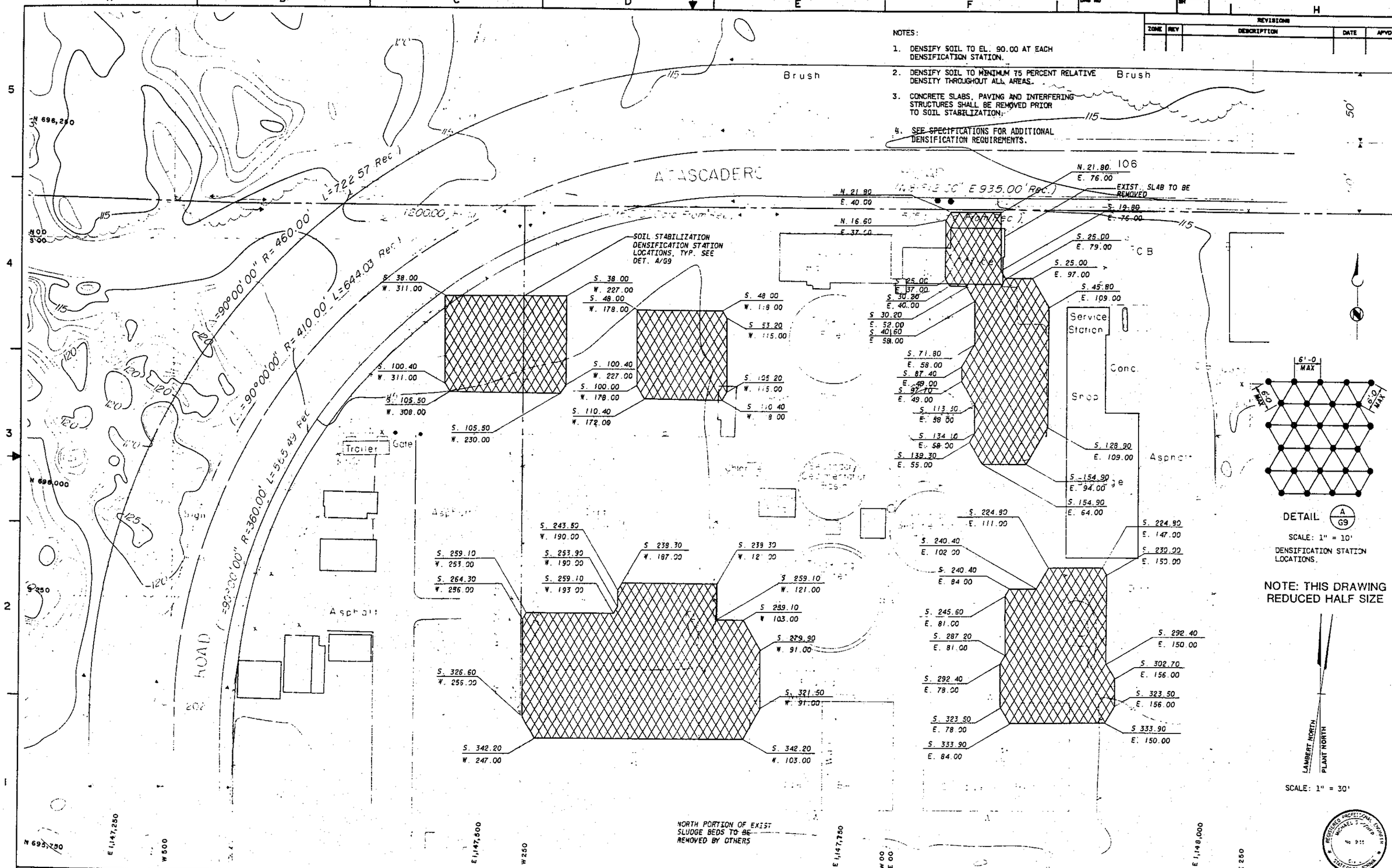
µmhos/cm (micromhos per centimeter): A measure of electrical conductance.

APPENDIX C – 1982 WASTEWATER TREATMENT PLANT EXPANSION SUBSOIL STABILIZATION PLAN

ZONE	REV	REVISIONS DESCRIPTION	DATE	APVD

NOTES:

1. DENSIFY SOIL TO EL. 90.00 AT EACH DENSIFICATION STATION.
2. DENSIFY SOIL TO MINIMUM 75 PERCENT RELATIVE DENSITY THROUGHOUT ALL AREAS.
3. CONCRETE SLABS, PAVING AND INTERFERING STRUCTURES SHALL BE REMOVED PRIOR TO SOIL STABILIZATION.
4. SEE SPECIFICATIONS FOR ADDITIONAL DENSIFICATION REQUIREMENTS.



BCDGPB

BROWN AND CALDWELL
CONSULTING ENGINEERS
EUGENE • PASADENA • SEATTLE
TUCSON • WALNUT CREEK

DESIGNED TS
CHECKED BAP
CHECKED LY

SUBMITTED
APPROVED (For Brown and Caldwell) DATE
APPROVED (For The City of Morro Bay) DATE

FILE 515
DATE SEPT '81

CITY OF MORRO BAY

IMPROVEMENTS TO MORRO BAY-CAYUCOS WWTP

SUBSOIL STABILIZATION PLAN

DRAWING NUMBER C10
SHEET 16

shall be placed until the foundation has been inspected by the Construction Manager. The Contractor shall, if directed by the Construction Manager, dig test pits and make test borings and foundation bearing tests. If the material tested is undisturbed soil, the cost thereof will be paid for as extra work. If the material tested is backfill material, the cost thereof will be paid as specified in 00710-4.05.

C. STRUCTURE BACKFILL:

Unless otherwise specified, structure backfill shall be Class B1.

After completion of construction below the elevation of the final grade, and prior to backfilling, forms shall be removed and the excavation shall be cleaned of debris.

Structure backfill shall not be placed until the subgrade portions of the structure have been inspected by the Construction Manager. No backfill material shall be deposited against concrete structures until the concrete has developed a strength of not less than 2500 pounds per square inch in compression, or until the concrete has been in place for 28 days, whichever occurs first.

Backfill material shall be placed in uniform layers and shall be brought up uniformly on all sides of the structure. Each layer of backfill shall be compacted to a relative compaction of not less than 90 percent. Where the backfill is under roadway or trafficked area, the material within 2.5 feet below the surface shall be compacted to a relative compaction of not less than 95 percent. When compaction is done by ponding and jetting, thickness of uncompacted layers shall not exceed 4 feet.

Compaction of structure backfill may be performed by ponding and jetting if the backfill material is of such character that it will be self-draining when compacted and that foundation materials will not be damaged by the applied water and no damage from hydrostatic pressure will result to the structure. Ponding and jetting shall not be used within 4 feet of finished grade and shall be performed in such a manner that water will not be impounded.

Unless otherwise specified, backfill around and above pipelines within the excavation line of any structure shall be the same as that specified for structures.

D. SUBSOIL STABILIZATION:

1. METHOD: Subsoil stabilization shall be performed throughout the areas shown on the drawings using a vibrocompaction method which compacts and densifies the native material, laterally, from ground surface to the minimum elevation shown on the drawings.

Vibratory compaction shall be performed as required to obtain the minimum relative density specified on the drawing. Densification stations where vibratory compaction is to be performed shall be arranged in a pattern as shown on the drawing. Contractor shall adjust the spacings between the stations to obtain the relative density required. However, the spacings shall not be greater than 6 feet. Each densification station shall be suitably backfilled, and backfill material shall be forced laterally into native material, and compacted to the minimum relative density shown on the drawings.

2. BACKFILL MATERIAL: Backfill material used in subsoil stabilization shall be Type A material.

3. EQUIPMENT: Vibrocompaction shall be performed using a mandrel capable of being lowered to a minimum depth of 10 feet below the minimum elevation shown on the drawings. Sufficient cranes pumps, trailers, tools, and accesseries required for efficient operation shall also be provided.

a. VIBRATOR: Each mandrel shall be equipped with an electrically powered, internal, down-the-hole vibrator with eccentric. The vibrator shall be located within the lower portion of the mandrel and shall be capable of operation at 1800 revolutions per minute (rpm). The vibrator shall produce a minimum horizontal centrifugal force of 20 tons with a minimum lateral amplitude of 10 millimeters. The vibrator shall be electrically operated and shall be provided with a recording ammeter.

b. WATER PASSAGEWAYS: Each mandrel shall be equipped with water passageways and associated valving to allow up to 150 gallons per minute (gpm) of flow, at a system pressure of 40 pounds per square inch, to be directed through a bottom jet, and alternately through one or more upper jets located between 3 feet and 10 feet above the bottom of the mandrel.

c. POWER SUPPLY: Each mandrel shall be provided with a portable electric generator unit capable of providing sufficient power to operate the electric vibrator over its full range of amperage.

d. NUMBER OF UNITS: A minimum of two mandrels, with all associated tools and equipment, shall be provided, with sufficient spare units to reasonably assure continuous operation of two vibrocompaction units at all times during subsoil stabilization.

4. OPERATING PROCEDURE: The following operating procedure shall be followed at each densification station. Using water flow through the bottom jet, insert the mandrel into the ground to a level at or below the minimum elevation shown on the drawings. Add sufficient backfill material to cover the vibrating portion of the

APPENDIX D – WATER REUSE MATRIX

Recycled Water Uses Allowed* In California

This summary is prepared for WateReuse Association, from the December 2, 2000, Title-22 adopted Water Recycling Criteria, and supersedes all earlier versions

Use of Recycled Water	Treatment Level: Disinfected Tertiary Recycled Water	Disinfected Secondary-2.2 Recycled Water	Disinfected Secondary-23 Recycled Water	Undisinfected Secondary Recycled Water
Irrigation of:				
Food crops where recycled water contacts the edible portion of the crop, including all root crops	Allowed	Not allowed	Not allowed	Not allowed
Parks and playgrounds	Allowed	Not allowed	Not allowed	Not allowed
School yards	Allowed	Not allowed	Not allowed	Not allowed
Residential landscaping	Allowed	Not allowed	Not allowed	Not allowed
Unrestricted-access golf courses	Allowed	Not allowed	Not allowed	Not allowed
Any other irrigation uses not prohibited by other provisions of the California Code of Regulations	Allowed	Not allowed	Not allowed	Not allowed
Food crops, surface-irrigated, above-ground edible portion, and not contacted by recycled water	Allowed	Allowed	Not allowed	Not allowed
Cemeteries	Allowed	Allowed	Allowed	Not allowed
Freeway landscaping	Allowed	Allowed	Allowed	Not allowed
Restricted-access golf courses	Allowed	Allowed	Allowed	Not allowed
Ornamental nursery stock and sod farms with unrestricted public access	Allowed	Allowed	Allowed	Not allowed
Pasture for milk animals for human consumption	Allowed	Allowed	Allowed	Not allowed
Nonedible vegetation with access control to prevent use as a park, playground or school yard	Allowed	Allowed	Allowed	Not allowed
Orchards with no contact between edible portion and recycled water	Allowed	Allowed	Allowed	Allowed
Vineyards with no contact between edible portion and recycled water	Allowed	Allowed	Allowed	Allowed
Non food-bearing trees, including Christmas trees not irrigated less than 14 days before harvest	Allowed	Allowed	Allowed	Allowed
Fodder and fiber crops and pasture for animals not producing milk for human consumption	Allowed	Allowed	Allowed	Allowed
Seed crops not eaten by humans	Allowed	Allowed	Allowed	Allowed
Food crops undergoing commercial pathogen-destroying processing before consumption by humans	Allowed	Allowed	Allowed	Allowed
Ornamental nursery stock, sod farms not irrigated less than 14 day before harvest	Allowed	Allowed	Allowed	Allowed
Supply for impoundment:				
Nonrestricted recreational impoundments, with supplemental monitoring for pathogenic organisms	Allowed**	Not allowed	Not allowed	Not allowed
Restricted recreational impoundments and publicly accessible fish hatcheries	Allowed	Allowed	Not allowed	Not allowed
Landscape impoundments without decorative fountains	Allowed	Allowed	Allowed	Not allowed
Supply for cooling or air conditioning:				
Industrial or commercial cooling or air conditioning involving cooling tower, evaporative condenser, or spraying that creates a mist	Allowed***	Not allowed	Not allowed	Not allowed
Industrial or commercial cooling or air conditioning not involving cooling tower, evaporative condenser, or spraying that creates a mist	Allowed	Allowed	Allowed	Not allowed
Other uses:				
Groundwater Recharge	Allowed under special case-by-case permits by RWQCBs****			
Flushing toilets and urinals	Allowed	Not allowed	Not allowed	Not allowed
Priming drain traps	Allowed	Not allowed	Not allowed	Not allowed
Industrial process water that may contact workers	Allowed	Not allowed	Not allowed	Not allowed
Structural fire fighting	Allowed	Not allowed	Not allowed	Not allowed
Decorative fountains	Allowed	Not allowed	Not allowed	Not allowed
Commercial laundries	Allowed	Not allowed	Not allowed	Not allowed
Consolidation of backfill material around potable water pipelines	Allowed	Not allowed	Not allowed	Not allowed
Artificial snow making for commercial outdoor uses	Allowed	Not allowed	Not allowed	Not allowed
Commercial car washes, not heating the water, excluding the general public from washing process	Allowed	Not allowed	Not allowed	Not allowed
Industrial process water that will not come into contact with workers	Allowed	Allowed	Allowed	Not allowed
Industrial boiler feed	Allowed	Allowed	Allowed	Not allowed
Nonstructural fire fighting	Allowed	Allowed	Allowed	Not allowed
Backfill consolidation around nonpotable piping	Allowed	Allowed	Allowed	Not allowed
Soil compaction	Allowed	Allowed	Allowed	Not allowed
Mixing concrete	Allowed	Allowed	Allowed	Not allowed
Dust control on roads and streets	Allowed	Allowed	Allowed	Not allowed
Cleaning roads, sidewalks and outdoor work areas	Allowed	Allowed	Allowed	Not allowed
Flushing sanitary sewers	Allowed	Allowed	Allowed	Allowed

* Refer to the full text of the December 2, 2000 version of Title-22: California Water Recycling Criteria. This chart is only an informal summary of the uses allowed in this version.

The complete and final 12/02/2000 version of the adopted criteria can be downloaded from : <http://www.dhs.ca.gov/ps/ddwem/publications/Regulations/recycleregs_index.htm>

** With "conventional tertiary treatment". Additional monitoring for two years or more is necessary with direct filtration.

*** Drift eliminators and/or biocides are required if public or employees can be exposed to mist.

**** Refer to Groundwater Recharge Guidelines, available from the California Department of Health Services.

Prepared by Bahman Sheikh and edited by EBMUD Office of Water Recycling, who acknowledge this is a summary and not the formal version of the regulations referenced above

APPENDIX E – MEMO FROM GARY YAMAMOTO, P.E., AND JAMES WADDELL, DEPARTMENT OF HEALTH SERVICES, TO CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARDS, JANUARY 8, 2003

State of California—Health and Human Services Agency
Department of Health Services

California Department of Health Services
ANA M. BONTÁ, R.N., Dr. P.H.
Director

GRAY DAVIS
Governor

January 8, 2003

TO: State of California
Regional Water Quality Control Boards

SUBJECT: Orchard and Vineyard Irrigation Using Recycled Water

This memo is being sent to provide you with clarification concerning the application of recycled water on orchard and vineyard crops based on the current position of the California Department of Health Services Food and Drug Branch (FDB). General guidance is also presented for developing permit conditions for existing and proposed projects involving orchard and vineyard crops identified under Section 60340 (d) of the Water Recycling Criteria.

Section 60304(d) of the Criteria allows for the use of undisinfected secondary recycled water for prescribed applications involving limited food and seed crops, subject to certain restrictions. Such applications are limited to 1) Orchards and Vineyards where the recycled water does not come into contact with the edible portion of the food crop, 2) seed crops not eaten by humans, and 3) food crops that must undergo commercial pathogen destroying processing before being consumed by humans. The FDB, with the concurrence of the Division of Drinking Water and Environmental Management (DDWEM) believes that undisinfected secondary effluent represents a potential public health threat when direct or indirect modes of public contact with the recycled water, or a food product having been directly exposed to the recycled water, is allowed to occur.

It is the position of the FDB that orchard and vineyard crops will quite likely come into contact with recycled water or soil irrigated with recycled water through typical harvesting practices (e.g. sweeping of nuts shaken from trees) and/or improper use-site control measures (e.g. harvesting of grounders). Furthermore, FDB has reported that recent studies have indicated there may be a potential for pathogens to gain access to the interior of fruits or seeds through uptake by the root system, breaks in the surface of the food product and stem scars. As a result, the FDB recommends that orchard and vineyard crops are irrigated with water, which (at a minimum) meets the requirements of a disinfected secondary-2.2 recycled water as defined in Section 60301.220. Furthermore, it is the position of FDB that the coliform standard be achieved using chlorine as the disinfectant due to limited data available on the effectiveness of other

Flex your POWER
Do your part to help California save energy. To learn more about saving energy, visit the following web site:
www.consumerenergycenter.org/flex/index.html

Division of Drinking Water and Environmental Management, Recycled Water Unit
1180 Eugenia Place, Suite 200, Carpinteria, California 93013
(805) 566-9767; (805) 745-8196 fax
Internet Address: www.dhs.ca.gov/ps/ddwem/

disinfectants on secondary effluent and a general lack of experience with their use. If a project proponent wishes to use an alternative disinfectant, they would need to demonstrate equivalency to microbial inactivation using chlorine to achieve a 7-day median 2.2 MPN.

The Criteria require the submittal of an engineering report for all proposed projects. In accordance with Section 60323 of the Criteria, the report must (in part) "clearly indicate the means for compliance with these regulations and any other features specified by the regulatory agency". The DDWEM has developed comprehensive guidelines for preparation of such reports to assist the industry in addressing the finite elements of the Criteria. If convincing documentation of how compliance with requirements of Section 60304 (d) will be assured at all times is not provided, FDB recommendation would be for project denial or that minimum treatment requirements be imposed which comply with the disinfected secondary-2.2 recycled water requirement.

It is noted that the existing Water Recycling Criteria prescribe minimum treatment and use-site requirements. They do not preclude regulatory agencies from imposing more stringent treatment and/or use site controls if deemed necessary for public health protection. Additionally, by memorandum dated January 19, 1998 (copy attached), DDWEM field staff was advised that some proposed uses of recycled water might require the review and approval of other agencies having jurisdiction over the use. This memorandum directed staff to ensure that all appropriate agencies are notified of recycled water proposals to ensure them the opportunity to review and comment on the proposal. In the case of food crops, the FDB should certainly be advised/consulted prior to permit issuance.

It is important to recognize that this general guidance is specific to orchard and vineyard type crops, and in no way alters the intent of requirements outlined under Section 60340 (a) which applies to food crops where direct contact between the recycled water and the food crop may occur.

If you have any questions concerning this issue, please contact Dr. Chang-Rae Lee with the FDB at (916) 327-8041 or Jeff Stone with DDWEM at (805) 566-9767.

Sincerely,

Gary Yamamoto, P.E., Chief
Technical Programs Branch
Division of Drinking Water
and Environmental Management

James M. Waddell, Chief
Food and Drug Branch
Division of Food, Drug
and Radiation Safety

cc: State Water Resources Control Board-Rich Mills
Regional/District Engineers
CCDEH

APPENDIX F – BIOSOLIDS CRITERIA FOR LAND APPLICATION

Table F.1 Biosolids Pollutant Concentration Limits for Land Application
Wastewater Treatment Plant Facility Master Plan
Morro Bay Cayucos Sanitary District

Pollutant	California General Order Ceiling Limits (mg/kg)[1]	503.13 Table 1 Ceiling Concentrations (mg/kg)[1]	503.13 Table 3 High Quality Pollutant Concentrations (mg/kg)[1]
Arsenic	75	75	41
Cadmium	85	85	39
Copper	4,300	4,300	1,500
Lead	840	840	300
Mercury	57	57	17
Molybdenum	75	75	NA[2]
Nickel	420	420	420
Selenium	100	100	100
Zinc	7,500	7,500	2,800

Notes:
1. Dry weight basis.
2. Temporarily suspended by EPA pending further consideration. Value was 18 mg/kg.

Table F.2 Annual and Cumulative Land Application Rates
Wastewater Treatment Plant Facility Master Plan
Morro Bay Cayucos Sanitary District

Pollutant	California General Order Cumulative Pollutant Loading Rate (lbs/acre)	503.13 Table 2 Cumulative Pollutant Loading Rate (kg/hectare)	503.13 Table 4 Annual Pollutant Loading Rate (kg/hectare)
Arsenic	36	41	2.0
Cadmium	34	39	1.9
Copper	1,336	1,500	75
Lead	267	300	15
Mercury	15	17	0.85
Molybdenum	16	--	--
Nickel	374	420	21
Selenium	89	100	5.0
Zinc	2,494	2,800	140

Table F.3 Class A Pathogen Reduction Alternatives Wastewater Treatment Plant Facility Master Plan Morro Bay Cayucos Sanitary District	
Alternative	**Description**
A1: Time and Temperature	Fecal coliform shall be less than 1,000 MPN/gram, or Salmonella sp. shall be less than 3 MPN/4 grams of total solids at the time of disposal. Maintain certain temperature and time period based on the percent solids and prescribed equations (see 503 Regulations for details).
A2: Biosolids Treated in a High pH-High Temperature Process	Maintain biosolids at certain elevated temperature and pH for prescribed period of time (see 503 Regulations for details).
A3: Biosolids Treated in Other Processes	The density of enteric viruses in the biosolids after pathogen treatment must be less than 1 PFU per 4 grams of total solids. The density of viable helminth ova in the swage sludge after pathogen treatment must be less than 1 per 4 grams of total solids. Report operating parameters to indicate consistent pathogen reduction treatment.
A4: Biosolids in Unknown Processes	The density of enteric viruses in the biosolids after pathogen treatment must be less than 1 PFU per 4 grams of total solids. The density of viable helminth ova in the sewage sludge after pathogen treatment must be less than 1 per 4 grams of total solids.
A5: Processes to Further Reduce Pathogens (PFRP)	
Composting	Using either the within-vessel composting method or the aerated static pile composting method, the temperature of the sewage sludge is maintained at 55 degrees Celsius or higher for three days. Using the windrow composting method, the temperature of the sewage sludge is maintained at 55 degrees or higher for 15 days or longer. During the period when the compost is maintained at 55 degrees or higher, there shall be a minimum of five turnings of the windrow.

Table F.3 Class A Pathogen Reduction Alternatives Wastewater Treatment Plant Facility Master Plan Morro Bay Cayucos Sanitary District	
Alternative	**Description**
Heat Drying	Sewage sludge is dried by direct or indirect contact with hot gases to reduce the moisture content of the sewage sludge to 10 percent or lower. Either the temperature of the sewage sludge particles exceeds 80 degrees Celsius or the wet bulk temperature of the gas in contact with the sewage sludge as the sewage sludge leaves the dryer exceed 80 degrees Celsius.
Heat Treatment	Liquid sewage sludge is heated to a temperature of 180 degrees Celsius or higher for 30 minutes.
Thermophilic Aerobic Digestion	Liquid sewage sludge is agitated with air or oxygen to maintain aerobic conditions and the mean cell residence time of the sewage sludge is 10 days at 55 to 60 degrees Celsius.
Beta Ray Irradiation	Sewage sludge is irradiated with beta rays from an accelerator at dosages of at least 1.0 megarad at room temperature (ca. 20 degrees Celsius).
Gamma Ray Irradiation	Sewage sludge is irradiated with gamma rays from certain isotopes, such as Cobalt 60 and Cesium 137, at room temperature (ca. 20 degrees Celsius).
Pasteurization	The temperature of the sewage sludge is maintained at 70 degrees Celsius or higher for 30 minutes or longer.
Use of Processes Equivalent to obtain PFRP	Demonstrate operating parameters and/or pathogen levels to be PFRP equivalent subject to permitting authority approval.

Table F.4	Class B Pathogen Reduction Alternatives Wastewater Treatment Plant Facility Master Plan Morro Bay Cayucos Sanitary District	
	Alternative	**Description**
B1:	Monitoring of Fecal Coliform	The geometric mean of seven samples of treated biosolids, collected at time of use or disposal shall meet a fecal coliform density of less than 2 million colony forming units or most probable number per gram of sewage sludge solids (dry weight basis).
B2:	Processes to Significantly Reduce Pathogens (PSRP)	Sewage sludge is treated by one of the five PSRP methods listed below.
	Aerobic Digestion	Sewage sludge is agitated with air or oxygen to maintain aerobic conditions for a specific mean cell residence time at a specific temperature. Values for the mean cell residence time and temperature shall be between 40 days at 20 degrees Celsius and 60 days at 15 degrees Celsius.
	Air Drying	Sewage sludge is dried on sand beds or on paved or unpaved basins. The sewage sludge dries for a minimum of three months. During two of the three months, the ambient average daily temperature is above zero degrees Celsius.
	Anaerobic Digestion	Sewage sludge is treated in the absence of air for a specific mean cell residence time at a specific temperature. Values for the mean cell residence time and temperature shall be between 15 days at 35 to 55 degrees Celsius and 60 days at 20 degrees Celsius.
	Composting	Using either the within-vessel, static aerated pile, or windrow composting methods, the temperature of the sewage sludge is raised to 40 degrees Celsius or higher and remains at 40 degrees Celsius or higher for five days. For four hours during the five days, the temperature in the compost pile exceeds 55 degrees Celsius.
	Lime Stabilization	Sufficient lime is added to the sewage sludge to raise the pH of the sewage sludge to 12 after two hours of contact.
B3:	Use of Processes Equivalent to PSRP	Demonstrate operating parameters and/or pathogen levels to be PSRP equivalent subject to permitting authority approval.

Table F.5	40 CFR 503 Vector Attraction Reduction Requirements Wastewater Treatment Plant Facility Master Plan Morro Bay Cayucos Sanitary District
Option	**Process**
(1)	The mass of volatile solids in the sewage sludge shall be reduced by a minimum of 38 percent during sewage sludge treatment.
(2)	When the 38 percent volatile solids reduction requirement cannot be met for an anaerobically digested sewage sludge, vector attraction reduction can be demonstrated by digesting a portion of the previously digested sewage sludge anaerobically in the laboratory in a bench-scale unit for 40 additional days at a temperature between 30 and 37 degrees Celsius. When, at the end of the 40 days, the volatile solids in the sewage sludge at the beginning of that period is reduced by less than 17 percent, vector attraction reduction is achieved.
(3)	When the 38 percent volatile solids reduction requirement in cannot be met for an anaerobically digested sewage sludge, vector attraction reduction can be demonstrated by digesting a portion of the previously digested sewage sludge that has a percent solids of two percent or less aerobically in the laboratory in a bench-scale unit for 30 additional days at 20 degrees Celsius. When, at the end of the 30 days, the volatile solid sin the sewage sludge at the beginning of that period is reduced by less than 15 percent, vector attraction reduction is achieved.
(4)	The specific oxygen uptake rate (SOUR) for sewage sludge treated in an aerobic process shall be equal to or less than 1.5 milligrams of oxygen per hour per gram of total solids (dry weight basis) at a temperature of 20 degrees Celsius.
(5)	Sewage sludge shall be treated in an aerobic process for 14 days or longer. During that time, the temperature of the sewage sludge shall be higher than 40 degrees Celsius and the average temperature of the sewage sludge shall be higher than 45 degrees Celsius.
(6)	The pH of sewage sludge shall be raised to 12 or higher by alkali addition and, without the addition of more alkali, shall remain at 12 or higher for two hours and then at 11.5 or higher for an additional 22 hours at 25 degrees Celsius.
(7)	The percent solids of sewage sludge that does not contain unstabilized solids shall be equal to or greater than 75 percent based on the moisture content and total solids prior to mixing with other materials.
(8)	The percent solids of sewage sludge that contains unstabilized solids generated in a primary wastewater treatment process shall be equal to or greater than 90 percent based on the moisture content and total solids prior to mixing with other materials.
(9)	Sewage sludge shall be injected below the surface of the land. No significant amount of the sewage sludge shall be present on the land surface within one hour after the sewage sludge is injected. When the sewage sludge that is injected below the surface of the land is Class A with respect to pathogens, the sewage sludge shall be injected below the land surface within eight hours after being discharged from the pathogen reduction process.

Table F.5	40 CFR 503 Vector Attraction Reduction Requirements Wastewater Treatment Plant Facility Master Plan Morro Bay Cayucos Sanitary District
Option	**Process**
(10)	Sewage sludge applied to the land surface or placed on a surface disposal site shall be incorporated into the soil within six hours after application to or placement on the land. When sewage sludge that is incorporated into the soil is Class A with respect to pathogens, the sewage sludge shall be applied to or placed on the land within eight hours after being discharged from the pathogen treatment process.
(11)	Sewage sludge placed on a surface disposal site shall be covered with soil or other material at the end of each operating day.
(12)	The pH of domestic septage shall be raised to 12 or higher by alkali addition and, without the addition of more alkali, shall remain at 12 or higher for 30 minutes at 25 degrees Celsius.

APPENDIX G – MORRO BAY CAYUCOS SANITARY DISTRICT WASTEWATER TREATMENT PLANT CORROSION ASSESSMENT

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MORRO BAY - CAYUCOS SANITARY DISTRICT WASTEWATER TREATMENT PLANT

CORROSION ASSESSMENT

Morro Bay, CA

Prepared for

Carollo Engineers
7580 North Ingram Avenue
Fresno, CA 93309

Project Engineer: Mr. Hank Galka, P.E.

Prepared by

SCHIFF ASSOCIATES
Consulting Corrosion Engineers
431 W. Baseline Road
Claremont, CA 91711

SA #07-0202ENG

May 15, 2007

431 West Baseline Road · Claremont, CA 91711
Phone: 909.626.0967 · Fax: 909.626.3316

EXECUTIVE SUMMARY

On March 21-23, 2007, Schiff Associates performed a corrosion survey at the Morro Bay – Cayucos Sanitary District (WWTP) Morro Bay, CA. A visual inspection and photo documentation (see Photos per Structure - Appendix A). of accessible facilities was performed, the following is a list of those facilities: Administration Bldg, Chlorination Bldg, Digester #1, Digester #3 Sludge Holding Tank, Headworks Pumps - Above Ground, MCC – D, MCC-C, Primary Clarifier #2, Secondary Clarifier, Trickling Filter #2, Biofilter Circulation Interstage Pumping Station, Chlorine Contact Basin, Digester #2, Headworks MCC, Maintenance Bldg, MCC-B, Primary Clarifier #1, Secondaries MCC Bldg, and the Trickling Filter #1. The structures were surveyed for noticeable corrosion and concrete surface damage. (See Gallery of Concrete Condition and Corrosion Types - Appendix A).

1. The metallic structures located inside and outside of the concrete tanks, (rake arms, valves, piping manifolds) are experiencing localized and general corrosion cells. (see Appendix A – Photo Gallery - general)

2. Coating damage in the form of delamination, peeling and sporadic osmotic blistering is present on above ground piping, valves and pumps throughout the concrete tanks and pipe manifolds. (see Appendix B Photos and Observation for each facility)

Soil samples were obtained at 5 locations as determined by the owner and analyzed in our lab for pH, resistivity, conductivity, major anions and cations, ammonium and nitrates, and redox potentials. The soil samples taken at 5 different locations within the plant contain the following soil conditions:

1. Soil pH values between 6.7 to 8.2. This range is neutral to moderately alkaline.
2. The soluble salt content of the samples ranged from low to moderate.
3. Ammonium was detected in low concentrations. The detected nitrate concentration was high enough to be deleterious to copper.
4. Variations in soil resistivity of an order of magnitude or more can create differential aeration corrosion cells that would affect all metals.
5. This soil is classified as severly corrosive to ferrous metals and aggressive to copper. (see Appendix D – Laboratory Soil Sample Test Data)

A Cathodic protection (CP) survey of the existing systems was performed, including rectifiers, sacrificial anode outputs at shunts, and pipe-to-soil-potentials. There are two Cathodic protection systems currently energized to protect the following below ground piping systems: 8" Low Pressure sludge Gas System, 4" Service Air and the 1" Natural Gas System. (See Cathodic Protection Data - Appendix D). The survey was performed to document the present status of the Cathodic protection systems.

1. There are 13 strategically placed cathodic protection test stations throughout the plant of which 6 have on potentials which range between -0.536nV to 0-.804mV. These pipe-to-potentials are below the minimum -.850 mV recommended by NACE Standard RPO169-2002 to mitigate against soil side corrosion (see Appendix E Cathodic Protection Data).

1.) It is our recommendation that the Morro Bay Cayucos Sanitary District (WWTP) consider establishing and more importantly, implementing a preventative corrosion program based on a scale of A,B,C, Conditions being as follows:

- A-Good Condition = Monitor and repair as needed before the item achieves condition B.
- B-Bad Condition. = Repair item before condition C becomes evident
- C-Worst Condition = Replace.

2.) Evaluate each structure based on the above mentioned conditions to determine priority of repairs.
3.) Additional investigation on concrete structures should be performed by sampling and testing determining ph levels, chloride content and the degree of degradation caused by H2s gases.
3.) Submerged surfaces should be evaluated during the next scheduled shut down or when ever the unit becomes available to be viewed.
4.) Repair any mild corrosion within the electrical buildings and consider dehumidification.
5.) Periodically washing the facility down of the accumulated salts with fresh water, minimizing chloride contact with the surfaces.
6.) Repair and Seal concrete surfaces to retard infiltration of chlorides.
7.) Carefully choose coating and lining systems for their intended use.
8.) Perform an interrupted cathodic protection survey to record pipe-to-soil potential shift and adjust the cathodic protection current output to meet the recommended -0.850mV NACE Standard RPO169-2002 to mitigate against soil side corrosion (see Appendix E Cathodic Protection Data).

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D. LABORATORY TEST RESULTS
E. CATHODIC PROTECTION DATA

INTRODUCTION

Schiff Associates (SA) conducted a corrosion investigation and tested the cathodic protection systems at the Morro Bay Cayucos Sanitary District (WWTP) located in the City of Morro Bay, California. The field work was performed March 21st to 23rd 2007, in accordance with our agreement with Carollo Engineers dated 2/6/07, Carollo project No. 7087B01.

The scope of work included the following tasks:

1. Visual inspection and photo documentation of accessible metallic and concrete structures at several facilities in and around the plant
2. Photo documentation, soil sampling, laboratory testing, and visual inspection of buried underground piping at five (5) excavation sites
3. Cathodic protection survey on three underground piping systems
4. Preparation of a report to include the findings, tabulated data, photos, conclusions and recommendations

TEST PROCEDURES

Schiff Associates inspected and documented corrosion damage on accessible aboveground metallic structures and any noticeable concrete deterioration at several facilities in and around the Morro Bay Cayucos Sanitary District (WWTP). The following 19 facilities were inspected: Appendix A presents an eight page photo-gallery of concrete condition and general types of corrosion observed. Appendix B presents photos and field observations for each of the 19 facilities inspected. Appendix C presents the 5 excavation sites and photos. Appendix D presents the laboratory soil sample test data and Appendix E presents the cathodic protection data.

Excavations

Five excavation sites were mutually selected by the Plant Supervisor, the Plant Engineer and Schiff Associates. Appendix C presents an aerial view of where the dig sites were located. The selected sites were hand dug by plant personnel and all soil and debris was removed removed from the pipeline's coating by hand. The pipeline coating was visually inspected and a one-pound soil sample was obtained from each of the five locations.

Excavation Site #1:
Dig site #1 was located on the South Side of Digester #1. The plant personnel exposed the 8-inch (LSG) Methane gas line and the 2-inch (NG) Natural gas line. The 8-inch Methane gas line is schedule 40, epoxy lined and thermoplastic coated black steel. The 2-inch line is schedule 40, thermoplastic coated galvanized steel. A one-pound soil sample was sent to the lab for analysis (see Appendix D Lab Soil Sample Test Data).

Excavation Site #2:
Dig site #2 was located on the South West Side of the the maintenance building. Plant personnel exposed the 1-inch natural gas line and the 2-inch non-potable city water line. Both pipelines are composed of schedule 40 galvanized steel. A one-pound soil sample was sent to the lab for analysis (see Appendix D Lab Soil Sample Test Data).

Excavation Site #3:
Dig site #3 was located on the East Side of the waste gas burner pit. Plant personnel exposed the 8-inch (LSG) Methane gas line. The 8-inch Methane gas line is schedule 40, epoxy lined and thermoplastic coated black steel. A one-pound soil sample was sent to the lab for analysis (see Appendix D Lab Soil Sample Test Data).

Excavation Site #4:
Dig site #4 was located on the North end of the MLSS (Mixed Liquor Secondary Sedimentation Channel). Plant personnel exposed the a 12-inch PVC-BFE (Bio-Filter Effluent) Pipe. A one-pound soil sample was sent to the lab for analysis (see Appendix D Lab Soil Sample Test Data).

Excavation Site #5:
Dig Site #5 was located on the South end of the Sludge Drying Beds (in roadway). The excavation did not expose any piping. A one-pound soil sample was sent to the lab for analysis (see Appendix D Lab Soil Sample Test Data).

Soil sampling

Approximately one pound of soil was sampled inside the excavation at the pipe depth, and sent to our laboratory for testing A one-pound soil sample was also sent to the lab for analysis where no pipe was exposed (see Appendix D Lab Soil Sample Test Data). Soil and debris was removed to provide a visual inspection and photo-documentation of any pipeline surface which was exposed. No corrosion was detected or observed.

Potential measurements

The excavation sites provided a visual inspection which was followed by recording a pipe-to-soil potentials using a portable copper-copper sulfate reference electrode and a Fluke 87 digital multimeter (DMM). The following dig sites provided a location for obtaining pipe-to-soil potentials: (Dig Site #1, 8-inch Methane Gas Line & 2-inch Natural Gas Southside of Digester #2 (-998mV), (Dig Site #2 (Northside of Gas Pit at Digester #1 (-1700mV), and (Dig Site #3 Waste Gas Burner – 8-inch Plant Gas Eastside of Waste Gas Pit (-1600mV).

Laboratory Testing

The electrical resistivity of each soil sample was measured in a soil box per ASTM G57 in its as received condition and again after saturation with distilled water. Resistivities are at about their lowest value when the soil is saturated. The pH of the saturated samples was measured. A 5:1 water:soil extract from the samples was chemically analyzed for the major soluble salts commonly found in soil. Table 1 in Appendix D Lab Soil Sample Test Data presents the laboratory testing results.

Cathodic Protection Survey

Pipe-to-Soil potentials were taken at all accessible ETS (electrical test station) locations while performing a current on / off cathodic protection survey. The survey data represents four underground piping systems: the 8-inch Low Pressure Sludge Gas System pipeline(LSG), the 4-inch Service Air pipeline (SA), the 1-inch Natural Gas System pipeline (NG) and the 1-inch Agitator Air pipeline (AA). The survey included a visual inspection of the rectifier and test stations, measurement of current outputs, interrupted pipe-to-soil potentials on the impressed

current system (4Sec./On – 8Sec./Off), and system output adjustments if required. Cathodic Protection data is included in Appendix E Cathodic protection Data.

DISCUSSION

In a 1982 Plan for improvements by the City of Morro Bay, San Luis Obispo County, California. Brown & Caldwell Consulting Engineers, Inc. was chosen as the engineer to design the initial construction of the facility structures at the Morro Bay - Cayucos Waste Water Treatment Plant. (MBCWWTP). In addition, a galvanic cathodic protection system (Magnesium Anodes – a total of 13 separate installations throughout the plant) was installed to protect the below ground steel piping. In 1991 CPS (Cathodic Protection Services) was contracted to investigate cathodic interference issues which were corrected by supplementing the existing galvanic cathodic protection system with an impressed current cathodic protection system.

Administration Building

The Administration Building houses an on-site laboratory, training room, men's locker room, control Room, office, electrical room and the generator room. The following two rooms were inspected: the generator room and the electrical room. The following structures were noted as having general corrosion: Master Control Center (MCC) electrical panels and switches, door jams, steel piping, air-heating duct work and an above ground diesel fuel tank located outside adjacent to the building.

Chlorination Building

The Chlorination Building is a split face deep scored block type building which is no longer used for its designed purpose. While the inside of the building appears to be in good condition the external electrical components are experiencing coating delamination, and peeling. The internal components of the breaker box and panel are experiencing general corrosion.

Digester #1, #2, and #3 Holding Tank (Sludge)

The three digester tanks are concrete mortar coated steel frame tanks with steel appurtenances. The tanks are interconnected above ground with steel pumps, pipe, fittings, and valves ranging in size from 2-inch to 8-inch. There is evidence of underside corrosion on valves and steel piping. Isolated corrosion damage is evident on steel pipe, structures and the underside of steel valves. Bubbles are beginning to form as result of coating delamination on the pump motors and motor pedestals as well as on piping manifolds. The concrete surface of the tanks have experienced scaling, plastic shrinkage cracking, crazing-hair line cracks, and Small pits, or voids, called bug holes and worm holes.

Headworks Pumps - Above Ground and MCC

The Headworks building is composed of the motor room, pump room, screenings area and the MCC (Master Control Center). The MCC is made up electrical panels, switchgear, and switches. The MCC equipment has experienced general corrosion at the interface from one electrical panel to the next. The inside of the electrical boxes are also experiencing general corrosion. The pump and motor room include steel piping, valves, and fittings ranging in size from 1-inch to 12-inch. The coatings have failed and are exhibiting areas of coating delamination with under coating corrosion product buildup on both steel piping and fittings. The concrete has experienced plastic

shrinkage cracks, fine crazed cracks as well as a loss of concrete material on pipe pedestal footings, stairway corners, at the handrail post and walkway interface and the walkway surface.

Secondaries MCC Bldg, MCC-B, MCC-C, and MCC–D

These buildings are constructed of deep scored split face concrete block with air conditioning units to keep the electrical equipment from overheating. The electrical equipment maintained within the boundaries of the building is made of electrical switchgear, electrical cabinets and switches. The wiring appears to be experiencing noticeable amounts of atmospheric corrosion at the exposed end connections. Dust and moisture have collected between panels and there exists general corrosion between the dust layer and the steel cabinet panels.

Primary Clarifier #1, #2, and the Secondary Clarifier

The Clarifiers are reinforced steel concrete cylinder tanks. There are connections to steel piping, pumps, fittings and valves ranging from 1-inch to 8-inch. These items were examined for corrosion of the metallic parts and coating condition. The coating is experiencing delamination and peeling on valves and piping. The present corrosion issues are limited to general and localized corrosion on both the steel walkways and steel pipe support. There is evidence of cracks around concrete coated pipe which has allowed moisture to migrate and create corrosion cells. The exposed external tank concrete surface has evidence of small pits, voids, called bug holes and worm holes. There is also evidence of concrete plastic shrinkage with the ends of rebar exposed on tank walls. There is crazed concrete cracking on the internal side of the tank walls, and concrete scaling of tank outside walls which has exposed concrete aggregate.

Trickling Filters #1, #2

The trickling filters are constructed of steel reinforced concrete and concrete block with a concrete-mortar cap. There is a considerable amount of isolated corrosion on the moving steel parts, especially on the arm end plates. The mortar concrete cap on the block wall has failed and has gaps ranging from 1/8-inch to 1-inch. There are areas of coating delamination, scaling, chipping and corrosion tubercles beneath the coating on the internal moving parts of the tank arms.

Biofilter Circulation Interstage Pumping Station

The Biofilter Circulation Interstage Pumping Station is constructed of an Motor Control Center (MCC) Room and steel valves, fittings, pumps and steel piping ranging in size from 1-inch to 14-inch. The station plumbing and pumps are all located outdoors with no overhead covering to protect the equipment from the elements. The following structures are located within the vicinity of the pumps and manifold piping area or around the tank: steel pump casings/pump pedestals, manifold piping, stairway, handrails and footing. The pumps, valves and steel piping have experienced coating delamination, scaling and chipping. Corrosion cells have developed randomly and widely spread to locations with extreme coating damage. The sluice gate housing which is made of steel reinforced concrete is experiencing concrete plastic shrinkage leaving rebar exposed on the exterior surface of the concrete tank walls, crazed concrete cracking on the internal side of the tank walls, and concrete spalling caused by the presence of reinforcing steel too close to the surface on the concrete structure corners.

Chlorine Contact Basin

The Chlorine Contact Basin is constructed of steel reinforced concrete with 8 compartments and a place for the above ground pumps and plumbing. The plumbing is made up of steel valves, fittings and pipe ranging in size from 1-inch to 6-inch. The plumbing is experiencing coating delamination, scaling, chipping and under deposit corrosion. Corrosion tubercles are developing beneath the coating on the internal moving parts of the tank and on the bottom side of coated above ground steel parts. The concrete wall surface has evidence of small pits, or voids, called bug holes and worm holes. There is a deposit of efflorescence; evidence of porosity on the concrete surface. There is concrete plastic shrinkage causing rebar to be exposed on isolated areas of the tank walls. There is evidence of crazed concrete cracks on the internal side of the tank walls and concrete scaling of the tank exterior walls and walkway; mortar has peeled away from the concrete tank exterior wall surface exposing rock pockets. There are plastic shrinkage cracks around rebar set too close to the tank wall surface which have caused the concrete surface to crack and corrode the exposed rebar. There is evidence of extreme corrosion damage to rake arms.

Maintenance Building

The maintenance building is divided into five sections; paint storage, parts storage, boiler room compressor room and the maintenance shop. The plumbing which connects the existing steel valves, fittings and piping to the plant ranges from 1-inch to 4-inch. In addition to the steel piping there is a Motor Control Center (MCC) for the electrical equipment. Coating damage to the MCC is limited to under deposit corrosion. There is general corrosion on areas of the steel pipe exhibiting coating damage.

Excavations

The excavations provided a one-pound soil sample which was chemically analyzed for the major soluble salts commonly found in soils. Three of the five dig sites provided the opportunity to observe the coating and pipe condition which at this time appear to be in good condition, the 8-inch Methane Gas Pipeline, and the 1-inch and 2-inch Natural Gas Pipelines.

Soil Corrosivity

A major factor in determining soil corrosivity is electrical resistivity. The electrical resistivity of a soil is a measure of its resistance to the flow of electrical current. Corrosion of buried metal is an electrochemical process in which the amount of metal loss due to corrosion is directly proportional to the flow of electrical current (DC) from the metal into the soil. Corrosion currents, following Ohm's Law, are inversely proportional to soil resistivity. Lower electrical resistivities result from higher moisture and soluble salt contents and indicate corrosive soil.

A correlation between electrical resistivity and corrosivity toward ferrous metals is:

Soil Resistivity in ohm-centimeters			Corrosivity Category
over		10,000	mildly corrosive
2,000	to	10,000	moderately corrosive
1,000	to	2,000	corrosive
below		1,000	severely corrosive

Other soil characteristics that may influence corrosivity towards metals are pH, soluble salt content, soil types, aeration, anaerobic conditions, and site drainage.

The average and stratum resistivities measured in the field were in the mildly and moderately corrosive categories. Average resistivities increased with increasing depth.

Electrical resistivities were in the mildly corrosive category with as-received moisture. When saturated, the resistivities were in the mildly to severely corrosive categories. The resistivities dropped considerably with added moisture because the samples were dry as-received. The wide variations in soil resistivity can create concentration type corrosion cells that increase corrosion rates above what would be expected from the chemical characteristics alone.

Soil pH values varied from 6.7 to 8.2. This range is neutral to mildly alkaline.

The soluble salt content of the samples ranged from low to moderate.

Ammonium was detected in low concentration. The nitrate concentration was high enough to be deleterious to copper.

Tests were not made for sulfide and negative oxidation-reduction (redox) potential because these samples did not exhibit characteristics typically associated with anaerobic conditions.

Variation in soil resistivity of an order of magnitude or more can create differential-aeration corrosion cells that would affect all metals.

This soil is classified as severely corrosive to ferrous metals, aggressive to copper, moderate/severe for sulfate attack on concrete, and aggressive with respect to exposure of reinforcing steel to the migration of chloride.

Cathodic Protection Survey

A galvanic anode cathodic protection system composed of 13 separate magnesium anode installations strategically located throughout the plant was installed in 1983 to protect the 8-inch low pressure sludge gas system (LSG), the 1-inch natural gas system (NG), the 4-inch service air system (SA) and the agitation air system (AA). This galvanic cathodic protection system protected the existing below ground pipe for the next seven years. In 1990, a survey of the plant by CPS[1](Cathodic Protection Service) concluded that the galvanic CP system was no longer able to provide the necessary protection to mitigate corrosion. CPS designed and installed a supplemental impressed current cathodic protection system consisting of six 3-inch diameter X 60-inch long graphite anodes in a horizontal anode bed, located between the East wall of the maintenance garage building and the natural gas burner. The impressed current cathodic protection system was installed in 1991, with the rectifier mounted on the East wall of the maintenance garage building. The negative rectifier structure lead connection was made to the 8-inch low pressure sludge gas system (LSG) pipeline at a location east of the open pipe vault next to the waste gas burner, and identified as test station box #5. The rectifier has since been relocated to the Headworks MCC Building and mounted on the East wall of the building.

The result of the recent survey indicates that 6 of the 13 galvanic cathodic protection test stations have on pipe-to-soil potentials below the minimum -.850 mV recommended by NACE Standard RPO169-2002 to mitigate against soil side corrosion (see Appendix E Cathodic Protection Data). The following is a list of the 6 test station number and pipe-to-soil potential accordingly: test station #2 (-692mV), #9 (-802mV), #10 (-695mV), #11 (-536mV), #12 (-580mV), and test station #13 (-601mV).

A new rectifier was installed in the Head Works Building prior to the cathodic protection survey. This is an indication that the potentials are on their way to reaching protective levels. According to the 1990 interference cathodic protection survey, the existing galvanic cathodic protection system required an additional 200 magnesium anodes to adequately protect the existing below ground piping systems: Low pressure gas system, Natural gas system, Service and Agitator air systems. The CPS report concluded that failed insulating flange kits was the cause for the additional current requirement and ultimate installation of the impressed current rectifier and anodes (see [1] CP Checkout Report, dated 8/29/90).

[1] CP Checkout Report, dated 8/29/90

CONCLUSIONS

1. The metallic structures located inside and outside of the concrete tanks, (rake arms, valves, piping manifolds) are experiencing localized and general corrosion cells. (see Appendix A – Photo Gallery - general)

2. Coating damage in the form of delamination, peeling and sporadic osmotic blistering is present on above ground piping, valves and pumps throughout the concrete tanks and pipe manifolds. (see Appendix B Photos and Observation for each facility)

3. There are 13 strategically placed cathodic protection test stations throughout the plant of which 6 have on potentials which range between -0.536nV to 0-.804mV. These pipe-to-potentials are below the minimum -.850 mV recommended by NACE Standard RPO169-2002 to mitigate against soil side corrosion (see Appendix E Cathodic Protection Data).

4. The soil samples taken at 5 different locations within the plant contain the following soil conditions:
    a. Soil pH values between 6.7 to 8.2. This range is neutral to moderately alkaline.
    b. The soluble salt content of the samples ranged from low to moderate.
    c. Ammonium was detected in low concentrations. The detected nitrate concentration was high enough to be deleterious to copper.
    d. Variations in soil resistivity of an order of magnitude or more can create differential aeration corrosion cells that would affect all metals.
    e. This soil is classified as severly corrosive to ferrous metals and aggressive to copper. (see Appendix D – Laboratory Soil Sample Test Data)

5. Concrete structures have experienced surface and structural damage in the following forms: (see Appendix B Photos and Observation for each facility)
    - Surface cracks
    - Exposed reinforcing bars
    - Settlement of fresh concrete
    - Cracks caused by weathering
    - Crazed cracking on sidewalk
    - Exposed rock pockets
    - Small voids on concrete surface referred to as bugholes
    - Efflorescence
    - Scaling, Spalling

RECOMMENDATIONS

1.) It is our recommendation that the Morro Bay Cayucos Sanitary District (WWTP) consider establishing and more importantly, implementing a preventative corrosion program based on a scale of A,B,C, Conditions being as follows:

- A-Good Condition = Monitor and repair as needed before the item achieves condition B.
- B-Bad Condition. = Repair item before condition C becomes evident
- C-Worst Condition = Replace.

2.) Evaluate each structure based on the above mentioned conditions to determine priority of repairs.
3.) Additional investigation on concrete structures should be performed by sampling and testing determining ph levels, chloride content and the degree of degradation caused by H2s gases.
3.) Submerged surfaces should be evaluated during the next scheduled shut down or when ever the unit becomes available to be viewed.
4.) Repair any mild corrosion within the electrical buildings and consider dehumidification.
5.) Periodically washing the facility down of the accumulated salts with fresh water, minimizing chloride contact with the surfaces.
6.) Repair and Seal concrete surfaces to retard infiltration of chlorides.
7.) Carefully choose coating and lining systems for their intended use.
8.) Perform an interrupted cathodic protection survey to record pipe-to-soil potential shift and adjust the cathodic protection current output to meet the recommended -0.850mV NACE Standard RPO169-2002 to mitigate against soil side corrosion (see Appendix E Cathodic Protection Data).

CLOSURE

Our services have been performed with the usual thoroughness and competence of the engineering profession. No other warranty or representation, either expressed or implied, is included or intended.

Respectfully submitted,
SCHIFF ASSOCIATES

Reviewed By,

Al Perez
NACE Corrosion Technologist #3811

Graham E.C. Bell, Ph.D., P.E.

Appendix A
Photo gallery (general) of concrete condition and corrosion types

Appendix B
Photos and observations for each facility

Appendix C
Sketch and photos of five excavation sites

Appendix D
Laboratory Soil Sample Test Data

Appendix E
Cathodic Protection Data

APPENDIX H – ELECTRICAL FACILITIES OVERVIEW

Morro Bay/Cayucos Sanitary District

WASTEWATER TREATMENT PLANT ELECTRICAL FACILITIES OVERVIEW

FINAL

September 2006

carollo engineers

Morro Bay/Cayucos Sanitary District

WASTEWATER TREATMENT PLANT
ELECTRICAL FACILITIES OVERVIEW

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WASTEWATER TREAMENT PLANT ELECTRICAL FACILITIES OVERVIEW

On August 29, 2006, a field review of the Morro Bay - Cayucos Wastewater treatment facility was conducted. The items reviewed included the following:

1. Main 480-Volt Electrical Service Switchboard
2. Electrical Motor Control Centers
3. Electrical Panelboards
4. Electrical Control Panels
5. Standby Generator System
6. Field Wiring, Connections, and Control Devices.
7. Other

The wastewater treatment facility is supplied from a single 2000 ampere 480/277- volt, 3-phase, 4-wire service switchgear assembly with an interrupting rating of 50KAIC. The main service switchgear supplies feeders to several motor control centers located throughout the plant. A standby generator also is connected to the main service switchgear. Pacific Gas and Electric Company is the serving electric utility and provides service from a pad-mounted transformer located in close proximity to the main switchgear.

The majority of electrical facilities were installed in and around 1981. Due the close proximity to the ocean and the associated salt air environment, varying degrees of corrosion were found to be prevalent on almost all electrical equipment. Electrical equipment located in a typical non-corrosive environment has a typical life expectancy of approximately 30 years before replacement is required. Since most of the existing equipment is approximately 25 years old, and located in a salt air environment, a life expectancy of 30-years is generous. Based on the condition of the equipment located at this facility, however, a minimum life of at least an additional five years is feasible. During that time frame a plan should be developed to outline a replacement program for most if not all the major electrical equipment, beginning with the most critical items first.

The facility has no wide spread SCADA system and has limited capacity for automatic operation or alarm and status notification relating to equipment and instrumentation located throughout the plant. The addition of a SCADA system is a near necessity in the current day’s operating environment.

Noteworthy, are the following comments for each major piece of electrical equipment:

1.0 MAIN ELECTRICAL SERVICE SWITCHGEAR

The main electrical service is supplied from a Westinghouse 277/480 volt, 3-phase, 4-wire switchgear assembly rated at 2000 amps load capacity and having an interrupting rating of 50 KAIC. The switchgear consists of the following lineup:

- A main service entry section
- A utility metering section.
- A main utility breaker section.
- A standby generator main breaker section.
- Three feeder breaker sections consisting of five feeder circuit breakers.
- Two “spare” circuit breaker compartments
- Four “space” circuit breaker compartments.

The main switchgear has a significant amount of corrosion on both its exterior and interior surfaces. Although the enclosure is corroded, the electrical components within the enclosure, consisting of circuit breakers, relays, indicating lights and switches, appear to be in good to average condition. These components should be able to provide reliable service for at least another five years. Replacing the main switchgear and these components with new units is recommended to ensure continued reliability. Any failure occurring on the main switchgear will result in an outage to the entire plant and could require that the standby generator operate for an extended period of time.

In addition the main switchgear employs an automatic transfer scheme that can no longer be considered current or reliable in terms of today’s methodology and technology. Although it is still functional, there are more reliable methods to consider in transferring the plant to a standby power source, such as a SCADA/PLC based automatic transfer scheme. These newer methods could be incorporated into a new switchgear assembly.

2.0 STANDBY GENERATOR SYSTEM

The existing standby generator is an ONAN 250 diesel engine/ generator that supplies standby power to the entire facility upon the loss of utility power. The capacity of the generator is rated at 250 Kw at 80 percent power factor.

The generator is equipped with a separate external fuel tank. The generator assembly and related controls have been adequately maintained and are in relatively good condition and will need only minor maintenance to primarily deal with a small amount of corrosion on the generator skid mount. In addition, the unit is exercised on a regularly scheduled basis. The generator has no load bank for use in exercising the generator and is currently exercised

using plant load. Consideration should be given to adding a load bank at some future date to avoid having to transfer to plant load each time the unit is exercised. The unit will only need replacing if load additions occur to the facility that would exceed the 250 Kw capacity of the unit.

3.0 MOTOR CONTROL CENTERS

Each of the five motor control centers (MCC's) are approximately 25 years old and are near the end of the typical thirty year life expectancy for electrical equipment. The motor control centers were all manufactured by Westinghouse and are of the five Star series. Approximately half of the motor control centers show signs of corrosion and deterioration and with any piece of equipment as it ages, replacement parts may be increasingly difficult to acquire. From discussions with Westinghouse Corporation, however, replacement parts were found to be readily available for these MCCs.

The motor control centers are as follows:

- MCC-A - This MCC is located in the administration building electrical room across from the main switchgear. This MCC primarily serves the administration building and all associated electrical loads. The MCC has a capacity of 600 amps. This MCC shows some corrosion although to a lesser degree than the main switchgear. Replacement of the 480 volt main switchgear at a new location would provide an opportunity to also replace the MCC and re-establish service at the new main switchgear location. Refer to Figure 1.

Figure 1 MCC-A

- MCC-B - This MCC has a capacity of 1200 amps and is located in the biofilter building adjacent to the biofilter effluent and circulation pumps. This MCC has a minor amount of corrosion for its age and could most likely be cleaned and refinished with continued use for another five to ten years. Refer to Figure 2.

Figure 2 MCC-B

- MCC-C - This MCC has a capacity of 800 amps and is located in the screens and influent pump station building - upper level. This MCC primarily serves the headworks and all associated equipment via MCC-C1, the primary clarifiers and related scum pumps, and blowers. Corrosion and deterioration on this MCC is somewhat more pronounced than on other MCC's in the plant. Although the enclosure is corroded, both externally and internally, the electrical components within the enclosure, consisting of circuit breakers, relays, indicating lights and switches, appear to be in good to average condition. Replacing this MCC with a new MCC, including new starter buckets as well however, is recommended to ensure continued reliability. A failure occurring on this MCC will result in an outage to a critical area of the plant. The plant staff has experienced some nuisance tripping when operating in the standby power mode and plans to replace the main circuit breaker soon. Refer to Figures 3 and 4.

Figure 3 MCC-C

Figure 4 MCC-C Open

- MCC-C1 - This MCC has a capacity of 600 amps and is located in the screens and influent pump station building - lower level. This MCC primarily serves the headworks and influent pumps station VFD's and all related equipment. Corrosion and deterioration on this MCC is somewhat minor when compared to it's source MCC and replacement is not necessary, except for the possible unavailability of components that may be needed to maintain the MCC. Refer to Figure 5.

Figure 5 MCC-C1

- MCC-D - This MCC has a capacity of 600 amps and is located in the vicinity of the secondary sedimentation basin and Biofilter No.2. This MCC primarily serves the Secondary clarifiers, scum pumps, and RAS pumps. Corrosion and deterioration on this MCC is somewhat more pronounced than on other MCC's in the plant. Although the enclosure is corroded, the electrical components within the enclosure, consisting of circuit breakers, relays, indicating lights and switches, appear to be in average condition. Replacing this MCC with a new MCC, including new starter buckets as well is recommended to ensure continued reliability. Refer to Figure 6

- MCC-E - This MCC has a capacity of 600 amps and is located in the maintenance shop building. This MCC primarily serves the steam boilers, converter circulation pumps, the maintenance shop, and instruments air compressors. This MCC has a minor amount of corrosion for its age and could most likely be cleaned and refinished. Refer to Figure 7.

Figure 6 MCC-D

Figure 7 MCC-E

- Of the five motor control centers, MCC's C and D are in greatest need for replacement and are therefore recommended for replacement.
- There are some "spaces" available on nearly all the MCC's and each appears to have adequate electrical capacity to serve increased load. As such, some additional loads could be added to the plant using the existing equipment.

The buildings containing the main service switchgear and motor control centers are no longer climate controlled or conditioned in an effort to keep moisture from entering the buildings. A positive pressure, heated ventilation system, such as air conditioning units with economizers, may help reduce the further corrosion likely to occur on this equipment as well as for other electrical and instrumentation equipment located within the buildings. The MCC's should also be equipped with heaters as condensation may be a more likely cause for corrosion than a salt air environment. In addition, all conduits entering the MCC should be sealed so as to prevent a draw of air from the external environment. Should it be deemed necessary, Westinghouse Electric (now Eaton Electrical) could schedule an engineering services representative to perform a thorough evaluation of all MCC components such as structure frames, internal bussing, bus separators, and other internal components to determine the complete extent of corrosion on this equipment.

4.0 ELECTRICAL PANELBOARDS

For the most part, electrical panel boards are located within buildings containing motor control centers and are individually mounted against a wall. Most are adequate to serve the current needs of the facility and have some "spaces" and "spares" remaining for capacity to serve additional circuits. Panelboards appear to have only a small amount of corrosion and are serviceable for at least another 10 - 15 years.

5.0 ELECTRICAL CONTROL PANELS

- The existing field located local control panels appear have an above average amount of corrosion if metallic in construction. This is simply because of their outdoor locations. Those that are constructed from non-metallic materials appear to be in good condition with only minimal corrosion on exposed metallic parts. Most control panels were found to be in conformance to NEMA and NFPA 820 area classifications for hazardous areas when required.

- Also located in the electrical room occupied by ‘MCC-C’ is the digester control panel and stand alone isolated PLC devices for the digesters and associated pumps. Most of the existing digester control panel is inactive and with many functions having been rewired to local control timers and relays. This equipment should be replaced with modern, state of the art Control system via PLC’s and a SCADA network.

6.0 FIELD WIRING, CONNECTIONS AND CONTROL DEVICES

Field wiring is consistent with NEC code requirements. Field wiring has been maintained in good operating condition over the years. Conduits appear to have been maintained as well.

7.0 SCADA

The absence of a SCADA system at this facility restricts the level of automatic operation and status reporting that is desirable in a modern plant suited for today’s operating environment and requirements. The addition of a SCADA network is strongly recommended, as it would allow for quicker notification and response capability for failures and trouble problems that could occur with an aging facility. This would also require modifications to all MCC starters, Replacement of several Field instruments. Installation of site conduits, and the installation of PLC’s at several locations.

Located near the front of the building is an old out of date Graphic Control Panel with associated enclosures and wiring which are located in a room behind the control panel. The existing panel is outdated and should be removed and replaced with a SCADA system. The room currently used for wiring to the graphics control panel is well suited for installation of a SCADA system and has a large number of conduit pathways already in place for extending the SCADA system to other electrical room locations.

8.0 OTHER

- Site lighting is for the most part, in need of maintenance or replacement. Several fixtures and poles are corroded and in need of maintenance or replacement. Some fixtures within classified areas may no longer be able to be rated as classified.

- Field wiring from some instruments currently enters the administration/control building, but only on a limited basis.
- Most Pull Boxes and Manholes have water accumulation because of a high water table in the area. This has been an ongoing problem and cannot be economically solved. A solution would require that above ground pull boxes be retrofitted throughout the plant and wiring re-pulled into the above ground pull boxes.

9.0 RECOMMENDATIONS - 5-YEAR PLAN

Approximate costs to replace the recommended equipment are as follows:

Recommended Equipment	Estimated Cost	
Main Switchgear - Replace and move switchgear to new electrical building.	Switchgear	$200,000
	Electrical Building	$200,000
Motor Control Center ‘MCC-A’ - Replace and move to new switchgear location.		$90,000
Motor Control Center ‘MCC-B’ - Maintain and repaint		$20,000
Motor Control Center ‘MCC-C’ - Replace with new MCC		$245,000
Motor Control Center ‘MCC-C1’ - Maintain and repaint		$20,000
Motor Control Center ‘MCC-D’ - Replace with new MCC		$150,000
Motor Control Center ‘MCC-E’ - Maintain and repaint		$20,000
Refurbish or replace some outdoor lighting		$40,000

The combined cost of all recommended electrical upgrades over the next five years is $985,000. These costs are based on current (2006) cost data and include contractor labor, overhead, and profit for installation of the listed equipment. These costs exclude any contingency for unidentified items, engineering, legal, and administrative costs. Also excluded is the cost for any demolition and removal work that will be required.

APPENDIX I – BIOSOLIDS MANAGEMENT OPTIONS COST ESTIMATES

TFSC - Class A		Capital Costs	
Unit Process	Parameter	Year 2006	Polymer (1000 lb/year)
Digester Rehabilitation	LS	$1,889,000	
Digester No. 1 Demolition	LS	$46,000	
Centrifuge	LS	$450,000	
PLC Controls	-		
Conveyor	-		
Stand and Framework	-		
Feed Pump	-		
Polymer System	-		16
Flow Meter	-		
Interconnective Piping and Electrical	-		
Composting Equipment/Facilities	-		
Thickening/Dewatering Building	LS	$300,000	
Front End Loader	LS	$70,000	
Turner	LS	$50,000	
Screen	LS	$30,000	
Concrete Slab (815 yd^3 * $269.21/$yd^3$)	LS	$316,000	
SUBTOTAL		$3,151,000	
Yard Piping/Sitework (includes digesters, centrifuge, building, concrete)	5%	$150,000	
Electrical and Instrumentation (includes digesters, centrifuge, building)	15%	$403,000	
SUBTOTAL		$3,704,000	
Estimating Contingency	20%	$741,000	
Engineering/Admin/Legal	35%	$1,556,000	
TOTAL PROJECT COSTS		$6,001,000	
O&M Cost Factor			$1,500
Annual Electrical Cost		$130,000	
Annual Labor		$99,000	
Annual Sludge Disposal Cost		$0	
Total O&M Annual Cost		$253,000	$24,000
PRESENT VALUES			
Capital Cost		$6,001,000	
Operations and Maintenance		$3,652,000	
TOTAL PRESENT WORTH		**$9,653,000**	

TFSC - Class B		Capital Costs	
		Year	Polymer
Unit Process	**Parameter**	**2006**	**(1000 lb/year)**
Digester Rehabilitation	LS	$1,889,000	
Digester No. 1 Demolition	LS	$46,000	
Centrifuge	LS	$450,000	
PLC Controls	-		
Conveyor	-		
Stand and Framework	-		
Feed Pump	-		
Polymer System	-		16
Flow Meter	-		
Interconnective Piping and Electrical	-		
Thickening/Dewatering Building	LS	$300,000	
SUBTOTAL		$2,685,000	
Yard Piping/Sitework	5%	$134,000	
Electrical and Instrumentation	15%	$403,000	
SUBTOTAL		$3,222,000	
Estimating Contingency	20%	$644,000	
Engineering/Admin/Legal	35%	$1,353,000	
TOTAL PROJECT COSTS		$5,219,000	
O&M Cost Factor			$1,500
Annual Electrical Cost		$130,000	
Annual Labor		$33,000	
Annual Sludge Disposal Cost		$28,000	
Total O&M Annual Cost		$215,000	$24,000
PRESENT VALUES			
Capital Cost		$5,219,000	
Operations and Maintenance		$3,104,000	
TOTAL PRESENT WORTH		**$8,323,000**	

TFSC - Class B (Wet)		Capital Costs	
		Year	Polymer
Unit Process	**Parameter**	**2006**	**(1000 lb/year)**
Digester Rehabilitation	LS	$1,889,000	
Digester No. 1 Demolition	LS	$46,000	
Centrifuge	LS	$450,000	
PLC Controls	-		
Conveyor	-		
Stand and Framework	-		
Feed Pump	-		
Polymer System	-		16
Flow Meter	-		
Interconnective Piping and Electrical	-		
Thickening/Dewatering Building	LS	$300,000	
SUBTOTAL		$2,685,000	
Yard Piping/Sitework	5%	$134,000	
Electrical and Instrumentation	15%	$403,000	
SUBTOTAL		$3,222,000	
Estimating Contingency	20%	$644,000	
Engineering/Admin/Legal	35%	$1,353,000	
TOTAL PROJECT COSTS		$5,219,000	
O&M Cost Factor			$1,500
Annual Electrical Cost		$130,000	
Annual Labor		$33,000	
Annual Sludge Disposal Cost		$109,000	
Total O&M Annual Cost		$296,000	$24,000
PRESENT VALUES			
Capital Cost		$5,219,000	
Operations and Maintenance		$4,273,000	
TOTAL PRESENT WORTH		**$9,492,000**	

EAAS - Class A		Capital Costs	
Unit Process	Parameter	Year 2006	Polymer (1000 lb/year)
Digester Rehabilitation	LS	$1,889,000	
Digester No. 1 Demolition	LS	$46,000	
Gravity Belt Thickeners	LS	$125,000	
Polymer Feed System	LS	$12,500	12
Centrifuge	LS	$450,000	
PLC Controls	-		
Conveyor	-		
Stand and Framework	-		
Feed Pump	-		
Polymer System	-		17
Flow Meter	-		
Interconnective Piping and Electrical	-		
Composting Equipment/Facilities	-		
Thickening/Dewatering Building	LS	$300,000	
Front End Loader	LS	$70,000	
Turner	LS	$50,000	
Screen	LS	$30,000	
Concrete Slab (815 yd^3 * $269.21/$yd^3$)	LS	$316,000	
SUBTOTAL		$3,289,000	
Yard Piping/Sitework (includes digesters, centrifuge, building, concrete)	5%	$157,000	
Electrical and Instrumentation (includes digesters, centrifuge, building)	15%	$423,000	
SUBTOTAL		$3,869,000	
Estimating Contingency	20%	$774,000	
Engineering/Admin/Legal	35%	$1,625,000	
TOTAL PROJECT COSTS		$6,268,000	
O&M Cost Factor			$1,500
Annual Electrical Cost		$131,000	
Annual Labor		$99,000	
Annual Sludge Disposal Cost		$0	
Total O&M Annual Cost		$275,000	$45,000
PRESENT VALUES			
Capital Cost		$6,268,000	
Operations and Maintenance		$3,970,000	
TOTAL PRESENT WORTH		**$10,238,000**	

EAAS - Class B		Capital Costs	
Unit Process	Parameter	Year 2006	Polymer (1000 lb/year)
Digester Rehabilitation	LS	$1,889,000	
Digester No. 1 Demolition	LS	$46,000	
Gravity Belt Thickeners	LS	$125,000	
Polymer Feed System	LS	$12,500	12
Centrifuge	LS	$450,000	
PLC Controls	-		
Conveyor	-		
Stand and Framework	-		
Feed Pump	-		
Polymer System	-		17
Flow Meter	-		
Interconnective Piping and Electrical	-		
Thickening/Dewatering Building	LS	$300,000	
SUBTOTAL		$2,823,000	
Yard Piping/Sitework	5%	$141,000	
Electrical and Instrumentation	15%	$423,000	
SUBTOTAL		$3,387,000	
Estimating Contingency	20%	$677,000	
Engineering/Admin/Legal	35%	$1,422,000	
TOTAL PROJECT COSTS		$5,486,000	
O&M Cost Factor			$1,500
Annual Electrical Cost		$131,000	
Annual Labor		$33,000	
Annual Sludge Disposal Cost		$31,000	
Total O&M Annual Cost		$240,000	$45,000
PRESENT VALUES			
Capital Cost		$5,486,000	
Operations and Maintenance		$3,464,000	
TOTAL PRESENT WORTH		**$8,950,000**	

EAAS - sub-Class B		Capital Costs	
		Year	Polymer
Unit Process	**Parameter**	**2006**	**(1000 lb/year)**
Digested No. 3 Rehabilitation	LS	$527,000	
Digester No. 1 Demolition	LS	$46,000	
Digester No. 2 Demolition	LS	$51,000	
Centrifuge	LS	$870,000	
PLC Controls	-		
Conveyor	-		
Stand and Framework	-		
Feed Pump	-		
Polymer System	-		26
Flow Meter	-		
Interconnective Piping and Electrical	-		
Thickening/Dewatering Building	LS	$300,000	
SUBTOTAL		$1,794,000	
Yard Piping/Sitework	5%	$90,000	
Electrical and Instrumentation	15%	$269,000	
SUBTOTAL		$2,153,000	
Estimating Contingency	20%	$431,000	
Engineering/Admin/Legal	35%	$904,000	
TOTAL PROJECT COSTS		$3,488,000	
O&M Cost Factor			$1,500
Annual Electrical Cost		$71,000	
Annual Labor		$33,000	
Annual Sludge Disposal Cost		$202,000	
Total O&M Annual Cost		$345,000	$39,000
PRESENT VALUES			
Capital Cost		$3,488,000	
Operations and Maintenance		$5,140,000	
TOTAL PRESENT WORTH		**$8,628,000**	

APPENDIX J – SAMPLE PRESENT VALUE CALCULATIONS

11.158 Present Given Annuity
6% Cost of money
3% Annual Inflation

	PW Factor	P/F Factors	**TFSC (Class A)**	Growth above first year	Present Given Future	**TFSC (Class B)**	Growth above first year	Present Given Future	**TFSC (Class B - Wet)**	Growth above first year	Present Given Future
1	1.000000	1	$ 253,000	$ -	$ -	$215,000	$0	$0	$296,000	$0	$0
2	0.943400	0.9434	$ 260,590	$ 7,590	$ 7,160	$221,450	$6,450	$6,085	$304,880	$8,880	$8,377
3	0.890000	0.89	$ 268,408	$ 15,408	$ 13,713	$228,094	$13,094	$11,653	$314,026	$18,026	$16,043
4	0.839620	0.83962	$ 276,460	$ 23,460	$ 19,697	$234,936	$19,936	$16,739	$323,447	$27,447	$23,045
5	0.792100	0.7921	$ 284,754	$ 31,754	$ 25,152	$241,984	$26,984	$21,374	$333,151	$37,151	$29,427
6	0.747260	0.74726	$ 293,296	$ 40,296	$ 30,112	$249,244	$34,244	$25,589	$343,145	$47,145	$35,230
7	0.704960	0.70496	$ 302,095	$ 49,095	$ 34,610	$256,721	$41,721	$29,412	$353,439	$57,439	$40,493
8	0.665060	0.66506	$ 311,158	$ 58,158	$ 38,679	$264,423	$49,423	$32,869	$364,043	$68,043	$45,252
9	0.627420	0.62742	$ 320,493	$ 67,493	$ 42,346	$272,356	$57,356	$35,986	$374,964	$78,964	$49,544
10	0.591900	0.5919	$ 330,108	$ 77,108	$ 45,640	$280,526	$65,526	$38,785	$386,213	$90,213	$53,397
11	0.558400	0.5584	$ 340,011	$ 87,011	$ 48,587	$288,942	$73,942	$41,289	$397,799	$101,799	$56,845
12	0.526790	0.52679	$ 350,211	$ 97,211	$ 51,210	$297,610	$82,610	$43,518	$409,733	$113,733	$59,914
13	0.496980	0.49698	$ 360,718	$ 107,718	$ 53,533	$306,539	$91,539	$45,493	$422,025	$126,025	$62,632
14	0.468840	0.46884	$ 371,539	$ 118,539	$ 55,576	$315,735	$100,735	$47,228	$434,686	$138,686	$65,022
15	0.442310	0.44231	$ 382,685	$ 129,685	$ 57,361	$325,207	$110,207	$48,746	$447,727	$151,727	$67,110
16	0.417270	0.41727	$ 394,166	$ 141,166	$ 58,904	$334,963	$119,963	$50,057	$461,158	$165,158	$68,916
17	0.393650	0.39365	$ 405,991	$ 152,991	$ 60,225	$345,012	$130,012	$51,179	$474,993	$178,993	$70,461
18	0.371370	0.37137	$ 418,170	$ 165,170	$ 61,339	$355,362	$140,362	$52,126	$489,243	$193,243	$71,765
19	0.350350	0.35035	$ 430,716	$ 177,716	$ 62,263	$366,023	$151,023	$52,911	$503,920	$207,920	$72,845
20	0.330520	0.33052	$ 443,637	$ 190,637	$ 63,009	$377,004	$162,004	$53,545	$519,038	$223,038	$73,718
				Present Given Growth	**$ 829,117**		**Present Given Growth**	**$ 704,586**		**Present Given Growth**	**$ 970,034**
				Present Value Given Annuity	**$ 2,822,974**		**Present Value Given Annuity**	**$ 2,398,970**		**Present Value Given Annuity**	**$ 3,302,768**
				Total Present Value	**$ 3,652,091**		**Total Present Value**	**$ 3,103,556**		**Total Present Value**	**$ 4,272,802**

EA (Class A)	Growth above first year	Present Given Future	**EA (Class B)**	Growth above first year	Present Given Future	**EA (sub-Class B)**	Growth above first year	Present Given Future
$ 275,000			$ 240,000			$ 345,000		
$275,000	$0	$0	$240,000	$0	$0	$355,350	$10,350	$10,350
$283,250	$8,250	$7,783	$247,200	$7,200	$6,792	$366,011	$21,011	$19,821
$291,748	$16,748	$14,905	$254,616	$14,616	$13,008	$376,991	$31,991	$28,472
$300,500	$25,500	$21,410	$262,254	$22,254	$18,685	$388,301	$43,301	$36,356
$309,515	$34,515	$27,339	$270,122	$30,122	$23,860	$399,950	$54,950	$43,526
$318,800	$43,800	$32,730	$278,226	$38,226	$28,565	$411,948	$66,948	$50,028
$328,364	$53,364	$37,620	$286,573	$46,573	$32,832	$424,306	$79,306	$55,908
$338,215	$63,215	$42,042	$295,170	$55,170	$36,691	$437,036	$92,036	$61,209
$348,362	$73,362	$46,029	$304,025	$64,025	$40,170	$450,147	$105,147	$65,971
$358,813	$83,813	$49,609	$313,146	$73,146	$43,295	$463,651	$118,651	$70,230
$369,577	$94,577	$52,812	$322,540	$82,540	$46,090	$477,561	$132,561	$74,022
$380,664	$105,664	$55,663	$332,216	$92,216	$48,579	$491,888	$146,888	$77,379
$392,084	$117,084	$58,189	$342,183	$102,183	$50,783	$506,644	$161,644	$80,334
$403,847	$128,847	$60,409	$352,448	$112,448	$52,720	$521,843	$176,843	$82,911
$415,962	$140,962	$62,349	$363,022	$123,022	$54,414	$537,499	$192,499	$85,144
$428,441	$153,441	$64,026	$373,912	$133,912	$55,878	$553,624	$208,624	$87,052
$441,294	$166,294	$65,462	$385,130	$145,130	$57,130	$570,232	$225,232	$88,663
$454,533	$179,533	$66,673	$396,683	$156,683	$58,188	$587,339	$242,339	$89,998
$468,169	$193,169	$67,677	$408,584	$168,584	$59,063	$604,960	$259,960	$91,077
$482,214	$207,214	$68,488	$420,841	$180,841	$59,772	$623,108	$278,108	$91,920
	Present Given Growth	**$ 901,214**		**Present Given Growth**	**$ 786,514**		**Present Given Growth**	**$ 1,290,370**
	Present Value Given Annuity	**$ 3,068,450**		**Present Value Given Annuity**	**$ 2,677,920**		**Present Value Given Annuity**	**$ 3,849,510**
	Total Present Value	**$ 3,969,664**		**Total Present Value**	**$ 3,464,434**		**Total Present Value**	**$ 5,139,880**

APPENDIX K – TREATMENT ALTERNATIVES COST ESTIMATES

Alternative No. 1 - TFSC		**Capital Costs Year**
Unit Process	**Parameter**	**2006**
Headworks	LS	$1,820,000
Primary Sedimentation	LS	$690,000
Interstage Pump Station	LS	$270,000
RAS/WAS Pumping Improvements	LS	$132,000
Trickling Filter/Solids Conact/Secondary Clarification	LS	$3,861,000
SUBTOTAL		$6,773,000
Demolition	-	$31,000
Miscellaneous	-	$0
Yard Piping/Sitework	5%	$339,000
Electrical and Instrumentation	15%	$1,016,000
SUBTOTAL		$8,159,000
Estimating Contingency	20%	$1,632,000
Engineering/Admin/Legal	35%	$3,427,000
TOTAL PROJECT COSTS		$13,218,000
Maintenance	1%	$82,000
O&M Cost Factor		
Annual Electrical Cost		$277,000
Annual Labor		$230,000
Total O&M Annual Cost		$589,000
PRESENT VALUES		
Capital Cost		$13,218,000
Operations and Maintenance		$8,502,000
TOTAL PRESENT WORTH		**$21,720,000**

Alternative No. 2 - EAAS Unit Process	Parameter	Capital Costs Year 2006
Headworks	LS	$1,820,000
RAS/WAS Pump Station	LS	$232,000
Oxidation Ditches	LS	$2,866,000
Secondary Sedimentation	LS	$1,847,000
SUBTOTAL		$6,765,000
Demolition	-	$213,000
Miscellaneous	-	$0
Yard Piping/Sitework	5%	$338,000
Electrical and Instrumentation	15%	$1,015,000
SUBTOTAL		$8,118,000
Estimating Contingency	20%	$1,624,000
Engineering/Admin/Legal	35%	$3,410,000
TOTAL PROJECT COSTS		$13,152,000
Maintenance	1%	$81,000
O&M Cost Factor		
Annual Electrical Cost		$291,000
Annual Labor		$131,000
Total O&M Annual Cost		$503,000
PRESENT VALUES		
Capital Cost		$13,152,000
Operations and Maintenance		$7,261,000
TOTAL PRESENT WORTH		**$20,413,000**

Alternative No. 3 - MBR		**Capital Costs Year**
Unit Process	**Parameter**	**2006**
Headworks	LS	$1,820,000
Primary Clarification (Equalization)	LS	$120,000
Secondary Sedimentation (Equalization)	LS	$95,000
Aeration Basins	LS	$1,307,000
MBR Basins	LS	$5,655,000
SUBTOTAL		$8,997,000
Demolition	-	$168,000
Miscellaneous	-	$3,588,000
Yard Piping/Sitework	5%	$450,000
Electrical and Instrumentation	15%	$1,350,000
SUBTOTAL		$14,553,000
Estimating Contingency	20%	$2,911,000
Engineering/Admin/Legal	35%	$6,112,000
TOTAL CAPITOL COSTS		$23,576,000
Maintenance	1%	$146,000
O&M Cost Factor		
Annual Electrical Cost		$512,000
Annual Labor		$164,000
Total O&M Annual Cost		$822,000
PRESENT VALUES		
Capital Cost		$23,576,000
Operations and Maintenance		$11,866,000
TOTAL PRESENT WORTH		**$35,442,000**

Alternative No. 4 - EAAS/Filtration		**Capital Costs Year**
Unit Process	**Parameter**	**2006**
Headworks	LS	$1,820,000
Primary Sedimentation (Equalization)	LS	$0
RAS/WAS Pump Station	LS	$232,000
Oxidation Ditches	LS	$2,866,000
Secondary Sedimentation	LS	$1,847,000
Cloth Media Disk Filters	LS	$1,063,000
SUBTOTAL		$7,828,000
Demolition	-	$213,000
Miscellaneous	-	$0
Yard Piping/Sitework	5%	$391,000
Electrical and Instrumentation	15%	$1,174,000
SUBTOTAL		$9,606,000
Estimating Contingency	20%	$1,921,000
Engineering/Admin/Legal	35%	$4,034,000
TOTAL CAPITOL COSTS		$15,561,000
Maintenance	1%	$96,000
O&M Cost Factor		
Annual Electrical Cost		$318,000
Annual Labor		$164,000
Total O&M Annual Cost		$578,000
PRESENT VALUES		
Capital Cost		$15,561,000
Operations and Maintenance		$8,344,000
TOTAL PRESENT WORTH		**$23,905,000**

APPENDIX L – PROJECT RECOMMENDATIONS COST ESTIMATES

Recommendation No. 1 - EAAS with Direct Haul

Unit Process	Parameter		Year 2006
Rehabilitation			
Headworks	LS		$1,320,000
Existing Secondary Clarifier	LS		$140,000
Partial rehabilitation of Digester No. 3 (Holding Tank)	LS		$527,000
Control Building	LS		$360,000
Existing Electrical Equipment	LS		$945,000
Miscellaneous Facilities (3-W, Plant Drain)	LS		$219,000
Construction of New Facilities			
RAS/WAS Pump Station	LS		$232,000
Oxidation Ditches	LS		$2,866,000
Secondary Clarifier	LS		$1,707,000
Disinfection Facilities	LS		$355,000
Solids Dewatering - Centrifuges	LS		$1,170,000
Yard Piping/Sitework		5%	$317,000
Electrical and Instrumentation		15%	$950,000
Miscellaneous Construction			
Demolition and Subsoil Stabilization	LS		$1,310,000
Flood Impact Mitigation (Preliminary Estimate)	LS		$2,500,000
SUBTOTAL			**$14,918,000**
Estimating Contingency		20%	$2,984,000
Engineering/Admin/Legal/1 Year Loan Interest		35%	$6,266,000
TOTAL PROJECT COSTS			**$24,168,000**
Total O&M Annual Cost			**$1,727,000**
PRESENT VALUES			
Project Cost			$24,168,000
Operations and Maintenance			$24,933,000
TOTAL PRESENT WORTH			**$49,101,000**

Recommendation No. 1 - EAAS with Partial Composting

Unit Process	Parameter		Year 2006
Rehabilitation of Existing Facilities			
Headworks	LS		$1,320,000
Existing Secondary Clarifier	LS		$140,000
Digester No. 2 and 3	LS		$1,889,000
Control Building	LS		$360,000
Existing Electrical Equipment	LS		$945,000
Miscellaneous Facilities (3-W, Plant Drain)	LS		$219,000
Construction of New Facilities			
RAS/WAS Pump Station	LS		$232,000
Oxidation Ditches	LS		$2,866,000
Secondary Clarifier	LS		$1,707,000
Disinfection Facilities	LS		$355,000
Solids Thickening - Gravity Belt Thickener	LS		$138,000
Solids Dewatering - Centrifuges	LS		$750,000
Composting Facilities and Equipment	LS		$150,000
Yard Piping/Sitework		5%	$302,000
Electrical and Instrumentation		15%	$907,000
Miscellaneous Construction			
Demolition and Subsoil Stabilization	LS		$1,259,000
Flood Impact Mitigation (Preliminary Estimate)	LS		$2,500,000
TOTAL CONSTRUCTION COSTS			**$16,039,000**
Estimating Contingency		20%	$3,208,000
Engineering/Admin/Legal/1 Year Loan Interest		35%	$6,736,000
TOTAL PROJECT COSTS			**$25,983,000**
Total O&M Annual Cost			**$1,633,000**
PRESENT VALUES			
Project Cost			$25,983,000
Operations and Maintenance			$23,574,000
TOTAL PRESENT VALUE			**$49,557,000**

Recommendation No. 1 - EAAS with Composting

Unit Process	Parameter		Year 2006
Rehabilitation of Existing Facilities			
Headworks	LS		$1,320,000
Existing Secondary Clarifier	LS		$140,000
Digester No. 2 and 3	LS		$1,889,000
Control Building	LS		$360,000
Existing Electrical Equipment	LS		$945,000
Miscellaneous Facilities (3-W, Plant Drain)	LS		$219,000
Construction of New Facilities			
RAS/WAS Pump Station	LS		$232,000
Oxidation Ditches	LS		$2,866,000
Secondary Clarifier	LS		$1,707,000
Disinfection Facilities	LS		$355,000
Solids Thickening - Gravity Belt Thickener	LS		$138,000
Solids Dewatering - Centrifuges	LS		$750,000
Composting Facilities and Equipment	LS		$466,000
Yard Piping/Sitework		5%	$318,000
Electrical and Instrumentation		15%	$907,000
Miscellaneous Construction			
Demolition and Subsoil Stabilization	LS		$1,259,000
Flood Impact Mitigation (Preliminary Estimate)	LS		$2,500,000
SUBTOTAL			**$16,371,000**
Estimating Contingency		20%	$3,274,000
Engineering/Admin/Legal/1 Year Loan Interest		35%	$6,876,000
TOTAL PROJECT COSTS			**$26,521,000**
Total O&M Annual Cost			**$1,657,000**
PRESENT VALUES			
Project Cost			$26,521,000
Operations and Maintenance			$23,923,000
TOTAL PRESENT VALUE			**$50,444,000**

Recommendation No. 1A - EAAS/Filtration with Direct Haul		
Unit Process	**Parameter**	**Year 2006**
Rehabilitation		
Headworks	LS	$1,320,000
Existing Secondary Clarifier	LS	$140,000
Partial rehabilitation of Digester No. 3 (Holding Tank)	LS	$527,000
Control Building	LS	$360,000
Existing Electrical Equipment	LS	$945,000
Miscellaneous Facilities (3-W, Plant Drain)	LS	$219,000
Construction of New Facilities		
RAS/WAS Pump Station	LS	$232,000
Oxidation Ditches	LS	$2,866,000
Secondary Clarifier	LS	$1,707,000
Disinfection Facilities	LS	$355,000
Disk Filter Modules	LS	$1,063,000
Solids Dewatering - Centrifuges	LS	$1,170,000
Yard Piping/Sitework	5%	$370,000
Electrical and Instrumentation	15%	$1,109,000
Miscellaneous Construction		
Demolition and Subsoil Stabilization	LS	$1,310,000
Flood Impact Mitigation (Preliminary Estimate)	LS	$2,500,000
SUBTOTAL		**$16,193,000**
Estimating Contingency	20%	$3,239,000
Engineering/Admin/Legal/1 Year Loan Interest	35%	$6,801,000
TOTAL PROJECT COSTS		**$26,233,000**
Total O&M Annual Cost		**$1,774,000**
PRESENT VALUES		
Project Cost		$26,233,000
Operations and Maintenance		$25,613,000
TOTAL PRESENT WORTH		**$51,846,000**

Recommendation No. 1A - EAAS/Filtration with Partial Composting

Unit Process	Parameter		Year 2006
Rehabilitation of Existing Facilities			
Headworks	LS		$1,320,000
Existing Secondary Clarifier	LS		$140,000
Digester No. 2 and 3	LS		$1,889,000
Control Building	LS		$360,000
Existing Electrical Equipment	LS		$945,000
Miscellaneous Facilities (3-W, Plant Drain)	LS		$219,000
Construction of New Facilities			
RAS/WAS Pump Station	LS		$232,000
Oxidation Ditches	LS		$2,866,000
Secondary Clarifier	LS		$1,707,000
Disinfection Facilities	LS		$355,000
Disk Filter Modules	LS		$1,063,000
Solids Thickening - Gravity Belt Thickener	LS		$138,000
Solids Dewatering - Centrifuges	LS		$750,000
Composting Facilities and Equipment	LS		$150,000
Yard Piping/Sitework		5%	$356,000
Electrical and Instrumentation		15%	$1,067,000
Miscellaneous Construction			
Demolition and Subsoil Stabilization	LS		$1,259,000
Flood Impact Mitigation (Preliminary Estimate)	LS		$2,500,000
SUBTOTAL			**$17,316,000**
Estimating Contingency		20%	$3,463,000
Engineering/Admin/Legal/1 Year Loan Interest		35%	$7,273,000
TOTAL PROJECT COSTS			**$28,052,000**
Total O&M Annual Cost			**$1,680,000**
PRESENT VALUES			
Project Cost			$28,052,000
Operations and Maintenance			$24,255,000
TOTAL PRESENT VALUE			**$52,307,000**

Recommendation No. 1A - EAAS/Filtration with Composting

Unit Process	Parameter		Year 2006
Rehabilitation of Existing Facilities			
Headworks	LS		$1,320,000
Existing Secondary Clarifier	LS		$140,000
Digester No. 2 and 3	LS		$1,889,000
Control Building	LS		$360,000
Existing Electrical Equipment	LS		$945,000
Miscellaneous Facilities (3-W, Plant Drain)	LS		$219,000
Construction of New Facilities			
RAS/WAS Pump Station	LS		$232,000
Oxidation Ditches	LS		$2,866,000
Secondary Clarifier	LS		$1,707,000
Disinfection Facilities	LS		$355,000
Disk Filter Modules	LS		$1,063,000
Solids Thickening - Gravity Belt Thickener	LS		$138,000
Solids Dewatering - Centrifuges	LS		$750,000
Composting Facilities and Equipment	LS		$466,000
Yard Piping/Sitework		5%	$371,000
Electrical and Instrumentation		15%	$1,067,000
Miscellaneous Construction			
Demolition and Subsoil Stabilization	LS		$1,259,000
Flood Impact Mitigation (Preliminary Estimate)	LS		$2,500,000
SUBTOTAL			**$17,647,000**
Estimating Contingency		20%	$3,529,000
Engineering/Admin/Legal/1 Year Loan Interest		35%	$7,412,000
TOTAL PROJECT COSTS			**$28,588,000**
Total O&M Annual Cost			**$1,704,000**
PRESENT VALUES			
Project Cost			$28,588,000
Operations and Maintenance			$24,604,000
TOTAL PRESENT VALUE			**$53,192,000**

Recommendation No. 2 - TFSC with Haul (Class B)

Unit Process	Parameter		Year 2006
Rehabilitation			
Headworks	LS		$1,320,000
Primary Clarifier No. 2	LS		$180,000
Interstage Pump Station	LS		$270,000
RAS/WAS Pump Station	LS		$132,000
Trickling Filter No. 2/Solids Contact Basin/Secondary Clarifier	LS		$325,000
Full rehabilitation of Digester No. 2 and 3	LS		$1,889,000
Control Building	LS		$360,000
Existing Electrical Equipment	LS		$945,000
Miscellaneous Facilities (3-W, Plant Drain)	LS		$219,000
Construction of New Facilities			
New Primary Clarifier	LS		$510,000
New Trickling Filter/Solids Contact Basins/Secondary Clarifier	LS		$3,536,000
Disinfection Facilities	LS		$355,000
Solids Dewatering - Centrifuges	LS		$750,000
Yard Piping/Sitework		5%	$258,000
Electrical and Instrumentation		15%	$773,000
Miscellaneous Construction			
Demolition and Subsoil Stabilization	LS		$1,177,000
Flood Impact Mitigation (Preliminary Estimate)	LS		$2,500,000
SUBTOTAL			**$15,499,000**
Estimating Contingency		20%	$3,100,000
Engineering/Admin/Legal/1 Year Loan Interest		35%	$6,510,000
TOTAL PROJECT COSTS			**$25,109,000**
Total O&M Annual Cost			**$1,661,000**
PRESENT VALUES			
Project Cost			$25,109,000
Operations and Maintenance			$23,977,000
TOTAL PRESENT WORTH			**$49,086,000**

Recommendation No. 2 - TFSC with Partial Composting

Unit Process	Parameter		Year 2006
Rehabilitation			
Headworks	LS		$1,320,000
Primary Clarifier No. 2	LS		$180,000
Interstage Pump Station	LS		$270,000
RAS/WAS Pump Station	LS		$132,000
Trickling Filter No. 2/Solids Contact Basin/Secondary Clarifier	LS		$325,000
Full rehabilitation of Digester No. 2 and 3	LS		$1,889,000
Control Building	LS		$360,000
Existing Electrical Equipment	LS		$945,000
Miscellaneous Facilities (3-W, Plant Drain)	LS		$219,000
Construction of New Facilities			
New Primary Clarifier	LS		$510,000
New Trickling Filter/Solids Contact Basins/Secondary Clarifier	LS		$3,536,000
Disinfection Facilities	LS		$355,000
Solids Dewatering - Centrifuges	LS		$750,000
Composting Equipment and Facilities	LS		$150,000
Yard Piping/Sitework		5%	$258,000
Electrical and Instrumentation		15%	$773,000
Miscellaneous Construction			
Demolition and Subsoil Stabilization	LS		$1,177,000
Flood Impact Mitigation (Preliminary Estimate)	LS		$2,500,000
SUBTOTAL			**$15,649,000**
Estimating Contingency		20%	$3,130,000
Engineering/Admin/Legal/1 Year Loan Interest		35%	$6,573,000
TOTAL PROJECT COSTS			**$25,352,000**
Total O&M Annual Cost			**$1,655,000**
PRESENT VALUES			
Project Cost			$25,352,000
Operations and Maintenance			$23,890,000
TOTAL PRESENT WORTH			**$49,242,000**

Recommendation No. 2 - TFSC with Composting

Unit Process	Parameter		Year 2006
Rehabilitation			
Headworks	LS		$1,320,000
Primary Clarifier No. 2	LS		$180,000
Interstage Pump Station	LS		$270,000
RAS/WAS Pump Station	LS		$132,000
Trickling Filter No. 2/Solids Contact Basin/Secondary Clarifier	LS		$325,000
Full rehabilitation of Digester No. 2 and 3	LS		$1,889,000
Control Building	LS		$360,000
Existing Electrical Equipment	LS		$945,000
Miscellaneous Facilities (3-W, Plant Drain)	LS		$219,000
Construction of New Facilities			
New Primary Clarifier	LS		$510,000
New Trickling Filter/Solids Contact Basins/Secondary Clarifier	LS		$3,536,000
Disinfection Facilities	LS		$355,000
Solids Dewatering - Centrifuges	LS		$750,000
Composting Equipment and Facilities	LS		$466,000
Yard Piping/Sitework		5%	$273,350
Electrical and Instrumentation		15%	$772,650
Miscellaneous Construction			
Demolition and Subsoil Stabilization	LS		$1,177,000
Flood Impact Mitigation (Preliminary Estimate)	LS		$2,500,000
SUBTOTAL			**$15,980,000**
Estimating Contingency		20%	$3,196,000
Engineering/Admin/Legal/1 Year Loan Interest		35%	$6,712,000
TOTAL PROJECT COSTS			**$25,888,000**
Total O&M Annual Cost			**$1,681,000**
PRESENT VALUES			
Project Cost			$25,888,000
Operations and Maintenance			$24,269,000
TOTAL PRESENT WORTH			**$50,157,000**

Recommendation No. 3 - MBR with Direct Hauling

Unit Process	Parameter		Year 2006
Rehabilitation			
Headworks	LS		$1,320,000
Primary Clarifier (Equalization Basin)	LS		$120,000
Secondary Clarifier (Equalization Basin)	LS		$95,000
Full rehabilitation of Digester No. 2 and 3	LS		$527,000
Control Building	LS		$360,000
Existing Electrical Equipment	LS		$945,000
Miscellaneous Facilities (3-W, Plant Drain)	LS		$219,000
Construction of New Facilities			
Aeration Basins	LS		$1,307,000
MBR Basins/Building/Associated Equipment	LS		$9,243,000
Disinfection Facilities	LS		$355,000
Solids Dewatering - Centrifuges	LS		$1,170,000
Yard Piping/Sitework		5%	$604,000
Electrical and Instrumentation		15%	$425,000
Miscellaneous Construction			
Demolition and Subsoil Stabilization	LS		$1,279,000
Flood Impact Mitigation (Preliminary Estimate)	LS		$2,500,000
SUBTOTAL			**$20,469,000**
Estimating Contingency		20%	$4,094,000
Engineering/Admin/Legal/1 Year Loan Interest		35%	$8,597,000
TOTAL PROJECT COSTS			**$33,160,000**
Total O&M Annual Cost			**$2,038,000**
PRESENT VALUES			
Project Cost			$33,160,000
Operations and Maintenance			$29,422,000
TOTAL PRESENT WORTH			**$62,582,000**

Recommendation No. 3 - MBR with Partial Composting

Unit Process	Parameter		Year 2006
Rehabilitation			
Headworks	LS		$1,320,000
Primary Clarifier (Equalization Basin)	LS		$120,000
Secondary Clarifier (Equalization Basin)	LS		$95,000
Full rehabilitation of Digester No. 2 and 3	LS		$1,889,000
Control Building	LS		$360,000
Existing Electrical Equipment	LS		$945,000
Miscellaneous Facilities (3-W, Plant Drain)	LS		$219,000
Construction of New Facilities			
Aeration Basins	LS		$1,307,000
MBR Basins/Building/Associated Equipment	LS		$9,243,000
Disinfection Facilities	LS		$355,000
Solids Thickening - Gravity Belt Thickener	LS		$138,000
Solids Dewatering - Centrifuges	LS		$750,000
Composting Facilities and Equipment	LS		$150,000
Yard Piping/Sitework		5%	$590,000
Electrical and Instrumentation		15%	$383,000
Miscellaneous Construction			
Demolition and Subsoil Stabilization	LS		$1,228,000
Flood Impact Mitigation (Preliminary Estimate)	LS		$2,500,000
SUBTOTAL			**$21,592,000**
Estimating Contingency		20%	$4,318,000
Engineering/Admin/Legal/1 Year Loan Interest		35%	$9,069,000
TOTAL PROJECT COSTS			**$34,979,000**
Total O&M Annual Cost			**$1,944,000**
PRESENT VALUES			
Project Cost			$34,979,000
Operations and Maintenance			$28,065,000
TOTAL PRESENT WORTH			**$63,044,000**

Recommendation No. 3 - MBR with Composting

Unit Process	Parameter		Year 2006
Rehabilitation			
Headworks	LS		$1,320,000
Primary Clarifier (Equalization Basin)	LS		$120,000
Secondary Clarifier (Equalization Basin)	LS		$95,000
Full rehabilitation of Digester No. 2 and 3	LS		$1,889,000
Control Building	LS		$360,000
Existing Electrical Equipment	LS		$945,000
Miscellaneous Facilities (3-W, Plant Drain)	LS		$219,000
Construction of New Facilities			
Aeration Basins	LS		$1,307,000
MBR Basins/Building/Associated Equipment	LS		$9,243,000
Disinfection Facilities	LS		$355,000
Solids Thickening - Gravity Belt Thickener	LS		$138,000
Solids Dewatering - Centrifuges	LS		$750,000
Composting Facilities and Equipment	LS		$466,000
Yard Piping/Sitework		5%	$605,000
Electrical and Instrumentation		15%	$383,000
Miscellaneous Construction			
Demolition and Subsoil Stabilization	LS		$1,228,000
Flood Impact Mitigation (Preliminary Estimate)	LS		$2,500,000
SUBTOTAL			**$21,923,000**
Estimating Contingency		20%	$4,385,000
Engineering/Admin/Legal/1 Year Loan Interest		35%	$9,208,000
TOTAL PROJECT COSTS			**$35,516,000**
Total O&M Annual Cost			**$1,968,000**
PRESENT VALUES			
Project Cost			$35,516,000
Operations and Maintenance			$28,413,000
TOTAL PRESENT WORTH			**$63,929,000**